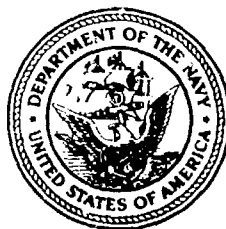


DA 128171

**DEPARTMENT OF THE NAVY  
SUPPORTING DATA FOR FISCAL YEAR 1984  
BUDGET ESTIMATES DESCRIPTIVE SUMMARIES (U)**



**SUBMITTED TO CONGRESS JANUARY 1983**

**RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY**

**BOOK 1 OF 3 BOOKS**

**TECHNOLOGY BASE  
ADV. TECHNOLOGY DEVELOPMENT  
STRATEGIC PROGRAMS**

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| REPORT DOCUMENTATION PAGE                                                                                                                                                                          |                       | READ INSTRUCTIONS<br>BEFORE COMPLETING FORM                    |
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| 1. REPORT NUMBER                                                                                                                                                                                   | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER                                  |
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| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>DEPARTMENT OF THE NAVY<br>OFFICE OF THE COMPTROLLER NCSL 2<br>PENTAGON RM 4C640<br>WASHINGTON DC 20350                                              |                       | 10. PROGRAM ELEMENT, PROJECT, TASK<br>AREA & WORK UNIT NUMBERS |
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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)                                                                                                                 |                       |                                                                |
| DESCRIPTIVE SUMMARIES<br>PEDS<br>RESEARCH, DEVELOPMENT, TEST & EVALUATION<br>RDT & E<br>TECHNOLOGY BASE<br>ADV TECHNOLOGY PROGRAM<br>STRATEGIC PROGRAMS                                            |                       |                                                                |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)                                                                                                                  |                       |                                                                |
| THIS VOLUME CONTAINS JUSTIFICATION MATERIAL SUPPORTING THE<br>PRESIDENT'S FISCAL 1984 BUDGET PRESENTATION TO CONGRESS<br>CONCERNING RESEARCH, DEVELOPMENT, TEST & EVALUATION.                      |                       |                                                                |

PROGRAM ELEMENT DESCRIPTIVE SUMMARIES  
INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. This data has been prepared for the purpose of providing information concerning the Navy Research, Development, Test and Evaluation Program. Section I (Descriptive Summaries) provides narrative information on all Navy RDT&E program elements and projects for which funds are requested in FY 1984. This section also includes Descriptive Summaries for program elements for which funds were requested in FY 1983 and which are now not funded in FY 1984 due to program cancellation or deferral. Where applicable, Descriptive Summaries include, in addition to RDT&E funds, related procurement costs and quantities, and related funds for Military Construction efforts. A Test and Evaluation Section is provided for all major weapon systems. Section II provides information with regard to construction at Navy, RDT&E facilities.

2. Comparison of FY 1982 and FY 1983 Data. A direct comparison of FY 1982 and FY 1983 data in the Program Element Descriptive Summaries dated February 1982 will reveal some significant differences. Specific explanations are set forth in each Descriptive Summary, however, most of the differences are attributable to the following factors:

- a. FY 1983 reductions/increases as a result of Congressional action on the appropriation.
- b. FY 1982 funding changes subsequent to October 1, 1981, including Navy RDT&E reprogramming actions.

3. Relationship of FY 1984 Budget Structure to the FY 1983 Budget Approved by Congress. The following table provides a list of program elements which do not appear on the Base for Reprogramming Actions (DDI414) for the Navy RDT&E appropriation which was prepared pursuant to final Congressional action on the FY 1983 DOD Budget Submission to Congress.

| <u>PROGRAM ELEMENT</u>                                    | <u>REMARKS</u>                                                                                                                                  |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Budget Activity 2, Advanced Technology Development</u> |                                                                                                                                                 |
| 63712N Advanced Modular Component Demonstration           | New program proposed for FY 1984.                                                                                                               |
| 63739N Personnel Productivity                             | New program proposed for FY 1984.                                                                                                               |
| <u>Budget Activity 3, Strategic Programs</u>              |                                                                                                                                                 |
| 33152N NMNCS Information System Modernization             | New program proposed for FY 1984.                                                                                                               |
| <u>Budget Activity 4, Tactical Programs</u>               |                                                                                                                                                 |
| 63256N Joint Services Advanced Vertical Lift Aircraft     | New Advanced Development program element for Project W1425, Joint Services Advanced Vertical Lift Aircraft, previously included in P.E. 64262N. |
| 63512N Catapults                                          | New program proposed for FY 1984.                                                                                                               |
| 63516N Radar Surveillance Equipment                       | New program proposed for FY 1984.                                                                                                               |
| 63549N Link Cedar                                         | New program proposed for FY 1984.                                                                                                               |
| 64252N Aircraft Propulsion (Engineering)                  | New program proposed for FY 1984.                                                                                                               |
| 64308N Link Ash                                           | New program proposed for FY 1984.                                                                                                               |
| 64355N Vertical Launch Anti-Submarine Rocket              | New program element for Project S1504, Vertical Launch ASROC, previously included in P.E. 64353N.                                               |
| 64563N Shipboard Physical Security (Engineering)          | New program proposed for FY 1984.                                                                                                               |
| 64578N Link Birch                                         | New program proposed for FY 1984.                                                                                                               |
| 64704N Oceanographic Instrumentation Support              | New program proposed for FY 1984.                                                                                                               |
| 64725N Regional Tactical Surveillance                     | New program started by below threshold new start notification in 1983.                                                                          |
| 24136N F/A-18 Squadrons                                   | New program element for effort transitioning from Engineering Development (P.E. 64263N) in FY 1984.                                             |

25601N High Speed Anti-Radiation Missile Improvement

New program element for effort previously funded in P.E.  
64360N in FY 1983.

Budget Activity 5, Intelligence and Communications  
31303N Field Operation Intelligence Office

New program proposed for FY 1984.

4. Classification. Classified information is identified by use of brackets [ ].



DEPARTMENT OF DEFENSE, MILITARY  
RDTE, NAVY  
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**SECTION I**  
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FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61152N  
DoD Mission Area: SIQ - Defense Research

Title: In-House Independent Laboratory Research  
Budget Activity: I-Technology Base

A. (U) RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                 | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|-----------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                       | 21,539         | 23,337           | 24,436           | 25,586           | Continuing               | Continuing           |
| NR0001                    | Navy Laboratories     | 839            | 944              | 976              | 1,007            | Continuing               | Continuing           |
| RR0001                    | Navy Laboratories     | 2,269          | 2,488            | 2,590            | 2,668            | Continuing               | Continuing           |
| ZR0001                    | In-House Laboratories | 18,431         | 19,905           | 20,870           | 21,911           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In-house independent laboratory research provides the principal means for in-house laboratories to stimulate original work in science and technology related to their missions and needs of the Navy. Objectives are to enhance the creativity and productivity of in-house laboratories, and to attract and retain talented and creative scientists. Work will continue in those fields of science most closely related to the Navy's mission, on investigations of environmental factors of interest to the Navy, and on new concepts relevant to future Navy requirements.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands).

The changes between the funding profile shown in the 1983 Descriptive Summary and that shown in this Descriptive Summary result from budget constraints during FY 1984 budget development.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                 | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|-----------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                       | 20,396         | 21,516           | 23,337           | 26,190           | Continuing               | Continuing           |
| NR0001                    | Navy Laboratories     | 832            | 839              | 944              | 1,064            | Continuing               | Continuing           |
| RR0001                    | Navy Laboratories     | 1,836          | 2,246            | 2,511            | 2,606            | Continuing               | Continuing           |
| ZR0001                    | In-House Laboratories | 17,728         | 18,431           | 19,882           | 22,520           | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:  
Not applicable.

F. (U) RELATED ACTIVITIES: This research effort is coordinated in a variety of ways reflecting the nature and level of activities and interests of different agencies. The overall independent research program is reviewed annually by Under Secretary of Defense for Research and Engineering. Medical research is coordinated through the Armed Services Biomedical Research Evaluation and Management Committee. Joint symposia are held with other military services and government agencies. Coordination is also accomplished through the usual means of professional scientific communication. Relationships are maintained with industrial

Program Element: 61152N  
DoD Mission Area: SIU - Defense Research

Title: In-House Independent Laboratory Research  
Budget Activity: I-Technology Base

research and development to insure transition from successful in-house research results to industrial development and to accommodate industrial requests for use of special in-house research facilities for tests and evaluation of components and instruments. This is done in accordance with the official Department of Defense policy on Technology Transfer.

G. (U) WORK PERFORMED BY: Naval Ocean Systems Center, San Diego, CA; Naval Underwater Systems Center, Newport, RI; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Air Development Center, Warminster, PA; Naval Coastal Systems Center, Panama City, FL; Naval Postgraduate School, Monterey, CA; Naval Aerospace Medical Research Laboratory, Pensacola, FL; Naval Dental Research Institute, Great Lakes, IL; Naval Health Research Center, San Diego, CA; Naval Medical Research Institute, Bethesda, MD; Naval Medical Research Unit #2, Manila, Republic of the Philippines; Naval Medical Research Unit #3, Cairo, Egypt; Navy Personnel Research and Development Center, San Diego, CA; Naval Submarine Medical Research Laboratory, Groton, CT; U.S. Naval Academy, Annapolis, MD; Naval Biodynamics Laboratory, New Orleans, LA.

H. (U) PROJECTS IN FY 1984: As previously discussed, the in-house independent laboratory research program provides the means for in-house laboratories to simulate original work in science and technology areas related to their missions and the needs of the Navy. Provided below is a representative set of FY 1982 accomplishments resulting from these efforts.

(U) FY 1982 ACCOMPLISHMENTS:

- An improved theory of Circulation Control (CC) airfoils indicates that a subtle change in the trailing edge contour of the CC rotor blades can yield a 50% increase in the XH-2 (helicopter) control moment.
- Procedures have been developed for the synthesis of a wide variety of 3:1 to 2:1 mixed orthocarbonates. The resulting compounds are potential components of future high explosive compositions.
- An x-ray radiation curing method has been developed for binders for energetic compositions. With the proper choice of prepolymers and radiation dose, it has been established that a quick cure of HMX or RDX filled explosive or propellant compositions can be achieved without detectable radiation induced damage to any of the ingredients.
- Magnetic Anomaly Detection (MAD) algorithms have been devised which automatically compensate for magnetometer noise due to aircraft motion and results in a 30% improvement in MAD detection ranges.
- Advances in the art of diamond single-point machining of optical surfaces involving the use of negative tool rake angle and in the art of preparing optical dielectric films involving the use of ion beam ardent during film deposition have resulted in the production of surfaces with substantially increased laser damage resistance.
- A novel microstrip phased array antenna utilizing tightly coupled parasitic elements for reactive beam steering has been developed.
- Increased understanding of adiabatic shear banding in warhead cases is contributing to improved warhead fragmentation.
- A ship hull "damage rule" has been derived by use of a simplified model for the deformation of a shell due to reloading from shock-wave induced cavitation as a result of a large underwater explosion.
- Ultra pure cooled water has now been shown to maintain an electrical field in excess of 150 Kv/cm for stress times in excess of 200 microseconds.

Program Element: 61152N  
DoD Mission Area: 510 - Defense Research

Title: In-House Independent Laboratory Research  
Budget Activity: I-Technology Base

- Recent investigations of relationships between chemical structure and sensitivity to explosive initiation have demonstrated that bonding arrangements which interfere with rotation about chemical bonds have adverse effects on sensitivity to impact.
- Drag measurements on ultra-small diameter arrays have been conducted to characterize their self noise and low Reynolds number behavior.
- Sound absorption below 1 kHz is being better characterized by means of a three-relaxation model, which gives good agreement with available ocean attenuation measurements, except for the Mediterranean for which additional data must be obtained.
- A method for calculating the three-dimensional steady-state configuration of a multi-segment towed cable has been implemented in a FORTRAN computer code.
- Understanding of the structure of instabilities in ramjets has been improved and forms the basis for better understanding of instability mechanisms.
- A new high-performance, insensitive explosive compound, CL-14, has been synthesized in the laboratory, and the synthesis is undergoing scale-up.
- Acoustic and seismic data collected by arrays of sensors in shallow water has been reduced to provide directionality of ambient noise.
- A computer code which was previously developed to predict forces and moments in extreme vehicle maneuvers has been exercised to evaluate its capability as a flow field vortex initializer to determine both near and far field velocity distribution.
- Use of hyperoxic gas mixture was found to improve the cardiac function of divers during period of heavy workload.
- Highly sensitive and specific assays have been developed to identify, characterize and purify rickettsial antigens, a major advance in the development of improved vaccines against epidemic and endemic typhus.
- Eye scan patterns were measured to investigate individual problem solving and information processing strategies.
- Measurement of brain electrophysiology has been applied to visual and auditory discrimination.
- A more effective model used in predicting the operational performance of electro-optical imaging systems has been conceived.
- A technique was developed for propagating B-lymphocytes in the laboratory, thereby improving prospects for treating nuclear warfare casualties through replacement of depleted antibody-producing cells.
- Advanced nonlinear finite element methods have been demonstrated to predict reasonable contact forces, surface displacements and frictional dissipation occurring during cyclic bending of a shaft with a shrink-fit sleeve bearing with unlubricated friction as a step towards accurate analysis of the integrity of bearings as a key to the reliability of power generation and transmission machinery systems.
- Localization errors due to propagation across straight fronts and cold core eddies have been estimated and found to become significant for long range propagation with small grazing angles to the front or eddy tangent.

Program Element: 61152N  
DoD Mission Area: 510 - Defense Research

Title: In-House Independent Laboratory Research  
Budget Activity: 1-Technology Base

- The generation of hot spots within deforming energetic crystalline materials has been explained in more detail than has been done previously.
- A dynamic pressure velocity probe has been installed on the USS Dolphin for investigating the nature of the small scale velocity variability in the upper ocean.
- Factors were identified for improving the presentation and learning of technical information.
- A project to improve performance for Navy moorings has demonstrated 25% greater holding capacity for drag embedment anchors in 20:1 model tests with simple design modifications.
- A version of an energetics-based sediment transport model has predicted observed patterns of onshore/offshore sediment movements.

I. (U) FY 1983 PROGRAM: Research during this period involves individual projects at many research facilities and covers areas of science and technology of interest to the Navy. The current program represents a coming together of the ideas of in-house scientists and the knowledge of fleet problems as expressed by Laboratory Commanding Officers, Laboratory Technical Directors, their staffs and other inputs from the operating forces. Projects include work on materials and structures; electronics; underwater acoustics including the reduction of radiated sound from submarines; drag reduction for torpedoes and ships; environmental investigations; command and control; high density energy sources; and areas of personnel research.

J. (U) FY 1984 PLANNED PROGRAM: Work will continue in those fields of science most closely related to the Navy's mission, in investigations of environmental factors of interest to the Navy, and in new concepts relevant to future Navy requirements. Since funds are used at the discretion of the Technical Directors to fund original work of interest to the Navy, initiated at times not necessarily in consonance with the budget cycle, the individual work units which will be active in the next year cannot be predicted in advance.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: 1-Technology Base

A. (U) RESOURCES (SUBELEMENT LISTING): (Dollars in Thousands)

| Subelement No. | Title                               | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------|-------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|                | TOTAL FOR PROGRAM ELEMENT           | 254,985        | 282,969          | 300,238          | 328,552          | Continuing               | Continuing           |
| 11             | General Physics                     | 30,282         | 33,318           | 35,518           | 38,013           | Continuing               | Continuing           |
| 12             | Radiation Sciences                  | 2,968          | 3,342            | 3,495            | 4,023            | Continuing               | Continuing           |
| 13             | Chemistry                           | 17,099         | 18,828           | 19,792           | 25,149           | Continuing               | Continuing           |
| 14             | Mathematical Sciences               | 22,245         | 29,002           | 27,978           | 32,718           | Continuing               | Continuing           |
| 21             | Electronics                         | 26,933         | 27,661           | 27,752           | 31,171           | Continuing               | Continuing           |
| 22             | Materials                           | 23,083         | 23,314           | 26,080           | 28,260           | Continuing               | Continuing           |
| 23             | Mechanics                           | 18,588         | 20,082           | 20,748           | 22,800           | Continuing               | Continuing           |
| 24             | Energy Conversion                   | 10,018         | 11,323           | 11,769           | 12,028           | Continuing               | Continuing           |
| 31             | Oceanography                        | 51,951         | 50,237           | 56,086           | 60,686           | Continuing               | Continuing           |
| 32             | Terrestrial Sciences                | 14,098         | 16,100           | 16,634           | 17,413           | Continuing               | Continuing           |
| 33             | Atmospheric Sciences                | 6,479          | 7,769            | 8,263            | 8,239            | Continuing               | Continuing           |
| 34             | Astronomy and Astrophysics          | 4,023          | 4,056            | 5,415            | 5,135            | Continuing               | Continuing           |
| 41             | Biological and Medical Sciences     | 17,880         | 17,660           | 18,926           | 20,555           | Continuing               | Continuing           |
| 42             | Behavioral and Social Sciences      | 9,338          | 10,277           | 11,782           | 12,362           | Continuing               | Continuing           |
| 51             | University Research Instrumentation | 0              | 10,000           | 10,000           | 10,000           | Continuing               | Continuing           |

As this is a continuing program, funding in FY 1985 includes escalation and encompasses all work or development phases planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this element is to sustain U.S. naval scientific and technological superiority and to be a source of new concepts and technological options for the maintenance of naval power and national security. The program includes theoretical and experimental research in selected areas of the physical, engineering, environmental, behavioral and life sciences. The research program has a broad programmatic approach and uses an investment strategy which:

- \* carries out research in selected fields of crucial importance to the Navy/Marine Corps and national security;
- \* maintains awareness of emerging scientific capabilities and their implications as a deterrent to technological surprise;
- \* retains a vigorous scientific manpower and laboratory base;
- \* promotes the dissemination and applications of new knowledge for timely use in naval systems, operations, and environmental support;
- \* balances long-term basic research with significant applied research efforts oriented to specific naval technological or operational needs;
- \* develops larger, more focused and more visible programs;
- \* strengthens ties between universities, industry, and in-house laboratory activities through well coordinated program plans and execution; and
- \* allows flexibility to capitalize on new research opportunities immediately.

Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: 1-Technology Base

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The reduction of 7,082 in FY 1983 is due to Congressional reductions. As a result of this reduction several major programs were reduced in size. Examples include:

- \* Life Assurance (FY 1983 reduction of 1,868). Identification and characterization of factors (such as wear and failure mechanisms, contact fatigue, and NDE techn.) which affect life prediction methodologies for high performance materials in such applications as ship board mechanical systems, turbines and high energy density batteries. As a result of this reduction, only the work on submarine shaft seals will be completed and transitioned. Other work initiated in FY 1982 or scheduled for initiation in FY 1983 will be terminated.
- \* Artificial Intelligence Transition (FY 1983 reduction of 500). Research to transition artificial intelligence techniques from basic research into the Navy user environment. This cut will result in not being able to conduct a joint university-Navy laboratory effort to transition expertise in AI techniques related to: (1) automated planning and scheduling for carrier aircraft spotting and launch sequencing; (2) expert systems for C3 situation assessment; (3) expert systems for target recognition; and (4) crisis learning and altering system for C3.
- \* Science Base for Materials Processing (FY 1983 reduction of 700). A multidisciplinary program to determine the mechanisms affecting materials microstructure - property relationships related to new materials processing techniques needed to take advantage of the latest advancements in materials technology for future naval systems. The reduction will preclude the establishment of research centers which would have brought together expertise from academia, industry, and Navy laboratories to impact the areas of polymer processing and the chemistry of electronic materials.

Other reductions impacted several other important research program areas. Examples of these efforts include:

- \* reduced support for Charged Particle Beam related programs including new concept accelerator designs and beam propagation characterization;
- \* reduced support for modeling of cognitive structures and processes related to skilled problem solving and human information processing;
- \* reduced research in the area of electromagnetic field effects on biological systems as related to both the harmful and beneficial properties of these fields;
- \* reduced efforts in the synthesis and characterization of high performance polymer and ceramic materials for missile systems; and
- \* reduced support for the scientific upgrading of Navy oceanographic ships operated by universities engaged in Navy research programs.

The projected FY 1984 reduction of 18,622 is the result of reductions throughout the five-year planning process. Since there is virtually no new growth in this budget, all new initiatives and program expansions described below are the result of terminations, transitions, or decreases in existing programs. Changes in funding for certain subelements reflect plans to optimize resource allocations for high priority programs in accordance with the research planning process. Program emphasis will be given to multidisciplinary research projects which address key issues.

New programs planned to start in FY 1984 include:

- \* Ultra Low Loss Glass Fibers (FY 1984 funding of 1,087). Research in the purification and drawing of high transparency materials suitable for optical fibers which will be used for secure long-distance data links.
- \* Biomolecular Systems for Naval Applications (FY 1984 funding of 1,674). A coordinated research effort examining the application of recombinant DNA synthesis techniques to specifically tailor biological polymers which would provide suitable replacements for materials now used in sensors, films and lubricants, fuels and micro-electronic circuits.

Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: I-Technology Base

- \* Marine Bioluminescence Systems for Naval Applications (FY 1984 funding of 1,975). An interdisciplinary program to provide prediction models of upper ocean optical properties and phenomena (i.e., transmissivity, absorption, scattering, and bioluminescence) useful for ASW.
- \* Compact Ramjet Propulsion Systems (FY 1984 funding of 1,225). Research to eliminate low frequency motor instabilities and improve the efficiency and performance of compact high performance tactical missiles powered by integral rocket ramjets.
- \* Millimeter (MM) Wave Technology (FY 1984 funding of 1,060). Determine new mechanisms for solid state sources at MM and near MM frequencies, investigate new mixer and detector technology (primarily at cryogenic temperatures) and utilize Indium Phosphide semiconductor materials in monolithic circuit formats to improve performance and reduce cost of MM wave devices.
- \* Distributed Tactical Decision Making (FY 1984 funding of 1,472). A program to generate models and techniques for representing command decision making in distributed Navy command and control systems and to use developed models and techniques for testing and predicting relationships between various system designs.
- \* Low Reynolds Number Aerodynamics (FY 1984 funding of 1,000). Experimental and theoretical research to provide the aerodynamic basis for assessing the feasibility of low speed, low Reynolds number flight for a small high endurance air vehicle required for a specific and unique Navy mission. This effort will complement an existing research thrust in transonic low Reynolds number aerodynamics for a related Navy application.
- \* Southern Ocean Studies (FY 1984 funding of 2,400). Expand oceanographic knowledge in new geographic areas of importance to the Navy. Define, classify and understand the dynamics of the South Atlantic and Indian Oceans.
- \* High Precision Astrometry and Satellite Positions (FY 1984 funding of 1,100). Research needed to develop an interferometric system in the optical and infrared spectrum capable of precise stellar positioning (.001-.01 arc seconds) which is applicable to the Navy's strategic program.
- \* Non-Acoustic ASW Environmental Research (FY 1984 funding of 1,931). Research to determine the physical processes responsible for the hydrodynamic background noise field for non-acoustic submarine detection.

Program thrusts which were started in previous years and that are undergoing major expansion (greater than 1,000) in FY 1984. (The amounts shown are the increases to these programs in FY 1984.)

- \* Chemical/Biological Warfare Defense (CBWD) (FY 1984 funding expansion of 1,750). A multi-disciplinary program to establish the technological base for Navy specific aspects of effective CBWD. Thrust areas include: collective protection at sea; sea water compatible decontamination materials and processes; and agent detection at sea. Additionally, Navy relevant personnel protection at sea will be addressed as necessary.
- \* Ultra Submicron Electronics Research (FY 1984 funding expansion of 1,521). Research on the materials, fabrication processes, device technologies, circuit design, systems architecture and reliability and maintainability of electronic devices/components which will be two to three orders of magnitude more powerful than those under consideration in the DOD's Very High Speed Integrated Circuits program.
- \* Graduate Fellowship Program (FY 1984 funding expansion of 1,118). Provide Graduate Fellowships in areas of science and engineering which are considered critical (or undermanned) for future naval technology activities. These areas include Naval Architecture, Materials Science, Applied Physics, Aerospace/Mechanical Engineering, Electrical Engineering and Computer Science.
- \* Multibeam Echo Sounders for Research Vessels (FY 1984 funding expansion of 1,550). Provide more cost effective bathymetric sounding capability to academic oceanographic research vessels engaged in Navy research through a combination of new multi-beam echo sounders and improved signal processing and computer display capabilities.
- \* Upper Ocean Variability (FY 1984 funding expansion of 1,200). Describe, understand and model the statistics, kinematics and dynamics of the upper ocean mixed layer and internal wave field to provide environmental support for SSBN security.



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DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: I-Technology Base

These large new initiatives or augmentations to existing programs correspond to 7% of the total program budget. An additional priority will also be given to research in areas of critical naval needs or in expanding fields of high scientific opportunity such as:

- \* marine materials
- \* information technology and computer science
- \* artificial intelligence
- \* reliability and maintainability of systems
- \* physical oceanography and its relation to anti-submarine warfare
- \* human factors engineering
- \* cold weather physiology
- \* electronic warfare
- \* electronic devices
- \* command and control
- \* vehicle performance

The new thrusts or expansions will be supported by the reallocation of resources from areas of reduced emphasis/terminated programs or completed/transitioned programs. Some examples of these programs are provided below. Additional examples of completed/transitioned programs from which funds for new programs are derived are listed in FY 1982 Accomplishments, Sections 1.2.a.1 and 1.2.a.2.

- \* Efforts on high energy density nitro/azido substituted preformed prepolymers reduced.
- \* Work on Titanium (Ti 6211) phase diagrams completed and transferred to Naval Sea Systems Command.
- \* Fundamental work on erosion of ceramics completed and results transferred directly to a missile dome application.
- \* Superconducting V<sub>3</sub>Ge, Vanadium Gallium, wire research completed and transferred to Naval Sea Systems Command.
- \* Turbine engine inlet to combustor compressor related cold flow gas phenomena efforts reduced.
- \* Auditory pattern recognition effort completed and transitioned to Naval Undersea Systems Center and Naval Ship Research and Development Center.
- \* Completed instrument suite for airborne gravity measurement capability and transferred to Defense Mapping Agency/Naval Oceanographic Office.
- \* Arctic research using ice floe stations (FRAM) completed.
- \* Completed and transferred tidal model to Defense Mapping Agency.

Lastly, reductions to the research funding have necessitated deferring the start and/or delaying completion of some programs. Examples of these programs include:

- \* Arctic ASW
- \* Coastal and/or shallow water ASW
- \* Artificial intelligence aspects of natural language processing
- \* Polymers for electronics applications
- \* Physiological defense against unidentified agents
- \* Resonance enhanced surface properties of electronic devices
- \* Space environment effects on electronic devices
- \* Advanced automation and production engineering

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Subelement No. | Title                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|----------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| 11             | TOTAL FOR PROGRAM ELEMENT | 221,022        | 254,705          | 290,051          | 318,860          | Continuing               | Continuing           |
| 12             | General Physics           | 26,696         | 30,479           | 33,853           | 36,897           | Continuing               | Continuing           |
| 13             | Radiation Sciences        | 3,604          | 3,000            | 3,495            | 3,718            | Continuing               | Continuing           |
|                | Chemistry                 | 15,118         | 17,073           | 19,486           | 21,907           | Continuing               | Continuing           |

Program Element: 61153M

DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences

Budget Activity: 1-Technology Base

|    |                                     |        |        |        |        |            |            |
|----|-------------------------------------|--------|--------|--------|--------|------------|------------|
| 14 | Mathematical Sciences               | 18,707 | 21,750 | 28,229 | 30,709 | Continuing | Continuing |
| 21 | Electronics                         | 22,457 | 27,051 | 27,727 | 29,010 | Continuing | Continuing |
| 22 | Materials                           | 19,867 | 24,210 | 25,759 | 29,194 | Continuing | Continuing |
| 23 | Mechanics                           | 14,868 | 18,203 | 20,003 | 22,362 | Continuing | Continuing |
| 24 | Energy Conversion                   | 9,193  | 9,987  | 12,545 | 14,097 | Continuing | Continuing |
| 31 | Oceanography                        | 43,088 | 51,139 | 51,768 | 58,653 | Continuing | Continuing |
| 32 | Terrestrial Sciences                | 12,706 | 14,415 | 17,530 | 19,272 | Continuing | Continuing |
| 33 | Atmospheric Sciences                | 6,221  | 6,446  | 6,805  | 7,469  | Continuing | Continuing |
| 34 | Astronomy and Astrophysics          | 3,907  | 4,013  | 4,295  | 4,700  | Continuing | Continuing |
| 41 | Biological and Medical Sciences     | 16,316 | 17,859 | 17,619 | 19,689 | Continuing | Continuing |
| 42 | Behavioral and Social Sciences      | 8,274  | 9,080  | 10,931 | 11,183 | Continuing | Continuing |
| 51 | University Research Instrumentation | 0      | 0      | 10,000 | 10,000 | Continuing | Continuing |

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: See individual Subelement Descriptions.

G. (U) WORK PERFORMED BY: Performers include various university, industry, not-for-profit institutions and in-house laboratories. About 51% of funding goes to universities, 39% to in-house laboratories, and 10% to industry. See individual Subelement Descriptions.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984: Not applicable.

I. (U) PROJECTS OVER \$10 MILLION FY 1984:

1. DESCRIPTION: This research effort is the primary means for deriving scientific understanding and the required technologies underlying improvements in Navy capabilities and operations. Increased research is required both to reach technological parity in some areas and gain/maintain technological superiority in others. Research is directed to search out, assess, and exploit potential scientific solutions to known near- and long-term naval problems. Corresponding to the broad spectrum of technical content of naval operational needs, investigations are conducted in the fundamental science areas of:

- |                      |                                       |
|----------------------|---------------------------------------|
| * General Physics    | * Energy Conversion                   |
| * Radiation Sciences | * Oceanography                        |
| * Chemistry          | * Terrestrial Sciences                |
| * Mathematics        | * Atmospheric Sciences                |
| * Electronics        | * Astronomy and Astrophysics          |
| * Materials          | * Biological and Medical Sciences     |
| * Mechanics          | * Behavioral and Social Sciences      |
|                      | * University Research Instrumentation |

Individual Subelement Descriptions contain specific information for each science area identified above.

2. PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. FY 1982 accomplishments: Significant progress has been made in many areas of the research program. The following provides a highlighted list of these accomplishments:

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DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: 1-Technology Base

- \* Experiments using an ion beam to incorporate vapor deposited films into the surface of metals showed that the incident fluence could be reduced by a factor of 10 below that required by direct ion implantation techniques. Improved surface modification techniques are important to the Navy for improving metal alloy resistance to corrosion and fatigue.
- \* Microelectronic devices have been developed as sensors to monitor polymer processing such as the use of epoxy resins used in high performance composite materials. The combination of polymer processing with microelectronic sensing offers an entirely new approach to quality control and lifetime assurance of critical structural components.
- \* Work on the robust estimation of Kalman filters has been applied to eliminate glint in the targeting of certain air to air missiles. This allows the missile system to function in a much broader operating envelope.
- \* Microwave imaging with resolution comparable to the human eye was demonstrated with a self coherent antenna array.
- \* A semiconductor laser was invented which exhibits controlled optical bi-stable operation. This device may form the basis for a new family of opto-electronic systems with operating speeds greatly in excess of those currently existing.
- \* The feasibility of using optical fibers for low frequency electromagnetic antennas was established.
- \* Significant accomplishments have been made on understanding and predicting aerodynamic effects for high speed missiles in a maneuvering environment.
- \* An elastic-plastic dynamic fracture model has been developed for crack propagation predictions useable in naval ship building and aircraft construction.
- \* Fabricated and tested 94 GHz radar for precision measurement of sand, ice and ocean scattering characteristics. This instrument may be useful to derive bathymetric data remotely.
- \* Computer simulations have shown the feasibility to artificially excite the ionosphere for generating extremely low frequency waves for secure communications to submarines.
- \* New ultraviolet cameras and spectrographs together with electronic readout adaptation are under test for the DoD Space Test Program shuttle flight.
- \* Developed new technique for growing human cells responsible for the immune response in a test tube. This technique can be used to generate compatible immune cells and products without exposing individuals to toxic BW/CW agents.
- \* Formulated a set of standards for planned computer-based adaptive versions of military selection tests.
- \* Color center lasers have exhibited laser operation over a tunable range of 2-4 micrometers. This development provides a laser source of prime importance in electro-optic counter measures.
- \* A multibeam echo sounder was used on its first scientific cruise. Twenty simultaneous beams map a swath of bottom bathymetry. This technology will revolutionize the examination of sea floor morphology.

Examples of research projects that have been completed during FY 1982 and transitioned into either Exploratory Development, Advanced Development, or other activities are provided below. The resources made available from these completed projects will be used for new thrusts or project expansions in other vital research areas.

1) Transitions to Navy/DoD:

- \* Ceramic Lead Zirconate Titanate - Polymer Composites have transitioned to hydrophone size scale-up evaluation by Naval Undersea Systems Center and Naval Research Laboratory.
- \* Use of crack inhibitors to slow crack growth and retard stress corrosion cracking in naval aircraft structures transferred to Naval Air Systems Command.
- \* Results of Radar Absorbent Materials research transitioned to Naval Air Systems Command and Joint Cruise Missile Project Office.
- \* Results of research on dosimetry interface effects and on the recombination of electron hole pairs produced in silicon dioxide by ionizing radiation transitioned to Defense Nuclear Agency. This will be used to determine whether commercial low energy X-ray sources can be used to characterize total dose radiation response of silicon integrated circuits at the wafer probe stage.

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DoD Mission Area: 510 - Defense Research

Title: Defense Research Sciences  
Budget Activity: 1-Technology Base

- \* Research results on the design and fabrication of woven composite structures for damage tolerant applications transitioned to the Naval Air Systems Command.
- \* Efforts in environmental statistics for ocean acoustics transitioned to Naval Electronic Systems Command.
- \* Transitioned surf wave prediction model and coastal marine atmospheric boundary layer model to the Naval Environmental Prediction Facility.
- \* Research on a blood factor that may enhance membrane permeability essential for wound healing transitioned to Naval Medical Research and Development Center.

2) Direct transitions to industry:

- \* Ion implantation techniques transferred to industry via Manufacturing Technology program. Industry will use techniques to harden tools and bearings.
- \* Model of the particle radiation environment in the vicinity of the earth has been adopted as an engineering design standard by the Air Force. This model is used by industry to estimate single event upsets and latch-up rates for spacecraft microelectronic devices.
- \* Methods for developing highly specific chemical sensors have transferred directly to industry.
- \* Portions of the conducting polymer work have been picked-up by the battery industry.
- \* Silver oxide battery plate technology transitioned directly to industry.
- \* Interim version of a computational code for 3-dimensional Euler Equations - transonic flow has been transferred to several airframe manufacturers and is being evaluated and used in conceptual and preliminary devices.

Additional FY 1982 accomplishments are provided in the individual Subelement Descriptions.

b. (U) FY 1983 Program: See individual Subelement Descriptions.

c. (U) FY 1984 Planned Program: Research will continue across the broad range of science and technology necessary for future naval requirements. The individual Subelement Descriptions provide details of the planned programs.

Subelement: 11  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: General Physics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: Experimental and theoretical research in physics is directed toward physical phenomena, materials, structures, processes, and measurement techniques underlying immediate and long range Navy/Marine Corps requirements and capabilities in weapons, weapons platforms, sensors, communications, surveillance, navigation, countermeasures, assessment of weapons effects, and characterization of naval environments. Major program thrusts are in solid state physics and structure determination; surface and interface physics; atomic and molecular physics; radiation, optics, optical processing and laser physics; physical and underwater acoustics; computational physics; plasma and ionic physics; and superconductivity.

B. (U) RELATED ACTIVITIES: Formal interservice coordination is provided, in part, through reviews by the Office of the Under Secretary of Defense for Research and Engineering and through Navy representation on: interagency committees on plasma physics, atomic physics, lasers, optical signal processing materials, electronics, and cryogenic refrigeration which effect coordination throughout all federal programs in these areas; the Solid State Sciences Committee of the National Academy of Sciences; the Committee on Atomic and Molecular Sciences of the National Academy of Sciences; Working Groups on Microwave Devices, Low Power Devices, Imaging and Display Devices, and Laser Devices of the Department of Defense Advisory Group on Electron Devices. The Laser program is closely related to and complements those of the Navy Systems Commands, Army, and Air Force. Close coordination is also maintained with Defense Advanced Research Projects Agency programs on free electron lasers, gas lasers, solid state lasers, and related science and technology. Coordination is maintained with the Defense Nuclear Agency in the areas of atomic, molecular and plasma research as they relate to weapons effects, and with the Army Research Office (Durham), the Air Force Office of Scientific Research, the National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, and with Navy and other military laboratories. Information exchange with foreign nations is effected through the North Atlantic Treaty Organization, by the Tripartite Technical Cooperation Program, and through various defense exchange agreements. This participation also involves interaction with the Office of the Under Secretary of Defense for Research and Engineering and with the other services.

C. (U) WORK PERFORMED BY: (Representative) Academic: University of California, Berkeley, CA; Catholic University of America, DC; Massachusetts Institute of Technology, Cambridge, MA; University of Arizona, Tucson, AZ; University of Illinois, Chicago, IL; University of Texas, Austin, TX; Industrial: United Technologies, East Hartford, CT; IBM Research Laboratories, Yorktown Heights, NY; Science Applications, Inc., Palo Alto, CA; Non-Profit: SRI International, Menlo Park, CA; In-House: Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

D. (U) FY 1982 Accomplishments: From a large number significant accomplishments advancing of the Navy technology base, selected highlights are described in the following. Solid State Physics: A universal response theory developed over the past two years has been applied to the viscosity of high molecular weight polymer with success. This provides new guidelines for polymer and composite material development. Navy support of synchrotron radiation sources, progress in the development of high intensity neutron sources (both funded by sources other than Subelement 11) and development of experimental determination of relative phases of x-ray diffraction amplitudes, have provided tools for structure identification of new materials and of physiologically and medically active substances of Navy interest. Surface anisotropy in ultra thin ion single crystal films has been measured and theory has been developed. These films deposited by new techniques of molecular beam epitaxy will be useful for new Navy magneto-optic devices. Atomic and Molecular Physics: Previously reported laser cooling of ions has been extended to neutral atoms for which atomic velocities have been reduced to 4% and beam velocity spreads have been reduced to 10%. These findings show that it will soon be possible to trap neutral atoms as it now is with ions so that much more precise time and frequency standards for Navy uses can be developed. The Townsend coefficient, a central measure of gas breakdown processes, has been generalized to account for avalanche. This generalization is directly transferrable to development of fast switch development, a part of the Navy pulse power program. Surface and Interface Physics: Small molecules reflected from metal surfaces have been found to exhibit

Subelement: 11  
Program Element: 61153K  
DoD Mission Area: 510 - Defense Research

Title: General Physics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

quantized vibrational and rotational states during the short time contact with the surface. This fundamental finding provides essential guidance for further research into catalysis and corrosion processes. Radiation and Optics, and Laser Physics: Trivalent cerium has exhibited fluorescent properties suitable for blue-green lasers when incorporated in scandium stabilized lanthanum aluminate. If acceptable single crystals of lanthanum aluminate can be grown, a potentially superior blue-green source will be available for Navy programs in air to underwater communications. The line width of a 3.2 micrometer free electron laser has been measured and found to be very close to transform limited. This means it is unlikely that extraneous line broadening processes will cause problems in the Navy free electron laser program. Initial experiments on electron beam energy recovery in the under-construction free electron laser accelerator have shown about 90% recovery. Continued development should increase recovery to levels desired for two stage free electron laser operation at high efficiency. A half-deuterated long chain hydrocarbon when irradiated with a carbon dioxide laser exhibited selective elimination of deuterium. This demonstration of nonstatistical photochemistry will lead to a reevaluation of photo-induced chemical dynamics necessary for the synthesis of new chemical compounds. Phase conjugation, a nonlinear optical four wave interaction which produces the phase conjugate of an incident wave, has been incorporated in a neodymium laser. The phase conjugation process provides correction of aberrations in the laser elements and laser media. This technique can be used to prevent beam property degradation as the power of a laser is increased. Application to Navy laser systems could provide significant improvement in operation. Color center lasers, previously reported, have been advanced to exhibit laser operation over a tunable range of two to four micrometers. This unique development, while affording an important research tool in a spectral range particularly important in chemical identification, provides a laser source of prime importance in electro-optic countermeasures. Physical and Underwater Acoustics: Experiments and calculations have shown that volume scattering will not degrade coherent acoustic array performance of arrays five to ten times larger than are now in use. This means that underwater acoustic arrays in deep water can be built to provide much higher angular precision and hence, discrimination, than those currently used. Near-field acoustic holographic techniques have been developed. These techniques will afford a precise diagnostic for in-situ transducer and scattering behavior required for advances in underwater acoustic applications and transducer development. Previously reported acoustic microscopy research has been advanced to exhibit resolution somewhat better than 0.08 micrometers. This new capability should, among its many applications, provide subsurface nondestructive diagnosis of multilayer electronic devices being developed under Navy programs. Plasma and Ionic Physics: A new concept has been proposed (and will be extensively examined) for a cyclic high current accelerator. It incorporates both betatron and stellarator principles in one device which preliminary estimates indicate should exhibit excellent stability properties. If further work confirms initial estimates, a practical, compact accelerator design should evolve for application to charged particle beam, millimeter wave generators, and perhaps free electron lasers, all of importance to Navy programs in high energy beam systems. A laser-guided electrical discharge in the atmosphere has been demonstrated to act as a radio frequency antenna. Possible uses for this phenomenon would be to provide antenna capabilities when conventional antennas are not possible. Previously reported accomplishments in microwave generators have been extended to demonstrate an increase in bandwidth to 13% for a gyro-TWT amplifier operating at 35 GHz. Further increases in bandwidth for such devices will afford significant options for Navy programs in electronic warfare applications. Superconductivity: Techniques have been developed for routinely producing tunnel junctions approaching  $3 \times 10^{-10}$  cm<sup>2</sup> square centimeters, and with such junctions critical supercurrent densities in excess of  $10^6$  A/cm<sup>2</sup> angstroms/square centimeter have been observed. These devices should provide switching times less than 0.1 psec. These devices should allow investigations of the intrinsic response limits of tunnel junctions and thereby provide reliable estimates of the frequency response limits necessary for projected electronic applications. Photon-assisted quantum tunneling effects have been investigated at 600 GHz. The quantum efficiency is superior to the best semiconductor detectors at this frequency, thus providing options for development of ultra high frequency electronic devices. Large coherent superconducting junction arrays consisting of some tens of junctions have emitted radiation reduced from a width of 200 MHz unlocked to about 2 MHz in the coherent state. This result is encouraging for large, millimeter wave source development. Computational Physics: A model was developed to simulate the migration and diffusion of magnetic fields with loops through the surface of the sun, and the model was compared to measured magnetograms. It was found that coronal holes, the source of high speed solar wind streams can be predicted months in advance. If this model is substantiated, prediction of terrestrial communication interruption should be possible. Such a predictive capability should prove of great value to Navy communication channel selection and management. A computation of the

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Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: General Physics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

propagation of a detonation in a reacting gas between two solid walls has shown detached pockets of unburned gas behind the shock. These pockets seem to explain the initiation of new detonation cells and the phenomenon of galloping detonation. These findings provide new understanding of detonation processes and possible control of detonation for Navy applications.

E. (U) FY 1983 Program: Current research under this subelement maintains emphasis in areas considered to be of continued importance to the Navy: Solid State Physics: New emphasis on research of ultra thin magnetic films; experimental and theoretical research on composition modulated alloys and research on multilayer microstructures. This has been made possible by new experimental techniques, including molecular beam epitaxy, and is expected to provide new electronic materials properties and device concepts. Atomic and Molecular Physics: Continued investigation of atomic and molecular species using new experimental and computational techniques to optimize utilization in new systems and to explain environmental behavior affecting Navy systems such as communications; continued work of wall-coatings for low temperature hydrogen masers needed for projected applications in Global Positioning Satellite systems; continued research on laser cooling of neutral atoms and ions so that both species can be used in spatial traps for improved time and frequency standards; further research on vibrational-rotational line widths for testing detailed state-to-state rotational relaxation rates needed for laser systems and chemical kinetics; and new experimental determination of cross sections for collisions of Rydberg atoms so that feasibility and optimization of Rydberg detection of electromagnetic radiation can be achieved. Radiation and Optics and Laser Physics: Continued emphasis on improvement of efficiency, stability, and lifetime of existing laser systems and search for new lasers having properties defined by Navy needs such as blue-green lasers and mid infrared lasers; investigation of new approaches for filters, and detectors for blue-green, vacuum ultraviolet and x-ray regions; utilization of picosecond and newly demonstrated femtosecond lasers for determining transient effects in semiconductors and on photochemical reactions so that they may be characterized according to usage in devices and processes; continued research on optical processors for electronic warfare, radar, and sonar; continued effort on two-stage, low-voltage free electron lasers in special focus program; continued emphasis on scaling excimer lasers to one kilojoule per pulse; expanded effort on color center lasers tunable over the mid infrared band for electro-optic countermeasures and in preparation for special program in FY 1984; investigation of noise sources in fiber optic systems applicable to special sensor applications; work on nonlinear optical techniques for microscopy of biological materials to provide a new method of biological examination; evaluation of conjugate wave processing techniques for correcting aberrated optical systems; and augmentation of research on nonoxide materials for use in optical fibers with reduced losses. Acoustics: Continued application of new scattering calculational techniques to complex underwater structures of Navy interest; continued investigation of anechoic and decoupling materials and mechanics for underwater use on Navy platforms and structures; continued work on optical acoustic field visualization methods and increased emphasis on acoustic holographic visualization methods useful for transducer analysis and sonar scattering process identification; continued investigation of nondestructive evaluation by acoustic methods to provide alternative structure inspection methods; and evaluation of deep and shallow water propagation properties as they influence passive and active sonar systems. Plasma and Ionic Physics: Continued work on plasma properties influencing pulsed power switching, gas discharge devices, and laser systems; determination of operational characteristics of autoacceleration and automodulation of intense relativistic electron beam devices needed for Navy high power, directed energy applications; increased emphasis on concepts for compact, cyclic accelerators needed for practical, shipboard use of directed energy systems; development of induction Linac technology for driver of advanced accelerators; investigation of propagation of electron and ion beams in air for determining feasibility of directed energy systems; inauguration of new thrusts on high power millimeter wave technology; and new initiative on charged particle beam technology. Superconductivity: Continued work on coherent arrays of superconducting emitters for special high frequency source applications and on arrays for logic switching and data storage with speeds improved over alternate technologies; continued research aimed at developing higher transition temperature and higher critical magnetic fields so that cooling and environmental constraints can be reduced; new emphasis on submicrometer film structures, both homogeneous and heterogeneous, for unique device applications; and research on noise generation mechanisms in Josephson Junction devices. Computational Physics: Continued application of new computational physics techniques and algorithms to problems in turbulence, combustion, and solar wind generation; development of an optimized chemically reacting flow modelling facility; and

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Title: General Physics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

generalization of Lagrangian simulation techniques to allow computation of complex processes of Navy applicability.

F. (U) FY 1984 Planned Program: Thrusts and changes planned are as follows: Solid State Physics: Basic investigations will be modified to include ceramics in addition to past emphasis on crystalline materials because of increased Navy interests and the development of techniques appropriate to the more complex ceramic materials; continued and expanded work in the femtosecond regime of transient phenomena guided by concern for even higher frequency operation of semiconductor devices; investigation of solid state properties and limitations for ultra submicrometer electronic devices; increased on emphasis processes and properties afforded by layered ultra thin film structures, produced by molecular beam epitaxy and perhaps by photo-induced chemical vapor deposition, anticipated to be important in magnetic, optical and x-ray devices; and the use of new synchrotron and high flux neutron sources to investigate the structure of materials, antibiotics, and energetic materials. Atomic and Molecular Physics: Refinement of concepts for stored neutral and ionic species for applications to frequency and time standards; continued support for special wall treatments of hydrogen masers for space platform applications; continued investigation of state changing collisions for Rydberg detection applications; continued treatment of electron removal processes in switching applications for high power switches; and research supportive of processes associated to explosive initiation of energetic materials. Radiation and Optics, and Laser Physics: Continued improvement of optical processes for sonar, radar and data processing; application on nonlinear optical phenomena to optical processing for defined processing requirements; application of special optical diagnostic techniques to narrow-bandgap materials of importance in the infrared wavelength region; continued exploration of the x-ray/gamma-ray region of the spectrum for coherent sources and means of controlling such radiation; continued research on site-specific photochemistry; work on optical limitation concepts for optical countermeasures applications; continued work on FY 83 initiative on low loss optical fibers; continued emphasis on two stage, low voltage free electron lasers for specific Navy applications; continued scaling research of excimer lasers to one kilojoule per pulse operation; and inauguration of new program in the development of color center lasers for optical countermeasures. Acoustics: Application of optical and acousto-holographic techniques to measurement problems in transduction and scattering related to sonar sources and sonar problems; extension of holographic and tomographic techniques to three dimensional acoustic problems; and extension of topographical and sub-bottom data to the solution of three dimensional issues in sonar problems as related to acoustic array detection. Plasma and Ionic Physics: Definition of optimal choices for generation of radiation from relativistic electron beam devices for directed energy applications; provision of options for accelerators suitable for shipboard directed energy systems; operation of free electron laser, operating single stage, driven by induction linac and determination of its limits of operation; results of charged ion beam propagation calculated on the basis of data provided by advanced accelerator sources; continued emphasis of initiative started in FY 1983 on millimeter wave, high power technology related to directed energy program; and expansion of the FY 1983 charged particle beam initiative. Superconductivity: Increased emphasis on multiple layer ultra thin film structures for device application; investigation of implementation of digital superconductive devices and systems with emphasis on high speed applications; and clarification of noise processes in Josephson Junction devices arising from deterministic processes.



Subelement: 12  
Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Radiation Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: The Navy must be capable of operating in hostile radiation environments from nuclear weapons, nuclear power sources, directed energy weapons, and natural radiations in space. Research under this Subelement: (a) improves our understanding of the basic physics of the interactions of radiation (x-rays, laser beams, microwaves, and charged particle beams) with matter and the production of damage by these radiations in materials and devices, (b) measures the vulnerability of advanced materials and electronic devices by actual testing with radiation sources, and (c) explores ways in which radiation can be used beneficially either to analyze materials and surfaces or to modify their properties. In addition, research is performed on advanced concepts for measuring the characteristics of radiations in various military applications.

B. (U) RELATED ACTIVITIES: The research in this Subelement is coordinated through Department of Defense reviews sponsored by the Under Secretary of Defense for Research and Engineering; through collaborative efforts between scientists from NRL and other government, industry and university laboratories; through close relationships between research projects and DOD applied problems; and through participation in numerous DOD technical committees and working groups.

C. (U) WORK PERFORMED BY: In-House: Naval Research Laboratory (NRL), Washington, D.C.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

D. (U) FY 1982 Accomplishments: Radiation Damage. A 2.5 micron diameter beam was used to examine charge collection mechanisms in a metal on silicon, MOS, capacitor and the experiments showed, for the first time, that the amount of charge collected depends on oxide thickness. Understanding of charge collection is critically important to the hardening of electronic devices, such as those used in Navy spacecraft, against single event upsets. The optically detected magnetic resonance technique has been used to show that antisite defects decrease the hard edge luminescence in Gallium Phosphide, GaP, and thus decrease the efficiency of light emitting diodes; knowledge about radiation induced defects is essential for developing radiation hard electronic devices from new semiconductor materials. Radiation Beams and Sources. A new formulation of the theory of free electron lasers was developed. Free electron lasers are of particular interest to the Navy for countermeasure applications. Experiments on using an ion beam to incorporate vapor deposited films into the surface of metals showed that the incident fluence could be reduced by a factor of 10 below that required to achieve a desired concentration by direct implantation. Improved surface modification techniques are important to the Navy for improving metal alloy resistance to corrosion and fatigue cracking. Synchrotron Radiation Applications. Optical and photoelectric measurements relating to the fundamental absorption edges of Beryllium Fluoride, BeF<sub>2</sub>, a potentially important optical window material, were completed and a theory was developed for their explanation. The design and procurement of two monochromators, one for the 10-15,000 electron volts range and one for the 4-20 thousand electron volt range, for use with the NRL-NBS beam lines at the National Synchrotron Light Source, Brookhaven, were completed. These beam lines will give the Navy a capability for performing experiments at the best synchrotron radiation facility in the world. Radiation Analysis. A new soft x-ray source was completed and employed in tests which assessed the sensitivity of photoresists for x-ray lithography. X-ray lithography is important because it may become the technique of choice for producing submicron electronic devices. Ultra high sensitivity direct atom counting of tritium gas was successfully demonstrated at the NRL cyclotron. Tritium detection is of interest in the Navy in several applications.

E. (U) FY 1983 Program: The FY 1983 Subelement program will include the following: Radiation Damage. Experiments and calculations on the effects of intense electron beams on energetic materials, metals, composites, and ceramics will be made. Exploratory measurements of the response susceptibility of electronic devices to microwave radiation will be initiated. Initial measurements of x-ray driven chemical reactions in aqueous systems will be performed. The electronic and atomic structure of point imperfections, important in radiation damage, will be computed and will include relaxation effects. Optically detected magnetic resonance will be used to obtain new microstructure information on radiation induced defects in various compound semiconductors. Measurements on defect structures will be extended to quaternary semiconductors. Radiation Beams and Sources.

Subelement: 12  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Radiation Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

Interactions of high energy electron beams with periodic magnetic structures will be investigated at the Naval Research Laboratory Linear Accelerator (Linac) as a possible source of intense coherent radiation. Hybrid surface treatment methods such as ion beam mixing of deposited surfaces layers or ion implantation in a reactive gas will be developed. Synchrotron Radiation Applications. Laser induced plasma and annealing processes in semiconductors will be characterized by means of synchrotron radiation and the newly developed excited state photoelectron technique. Hard and soft x-ray beam lines will be assembled, tested, and put into operation, placing NRL among the first groups to carry out materials experiments on the X-ray ring at the National Synchrotron Light Source. Initial experiments will be concerned with crystal structure, surface properties, and effects of laser irradiation. Radiation Analysis. Methods of improving the sensitivity of direct atom counting of tritium on the Naval Research Laboratory cyclotron will be evaluated. X ray emission from plasmas produced by a repetitively pulsed Neodymium laser will be measured and applications to spectroscopy and x-ray lithography demonstrated. Spacecraft Survivability. The new microbeam capability to produce pulsed ion beams triggered from a device timing cycle will be exploited to study the time dependence of charge collection in clocked or cycled microcircuits for application to single event upset problems. Differences in the damage effects produced by gamma rays, protons, and electrons in test MOS devices will be investigated. Thermal annealing of irradiated Gallium Arsenide and silicon solar cells will be performed in order to investigate the behavior of radiation defects at various temperatures. A heavy-ions-in-space experiment will be prepared for launch on the Long Duration Exposure Facility (LDEF) spacecraft. The package will determine the flux and composition of heavy ions in space.

F. (U) FY 1984 Planned Program: Radiation Damage: Interactions between adjacent radiation induced point defects will be examined theoretically and experimentally with applications to diffusion, annealing, and ion-induced materials modification. The mechanisms for materials damage by intense particle beams will be investigated. Low temperature irradiations will be initiated so that defect migration and recombination properties can be researched in compound semiconductors. The relationships between radiation induced defects in semiconductor materials and the performance characteristics of devices made from these materials will be investigated. Radiation Beams and Sources. The production of tunable electromagnetic radiation from the interaction of relativistic electrons with periodic magnetic structures will be investigated. Nonlinear stability investigations will be made of electrons in undulator structures and will be related to free electron laser experiments. Hybrid beam techniques which overcome implant depth limitations and provide novel approaches to the synthesis of refractory surface coatings will continue to be exploited. Synchrotron Radiation Applications. The excellent research and diagnostic capabilities of the NRL/NBS (National Bureau of Standards) facilities at the National Synchrotron Light Source will be fully utilized. Investigations of interface states, atomic defects, submicron electronic structures, highly excited states of matter (e.g. laser excited), and crystal structures will be initiated and carried out. Radiation Analysis. Radiation effects experiments and theoretical investigations will be initiated for a variety of new types of sensors fabricated with integrated circuit techniques. Direct atom counting with integrated circuit techniques. Direct atom counting will be attempted with relatively low-voltage ion beam accelerators. Measurements of high speed changes in materials (e.g. shock-wave induced transformations) will be investigated with x-rays from plasmas. The soft x-ray source at NRL will be utilized to perform high resolution emission, absorption, and reflection spectroscopy of materials of known electronic structure. Spacecraft Survivability. Charge collection investigations will be made in silicon and Gallium Arsenide test structures and devices. Electron, proton, and gamma ray damage equivalence in non-MOS devices will be investigated and compared to MOS devices. Laser damage to exterior satellite components will be analyzed and new techniques for hardening such components will be examined. The heavy ions in space experiment will be deployed in orbit in FY 1984 and returned to earth in FY 1985. Data analysis will commence in FY 1985.

Subelement: 13  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Chemistry  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: Research in this subelement provides understanding of materials, devices and analytical techniques needed for construction and improvement of advanced Navy/Marine Corps systems and capabilities. The program includes: the chemical synthesis, characterization and processing of new and improved materials, including polymers and solid state materials; the physical chemistry of materials; the chemistry of electrochemical power sources; surface chemistry, including reactions at interfaces, catalysis, and the electrochemical modification of surfaces; chemical instrumentation and analytical techniques to solve material and environmental problems; and chemical theories related to the above.

B. (U) RELATED ACTIVITIES: Coordination is maintained through presentations to the Office of the Under Secretary of Defense for Research and Engineering and with the Army, Air Force, National Aeronautics and Space Administration, National Science Foundation, Department of Energy, and National Institutes of Health by regularly scheduled meetings and reviews at which representatives of the agencies discuss interests and problems of their respective programs and exchange of information on proposals and actions taken on them. Coordination and joint planning of special areas, e.g., chemical warfare defense, are maintained through regular meetings of a working group of all Navy chemical research directors. Closely coupled basic research and exploratory development projects are simultaneously maintained by Navy scientists. Examples of such joint areas include electroactive polymers and photochemical aspects of materials for information storage in computers. Joint projects among the services and with Defense Advanced Research Projects Agency are frequently managed by Navy scientific officers. Current examples include a joint Army-Navy task at Colorado State University and a joint Defense Advanced Research Projects Agency-Navy task at the University of Pennsylvania.

C. (U) WORK PERFORMED BY: (Representative) In-House: Naval Research Laboratory, Washington, DC. Industrial: IBM, Yorktown Heights, NY; Kings Mountain Specialties, Inc., Kings Mountain, NC; EIC Laboratories, Inc., Newton, MA; Academy: University of California, Los Angeles, CA; University of Texas, Austin, TX; Howard University, Washington, DC; University of Massachusetts, Amherst, MA; University of Utah, Salt Lake City, UT; University of Illinois, Urbana, IL.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

C. (U) FY 1982 Accomplishments: In Chemical Materials, clear fluoroepoxy polymers have been synthesized which, unlike conventional epoxies, are highly oil and water repelling. Fluoroacrylate polymers have been developed which, after one year immersion absorb less than 0.06% water. The advantages of these highly environmentally resistant polymeric materials include their high optical clarity and simple application (one component coating system). These materials will be useful in undersea optical devices. Initial funding of research on polyacetylene led to the establishment of a new research field of conducting polymers. Recently, theoretical models have been developed to account for experimentally observed optical and infrared properties, and methods have been developed to use conducting polymers as electrodes. This research has transitioned to other government agencies, and the public sector in the form of large industrial programs aimed toward the development of new, high energy density batteries, and to Exploratory Development Navy effort which promises lightweight camouflage, shielding materials. A theory has been developed to account for the unusual piezoelectric activity (pressure/acoustic sensitive response) of polyvinylidene fluoride (PVF<sub>2</sub>), which is becoming an important naval acoustic sensor material. Importantly, the theory also provides guidance for the development of new and improved polymeric acoustic sensor materials. Microelectronic devices have been developed as sensors to monitor polymer processing such as the cure of epoxy resins used in composites in high performance aircraft and ships. This combination of polymer processing with microelectronic sensing offers an entirely new approach to quality control and lifetime assurance of critical structural materials. In Analytical Chemistry, a triple quadrupole mass spectrometer has been invented and is being developed for atmospheric monitoring and analysis. This instrument which is patented, is under active exploratory development by Navy laboratories, commercial instrument manufacturers, and NASA. In Solid State Chemistry, a sample assembly has been designed for research in which a high flux of atomic hydrogen can be introduced to the surface of a metal to permit studying a much wider range of surface reactions, over a wider range of temperatures and

Subelement: 13  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Chemistry  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

surface concentration. Electron tunneling spectroscopy has been developed and applied to microanalysis of organics on aluminum oxide surface. The vibrational spectrum of less than a nanogram of material has been obtained. Investigations of the chemical bonding and electronic and geometric structure of refractory metal/silicon interfaces has revealed the basic mechanisms of interfacial chemical reactions responsible for silicide and Schottky barrier formation in electronic devices. In Electrochemistry, rechargeable lithium batteries with capacities five, ten, or twenty ampere-hours have been prepared on a laboratory scale. These batteries now have cycle lives exceeding fifty cycles. An investigation into the behavior of silver battery electrodes on cycling has led to a modification of the method of manufacture of plates for batteries used in the fleet ballistic missile.

E. (U) FY 1983 Program: In Chemical Materials, continued emphasis is being given to research on new electroactive materials for electronic and electrical applications, acoustic and thermal sensors, and countermeasures and camouflage. This research includes tailoring properties of flexible conducting polymers through evaluation of new dopants, mechanical effects (e.g., stretch orientation) new dopant processes (e.g., electrochemical methods); evaluation of piezoelectric polymers focusing on ultra-pure polyvinylidene fluoride and promising new materials for sensors; work on novel conducting metal complexes which have potential for improving electro-optical devices and electrochemical processes. The improvement of environmental stability of polymers continues to receive emphasis, including: improved coating systems and toughened adhesives; aging and curing work to improve service life of composite matrix materials. The conversion of polymers directly to ceramic materials (e.g., silicon nitride) will be expanded to include boron nitride precursors with the objective of providing an efficient new technology for the preparation and processing of high strength/temperature ceramic fibers and bodies for composite reinforcement, turbine blades and heat exchangers. Research related to infrared decoy materials and new polymers for acoustic camouflage will be initiated. Work is underway on linear and crosslinked fluoroacrylates as new environmentally resistant coatings and plastics. Research will be expanded in the polymer processing science area to include research on ultrahigh strength polymers for composites and lightweight armor. Research will be initiated toward chemical modification of materials by ion and radical implantation to improve the service lifetime of naval equipment. The electrochemical and thermocatalytic reduction of carbon dioxide will be emphasized to provide a new approach to efficient atmospheric purification. In Analytical chemistry, advanced chemical instrumentation to investigate the composition, performance and stability characteristics of materials, and the development of diagnostic techniques to monitor the processing of materials will be stressed. Nondestructive evaluation methods for examining the cure states of polymers by nuclear magnetic resonance techniques is being emphasized. Rapid methods for the analysis of selected trace metals, dissolved organic materials and chemical agents in seawater will be evaluated. The Solid State Chemistry program will emphasize the chemical, structural and electronic properties of interfaces by addressing research areas that include electron, photon and particle beam induced surface chemistry and interactions, passivation, adhesion lubrication and catalysis. Optical techniques for surface analysis will be examined with emphasis on instrumentation for in situ chemical characterization of solid/solid and gas/solid interfaces. A program on electronic materials will stress the chemical and physical mechanisms related to the fabrication and characterization of electronic microstructures. This will include efforts on instrumentation and methodology for quantitative chemical and structural analysis of the microstructures. A new experimental program on particle beam and laser stimulated surface chemical processes will be initiated. The wear resistance to laser-sprayed and other coatings will be investigated. In Electrochemistry, research to determine the electrochemical properties of polymer based ionic conductors and other solid electrolytes relative to their application to power sources and displays will continue to expanded. Research on the electrochemical fundamentals necessary to develop a battery lifetime predictive capability will be continued. Applications of surface spectroscopic techniques including in situ measurements to fundamental problems the electrode-electrolyte interface will continue.

F. (U) FY 1984 Planned Program: In Chemical Materials, emphasis on environmentally stable polymers including elastomers and thermosets will continue. This will include the synthesis and evaluation of coatings, composite materials and adhesives resistant to harsh Navy environment. Polymer research on novel processing methods will be initiated to provide new options for dealing with Navy needs for high performance polymers which are difficult to process; emphasis will also be placed on nonequilibrium aspects of processing. Carbon dioxide chemistry research relevant to the control of atmospheres in submarines will be expanded to include

Subelement: 13  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Chemistry  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

additional emphasis on electrochemical reduction of carbon dioxide. Research on electroactive materials including molecular electronic devices will continue as the development of new electronic and electrical materials for sensors and electrochemical, camouflage and countermeasures applications is perceived as a critical need. A breakthrough in conducting polymers which promises stable, high strength, lightweight fibers of controllable conductivity will be pursued. In Analytical Chemistry, the development of unique laboratory instrumentation and chemical sensors that can be applied to Navy needs will continue to be emphasized. In Solid State Chemistry, research related to the chemistry of electronic materials and microstructural fabrication will continue to be stressed. This research will include material synthesis, atom cluster identification properties and chemical analysis of electronic materials, and work on the fabrication and characterization of micron-sized electrodes for use in non destructive evaluation applications and chemical warfare defense detectors. The new experimental program on laser and particle beam stimulated surface chemical processes will be expanded. In Electrochemistry, solid electrolytes and ionic conductors and their applicability to power sources and other devices will continue to receive increased attention. Research to elucidate the fundamentals of electrode processes and their influence on power source performance and reliability will continue. Characterization of the electrode-electrolyte interface will remain an area of emphasis. Research on high temperature electrochemical processes and their applicability to naval needs will be expanded.

Subelement: 14  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Mathematical Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: This subelement comprises research directed toward solving mathematical and analytic problems in the functional military areas of surveillance, logistics, manpower, intelligence, acquisition and procurement, and command and control; and towards providing new mathematical and statistical and computational tools useful for requirements determination, planning, design, development, maintenance, and use of operational naval vehicles and systems. The results lead to new techniques for the acquisition and processing of data for logistics and for recruitment and allocation of personnel; to analytic and numerical methods for engineering design, and for estimation, evaluation and comparison of weapon system requirements and performance; and to more effective approaches to assessing and controlling system reliability, costs and schedule in project management. The research is also pertinent to deriving theories and techniques of information processing, storage and retrieval, and to the design of novel architectures for computing devices and information processing systems. The effort is conducted in the areas of numerical analysis, mathematical analysis and applied mathematics, mathematical programming, mathematical statistics, quality assurance and reliability theory, computer simulation, signal processing, decision theory, system and control theory, logistics, operations research, artificial intelligence and robotics, and computer software and hardware.

B. (U) RELATED ACTIVITIES: This research is related to efforts in Army, Air Force, the Defense Advanced Research Projects Agency, the National Aeronautics and Space Administration, the Department of Energy and the National Science Foundation. Active liaison is maintained with these agencies through regular professional communication, through annual formal reviews by the Under Secretary of Defense for Research and Engineering and through numerous joint conferences in selected technical areas. Significant support relations exist with the Defense Advanced Research Projects Agency information technology research program, with the naval exploratory development programs under the Naval Material Command in ship performance evaluation, manpower, logistics, command and control, and with the advanced development studies and analysis programs of the Chief of Naval Operations and Planning, Analysis and Evaluation Office of the Department of Defense.

C. (U) WORK PERFORMED BY: (Representative List) Massachusetts Institute of Technology, Cambridge, MA; Yale University, New Haven, CT; Stanford University, Stanford, CA; Princeton University, Princeton, NJ; Brown University, Providence, RI; Carnegie-Mellon University, Pittsburgh, PA; University of Pennsylvania, Philadelphia, PA; University of Rhode Island, Kingston, RI; University of Texas, Austin, TX; and University of North Carolina, Chapel Hill, NC.

D. (U) FY 1982 ACCOMPLISHMENTS: In ROBOTICS, formulation of a mathematical solution to robot manipulator dynamics equations has improved solution times from exponential with the number of joints to linear with the number of joints. This dramatically increases the ability for real-time control of complex robot arms. Also, a direct drive arm has been developed with small powerful motors at each joint. This system is mechanically very stable and extremely accurate. Both developments strongly aid in the development of autonomous robots for carrying out dangerous naval missions. In ARTIFICIAL INTELLIGENCE, a system has been developed for natural language text understanding which is capable of understanding more than one natural language; English and Chinese have been used as the demonstration languages. Such a system will greatly facilitate execution of joint naval exercises. In APPLIED MATHEMATICS, the so-called Boorn-Rytov approximation has been used to extend scalar diffraction tomography to the vector-valued electromagnetic case for inverse scattering applications. A typical such application involves the radar imaging of targets in clutter fog and rain. In NUMERICAL AND COMPUTATIONAL METHODS, a new numerical code has been developed for 2-d breaking water waves which includes air entrainment and multiple water/air interfaces. In STATISTICS, an exciting technique for the exploratory analysis of high dimensional data has been demonstrated successfully. A combination of a theoretical development, projection pursuit, and a computer graphics system, this technique will allow for analysis of up to 16 simultaneous measurements from complex naval systems. In SIGNAL PROCESSING, some fundamental work on the robust estimation of Kalman filters has been applied to eliminate glint in the targeting of SPARROW missiles. This application allows the missile system to operate in a much wider environment. Through algorithmic improvement, a new capability has been achieved in a target tracking algorithm applied to the surface surveillance mission of the E2C aircraft. This will create the ability of the E2C to support amphibious operations. In OPERATIONS RESEARCH, dramatic new computational techniques for the solution of network related problems have been developed.

Subelement: 14  
Program Element: 61153N  
DoD Mission Area: SIO - Defense Research

Title: Mathematical Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

These techniques have been used to solve a multicriteria personnel assignment problem with 10,000 constraints and 780,000 variables and have reduced the computation time on a personnel career path model used by DoD from 3 hours to 9 minutes. A combination of algorithmic advances and implementation of techniques for human/machine interaction has resulted in the largest mathematical programming system for vehicle dispatching in the world. The Military Sealift Command is intending to apply these techniques to problems in mobilization planning.

E. (U) FY 1983 PROGRAM: In ROBOTICS, emphasis is on the merging of the Computer-Aided Design and Computer-Aided Manufacturing (CAM) processes into a system which will account in the design process the real manufacturing constraints and design the manufacturing facility as well as the item to be manufactured. Emphasis is on cheap prototypes. A major program in precision engineering has begun in FY 1983. In ARTIFICIAL INTELLIGENCE, emphasis will be on more effective mechanisms for machine representation of the priorities of real-world objects and events, achievement of machine understanding of the relationships among people, objects and events coupled with modeling of human factors, and creation of a dynamic, data-driven concept of context to distinguish individual differences and preferences. Motivation for the AI program is to provide military commanders with rapid expert advice. In SOFTWARE ENGINEERING, emphasis is on automating the software development process including not only the design, but also the maintenance of software. Approaches include modular reusable software, graphics aids for software and software embedded in hardware. In APPLIED MATHEMATICS, emphasis will be on the use of mathematical analysis for use in space systems application such as surveillance, communications, navigation and environmental monitoring. Particular emphasis will be given to problems associate with improved orbit determination, control of large structures in space, and nonlinear waves. A large new thrust has begun in the area of inverse methods which will be applicable not only to scattering phenomena in the ocean but also to nondestructive evaluation of naval materiel. In NUMERICAL AND COMPUTATIONAL METHODS, emphasis continues on numerical methods applicable to fluid and structural mechanics problems. An interdisciplinary program in large scale scientific computing enters its second year. A large new program in Very Large Scale Integrated (VLSI) computational architectures begins this fiscal year with a focus on dramatically improving signal processing architectures. In STATISTICS, emphasis will increase in the area of computational statistics for the analysis of naval systems. Work in the area of remote sensing data analysis has reached its maximum planned level and has begun to transition. Image processing techniques are being implemented at the Naval Research Laboratory and at the Naval Air Systems Command. A large interdisciplinary program (joint with researchers in mathematics, physiology) in the area of modelling human learning and memory will begin. In SIGNAL PROCESSING, funding for non-Gaussian signal processing will be completed. Transition has already begun to Naval Electronics Systems Command and Naval Sea Systems Command. Work in the area of target tracking is already marking a transition to the Naval Electronics Systems Command and the Naval Air Systems Command. Emphasis will be placed on extension of non-Gaussian results to sonar arrays and implementation in VLSI architectures. In OPERATIONS RESEARCH, increased emphasis will be placed on quality control research for naval systems and a decreased emphasis on fundamental work in reliability. Emphasis will be rather on exploitation of reliability work. The de-emphasis on reliability theory is made because of a large Air Force initiative in this area. Research in the area of logistics is scheduled for a careful re-examination.

F. (U) FY 1984 PLANNED PROGRAM: In ROBOTICS, emphasis will continue on the CAD-CAM work as well as a special emphasis on flexible manufacturing. Particular interest will be focused on research issues related to the design and development of manufacturing facilities for a small number of items such as frequently occur in naval materiel requirements. In ARTIFICIAL INTELLIGENCE, a major new initiative is planned in the area of Expert Systems with special emphasis in learning and reasoning in the Command and Control environment. Emphasis will also be on the transition of research to the Naval Research Laboratory. In SOFTWARE ENGINEERING, emphasis will continue on automating the software development process. A major research program in highly parallel computing architectures will come to a conclusion in FY 1984. In APPLIED MATHEMATICS, a major initiative in mathematical modelling of distributed decision processes will begin. Emphasis will be on distributed decision making in the Command and Control environment. In NUMERICAL AND COMPUTATIONAL METHODS, there will be continued research in the area of large scale scientific computing and mathematical algorithms for VERY LARGE SCALE INTEGRATED (VLSI) circuit architectures. In STATISTICS, the program in the stochastic modelling of learning and memory structures in the human brain will continue.

Subelement: 14  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Mathematical Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

Emphasis on the computational aspects of statistics will continue with particular attention to advanced statistical software. In SIGNAL PROCESSING, the major research effort in non-Gaussian signal processing will come to a close against a background of much empirical work. A related new initiative in ocean surveillance signal processing will begin. Emphasis in this program will be on the development of new array processing techniques growing out of the non-Gaussian program and the VLSI architectures program mentioned under the Numerical and Computational Methods section. In OPERATIONS RESEARCH, emphasis will be placed on discrete mathematical methods with applications to productivity improvement in manufacturing and distribution processes. Work will continue in the area of decision methods and in the area of quality control.



Subelement: 21  
Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Electronics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) SUBELEMENT DESCRIPTION: Research in this subelement is directed toward meeting long range naval operational requirements in the areas of communications, command and control, navigation, electronic warfare, guidance and fire control, avionics, surveillance, and antisubmarine warfare. The major areas of this research are: Electromagnetic Waves and Space Radiation, involving generation, propagation, reflection, absorption, refraction and scattering of electromagnetic waves; antenna theory; radar target detection and identification; magnetospheric electric and magnetic fields; solar radiation and energetic particles in the magnetosphere; electronic warfare; Physical Electronics involving synthesis characterization and analysis of electronic materials and structures; Solid State Electronics, including microwave and millimeter wave devices, ion implantation, radiation effects in solids, integrated circuits, signal sources, and optical sources, and optoelectronics; Electronic Systems and Communications Theory, including information, circuit and control theory, network analysis, linear and nonlinear system theory, distributed processing, signal coding, signal processing and fault analysis.

B. (U) RELATED ACTIVITIES: Interservice coordination is accomplished through Office of Under Secretary for Defense Research and Engineering Reviews and direct tri-service coordination. Some significant efforts are supported jointly by the Army Research Office, Office of Naval Research, and the Air Force Office of Scientific Research. The Joint Services Electronics Program which contracts with 14 universities is monitored by a Tri-Service Technical Coordination Committee to provide a base of support for proven sources of new electronics ideas and to ensure that work performed is of highest quality and relevant to Department of Defense interests. The subelement is coordinated with Navy exploratory development programs and the Electronics and Electro-Optics Strategy Group. Other important coordination is provided through the National Science Foundation Interagency Group on Materials and the Interagency Committee for Electronics Research in which representatives of the Army, Navy, Air Force, Department of Energy, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency and the National Science Foundation meet regularly to review progress and plans; to ensure adequate funding of critical areas and prevent duplication of effort. Coordination is also provided through the Office of Under Secretary of Defense Research and Engineering Advisory Group on Electron Devices.

C. (U) WORK PERFORMED BY: (Representative) In-House: Naval Research Laboratory, Washington, DC; Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA. Industrial: IBM, T.J. Watson Research Center, Yorktown Heights, NY; McDonnell-Douglas Astronautics Laboratory, Huntington Beach, CA; Hughes Research Laboratories, Malibu Beach, CA; Rockwell International Science Center, Thousand Oaks, CA; Academic: Harvard University, Cambridge, MA; Stanford University, Stanford, CA; Ohio State University, Columbus, OH; University of Illinois, Urbana, IL.

D. (U) FY 1982 ACCOMPLISHMENTS: Electromagnetic Waves and Space Radiation - Extended the knowledge of the galactic cosmic ray intensity to 25 astronomical units from the sun; participated in the first ionospheric modification experiments conducted from the Space Shuttle; obtained comprehensive global images of the polar aurora from satellite based sensors; have shown positive correlation between a strong southward interplanetary magnetic field and the onset of magnetospheric plasma sheet expansion; and have shown that total magnetospheric plasma density related to the  $P_c - 3$  magnetic pulsations with periods from  $t = 15 - 45$  sec. All of the above are related to the reliability and predictability of long range communications systems. A precise radar scattering range became operational for generation of data base and testing of target recognition schemes; microwave imaging with resolution comparable to the human eye was demonstrated with self coherent antenna array; and a new technique was developed for resolving, in the presence of noise, two closely spaced resonances having a large difference in amplitude. In the area of Electronic Warfare and analysis of the behavior of Broadband Frequency Shift Keying spread spectrum systems has indicated that these systems are more vulnerable to jamming than previously believed. The analysis has suggested possible jamming strategies. The High Power Auroral Stimulation (HIPAS) experimental facility has become operational. Initial experiments have shown enhancement of scattered amplitude modulated waves. This technique could lead to a new ELF communication system. Physical Electronics - Professor M. Bloembergen at Harvard University was awarded the 1981 Nobel Prize in Physics for research in quantum electronics which was supported solely by the Joint Services Electronics Program. The knowledge gained in this research

Subelement: 21  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Electronics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

is of value to Navy laser related programs. Theoretical work on tightly bound electronic defect states in semiconductors ("Deep Levels") has provided insight into the relation of level properties to the chemistry of the defect. This knowledge is necessary for predictive design and control of the performance of semiconductor electronic devices for future Navy systems, particularly the newer compound semiconductor devices. Large wafers of polycrystalline silicon layers overlying oxide have been successfully recrystallized using scanning strip heaters. Complementary metal-oxide-semiconductor (CMOS) devices fabricated on this material have exhibited charge carrier mobilities higher than for silicon-on-sapphire (SOS), and comparable to bulk crystalline silicon. Further development of the quality of this material will have major impact, not only on Navy electronic systems, but also in commercial electronic products. Solid State Electronics - A new semiconductor laser was invented which exhibits controlled optical bistable operation. This device may form the basis for an entirely new family of Naval opto-electronic systems with operating speeds greatly in excess of those available from all previously existing devices. There was clarification of the properties of velocity overshoot effects in the high electric field motion of electrons in compound semiconductors, showing that transient effects and path lengths will have dramatic impact on the usefulness of these materials in future Navy high speed electronic systems. Electronic Systems and Communication Theory - Minimax modeling of systems has led to the design of signal processing procedures that perform well under a wide variety of signal and noise environments. These methods have led to the specification of robust source encoding techniques having high antijamming protection. New algorithms for diagnosing hard and soft faults in large scale linear electronic circuits/systems have been developed. These algorithms have the ability to detect all single and some multiple faults with nominal as well as within-tolerance component values. Models and methods for efficiently partitioning extremely large scale networks into subnetworks by path bit slicing have been developed. Previous procedures have been restricted to networks containing a relatively small number of components due to the inherent complexity of these procedures. The bit slicing methods may have application to VLSI architectures.

E. (U) FY 1983 PROGRAM: Electromagnetic Waves and Space Radiation - Radar target identification of high speed missiles and aircraft in a hostile marine environment is a critical Navy problem whose solution requires an improved understanding of EM scattering, sea clutter effects, antenna design, and the propagation of EM waves through non-uniform media. The development of new/novel signal processing concepts (e.g., superresolution techniques for spatial filtering, integration of signal processing electronics with antenna array elements) could provide important payoffs in target detection, identification and classification. Active ionospheric, magnetospheric, and solar dynamics theory and experiments will be continued in our effort to understand the plasma interactions involved in production and decay of geomagnetic storms which disrupt communications channels important for controlling naval forces. The Electronic Warfare Area research will concentrate on identification of generic unknowns associated with the EW operating environment as necessary background for developing robust EW systems. Solid State Physical Electronics - A broadbased thrust will be address the examination of the physical and electronic properties of interfaces between electronic materials. These interfaces are often major contributors of problems which limit the performance of new compound semiconductor devices. The investigation of the physics of submicron structures will be intensified to obtain a better understanding of the properties to be expected in future when devices are much smaller than presently available. These future extremely small devices offer promise of much faster, more complex electronic systems, with consequent benefit to military guidance systems and munitions. Heterojunction and multilayer semiconductor/metallic systems will be fabricated and examined. Entirely new electronic device structures are envisioned through use of these materials. Electronic Systems and Communications Theory - New efforts have been undertaken in the area of advanced statistical techniques for image compression, classification and enhancement. Procedures for providing low probability of intercept communication in an uncertain and possibly hostile environment are also being examined. The approaches under consideration include the use of adaptive filters in spread-spectrum receivers as well as the design of efficient algorithms for rapid acquisition and tracking of frequency spread/hop transmissions. A second new program is concerned with providing routing, protocol and control methods for large, multiple-user communication networks. This work includes systems for handling conflict resolution when multiple messages are received simultaneously.

F. (U) FY 1984 PLANNED PROGRAM: Electromagnetic Waves and Space Radiation - In the radar target identification area emphasis will be on improved techniques for calculating scattering from complex bodies, development of EM reverse scattering theory, and

Subelement: 21  
Program Element: 61153H  
DoD Mission Area: 510 - Defense Research

Title: Electronics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

development of superresolution techniques for improved angular resolution. Active ionospheric, magnetospheric, and solar dynamics theory and experiments will be continued in our effort to understand the plasma interactions involved in production and decay of geomagnetic storms which disrupt communications channels important for controlling naval forces. In the Electronic Warfare area the generic information developed in FY 1983 will be incorporated into a theory which it is hoped will result in eventual development of robust EW systems capable of jamming even frequency shift keying signals. Solid State and Physical Electronics - The investigation of interfaces between electronic materials will be continued, and their impact on electronic device reliability examined. Experimental work in this area will be increased. Submicron devices will be fabricated and tested in real circuits. Heterojunction and multilayer structures will be of increasing importance, and new devices will become operational based on these materials. Electronic Systems and Communication Theory - A program will be undertaken in the area of high speed signal processing methods and algorithms which exploit parallel architectures. This is an area of research that has high potential for growth as compared to the more matured integrated circuits technology. Advanced architectures and fast algorithms for signal processing can increase throughput by several orders of magnitude using existing device technologies. Advanced architectures include tree machines, polycyclic machines, data-flow machines, and systolic arrays. Fast algorithms include matrix inversion, Toeplitz matrix solver, and generalized Eigenvalue solutions. A second area of interest is that of integrated three-dimensional electronic structures. This research would take advantage of the Very Large Scale Integration technology and the anticipated Wafer Scale Integration (WSI) technology to realized 3-D signal processing architecture. Procedures for specifying optimal 3-D architectures are not currently available.

Subelement: 22  
Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Materials  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: Research is directed to providing: the understanding and capabilities necessary to predict and control the properties of materials used by the Navy/Marine Corps; determination of effects of anticipated in-service environment on performance of materials; systematic investigation of new materials needed for future Navy/Marine Corps applications. Areas of materials research include: metals and alloys, ceramics, insulators and inorganic solids; composite materials; and polymers. The research emphasizes control of materials processing and chemistry to improve mechanical properties, corrosion resistance, materials protection, radiation resistance, and physical property requirement such as improved electromagnetic and optical behavior.

B. (U) Related Activities: Coordination of materials research is provided through the Office of the Under Secretary of Defense for Research and Engineering by yearly reviews and periodic conferences. The Navy Council on Materials and Structures provides a forum for Navy coordination of materials research and development. The Navy materials program is coordinated with the National Aeronautics and Space Administration, Department of Energy, National Science Foundation, Bureau of Mines, and National Bureau of Standards through frequent interagency Coordination Group meetings. The Technical Cooperation Program coordinates materials research and development thrusts and results with the member countries (Australia, United Kingdom, Canada, New Zealand, and the United States). The NATO Advisory Group for Aerospace Research and Development involves thirteen countries that meet semiannually to discuss topical materials issues such as corrosion research and nondestructive testing. The Tri-Service Corrosion Coordinating Committee surveys corrosion research and development in the DOD and holds regular conferences. Other materials interaction groups include the Committee on Materials; Working Group on Rapid Solidification Technology; the DOD/National Aeronautics and Space Administration Composites Working Group; DOD Working Group on Directional Solidification. The Navy is represented on many technical panels such as the American Society of Testing Materials; Institute of Metallurgical and Mechanical Engineering. Navy participation in the National Materials Advisory Board reviews is extensive.

C. (U) Work Performed By: (Representative) Massachusetts Institute of Technology, Cambridge, MA; Carnegie-Mellon University, Pittsburgh, PA; Rensselaer Polytechnic Institute, Troy, NY; Pennsylvania State University, University Park, PA; Colorado School of Mines, Golden, CO; United Technologies, East Hartford, CN; General Electric Company, Schenectady, NY; Rockwell International, Thousand Oaks, CA; Naval Research Laboratory, Washington, DC; Naval Air Development Center, Warminster, PA.

D. (U) FY 1982 Accomplishments: Major accomplishments include: Metals: fundamental information was developed on the structure and processing of titanium critical to development of new alloys for submarine and aircraft structures; major advances were made in the understanding of the fatigue behavior of steel and titanium related to aircraft components; fracture mechanical was shown to be applicable to predicting fatigue crack growth in high temperature turbine alloys. Rapid Solidification: significant grain refinement in rapidly solidified powders offers a new route to tough structural steels; wear, fatigue and fretting fatigue resistance was markedly improved by implanting bearing alloys with carbon or nitrogen ions; the feasibility of scale-up of an ion-implantation facility was demonstrated and transitioned to manufacturing technology; a new class of transition metal-rare earth magnetic materials were discovered that are suitable for transducer or permanent magnet applications; Ceramics: multilayer piezoelectric ceramics were transitioned into exploratory development for high power sonar applications; high strength and toughness were achieved on partially stabilized zirconia crystals for radomes; new processing concepts were found for reliable ceramics multilayer capacitors employed in strategic missile guidance systems; new composite hydrophone materials for large area array applications were transitioned to exploratory development; Special Materials and Techniques: the feasibility of using optical fibers for low frequency electromagnetic antennas was established.

E. (U) FY 1983 Program: The Metals program includes research on the metallurgy of titanium alloys of naval interest including basic information on phase equilibria, microstructure-property relationships, deformation and fracture behavior, welding, and nondestructive evaluation. Metal-matrix composites will be analyzed with regard to strengthening mechanisms in silicon carbide-reinforced aluminum, such composites offering high specific strength and stiffness for missile applications. Superconducting

Subelement: 22  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Materials  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

research will involve transition metal nitrides and carbides, and magnetic superconducting compounds for advanced propulsion systems. Pressure-impulse behavior of laser-material interactions will be examined and related to directed energy weapons damage. Research on Rapid Solidification will emphasize unique structures that can be formed in steels, pursuing possible benefits in toughness and corrosion resistance. New magnetic and acoustic damping alloys for propulsion devices will be examined that are produced by the rapid solidification processes such as melt spinning or centrifugal atomization. Factors affecting the quality of structural welds such as weld defects will be related to mechanical performance of weldments. Corrosion research will emphasize environmental factors affecting material performance on ships and aircraft. In particular, protective organic coatings and their delamination in harsh naval environments will be examined. Associated research will be carried on in the areas of mechanisms of aqueous corrosion, stress corrosion cracking, hydrogen embrittlement, and hot corrosion. Corrosion behavior of metal-matrix composites will be clarified since some combinations of reinforcement and matrix react badly in sea water. The Ceramics research will emphasize improved acoustics transducer materials and new toughening mechanisms for ceramics used in infrared and radar windows. Research on advanced composites such as ceramic-ceramic-metal and ceramic-ceramic will be expanded because of their possibilities for use in lightweight armor. The micromechanics of armor failure and thermal-mechanical fatigue will be investigated. Research on new Dielectric Materials used for microwave modulation, ultrasmall capacitors, and nonlinear devices will be expanded. In Special Materials and Techniques, research on structure-property characterization in nose tip carbon-carbon materials will be continued. Research on factors affecting the dimensional stability of beryllium used in gyroscopes will be phased out over a two-year period. Amorphous metals research will emphasize interesting magnetostrictive alloys for high performance sensors made by the melt-spinning technique. In Materials Processing special emphasis will be given to new consolidation techniques for preserving the unique structure obtained by rapid solidification of structural naval alloys. Newly initiated research on porosity and inclusions in powder metallurgy titanium alloys will be initiated to assist the creation of lower cost alloys in this metal system. Superplastic forming of aluminum alloys will be explored for its capability of forming unique, complex structures. New machining methods will be explored for defect-free finishing of ceramic materials. The Polymers research will emphasize defects and their effects on fracture under applied loads in various naval environments.

F. (U) FY 1984 Planned Program: In Metals, the program will emphasize research on those factors which affect the mechanical properties, deformation characteristics, and fracture of naval structural alloys. Systematic modification of the microstructure through chemistry modifications and processing will be employed to tailor aluminum and titanium alloys with special properties for naval use. A new thrust will be initiated on the science of microstructures of ultrathin, multilayer materials with emphasis on magnetic and superconducting properties, electric transport and absorption of electromagnetic radiation for various naval devices. In Ceramics research on new dielectric materials will be continued to improve performance and reliability of ultrasmall capacitors and nonlittre devices used in guidance systems. An effort will be initiated on new processing concepts to create oxidation-resistant bulk properties and coatings for carbon-carbon composites that could be used in advanced turbine engines. Analytical and experimental work on thermo-stress fracture in these carbon-carbon composites will continue. Research will be expanded on new microstructural designs for composites for electromagnetic functions such as acoustic transducers and sensors. Research on the science of welding will be expanded to examine areas such as dissimilar metal joining and new weld process characterization techniques needed for structural welding. Multiphase transducer composites research emphasizing toughening through the introduction of second-phase particles or fibers will continue. In Corrosion a new research program on coatings will be initiated with emphasis on inorganic surfaces to protect naval components against corrosion, oxidation and wear. Barrier layers will be examined to reduce harmful interdiffusion of coatings into the bulk material at high temperatures applicable to turbine blades. Characterization of corrosion mechanisms of naval alloys will be pursued using state-of-the-art characterization techniques such as scanning transmission electron microscopy and atom probe field-ion microscopy. In a new biomolecular engineering research program revolutionary advances in biology will be used to create new materials and improve existing ones. The impact of this approach on lubricants, adhesives, sealants, coatings, and environmental protection will be examined. In Special Materials and Techniques amorphous metals research will focus on magnetic behavior and thermal stability particularly related to magnetostrictive properties for sensor applications. Research will be initiated on the mechanisms of bonding of organic matrix composites to metal alloys with the aim of improving bond strength and durability of aircraft structures.

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Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Materials  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

Processing research on Navy materials will include new methods for producing ceramic powders, chemomechanical machining, and novel solidification and densification concepts. The Rapid Solidification area will emphasize research on oxidation and corrosion-resistant, high-strength iron-nickel alloys and novel, high-strength titanium alloys. Critical materials will be addressed in programs on chromium-free, oxidation-resistant, structural iron-aluminum alloys; niobium and tantalum effects in high temperature, turbine superalloys, and properties of cobalt-free permanent magnets used in motors.

Subelement: 23  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Mechanics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: The objective of the research conducted in the Mechanics Subelement is to improve the hydrodynamic and aerodynamic performance and structural design of Navy ships, submarines, aircraft, missiles, underwater weapons and shore installations. These improvements are needed on a continuing basis to insure the successful performance of Navy and Marine Corps vehicles and systems. This objective is achieved through the pursuit of theoretical and experimental research programs of very broad scope in hydrodynamics, aerodynamics, and structural mechanics.

B. (U) RELATED ACTIVITIES: Formal coordination of the research programs in the Mechanics Subelement is achieved through Office of Under Secretary of Defense for Research and Engineering Reviews, the General Hydromechanics Research Council of the Naval Sea Systems Command, the Navy Aeroballistics Committee, the National Advisory Council on Materials and the Ship Structures Committee of the National Academy of Science, the National Academy of Engineering Committee on Aerodynamic Simulation Technology, the NASA/DOD Aeronautical subpanel for the Numerical Aerodynamic Simulator, the National Boundary Layer Transition Group, the Complaint Coating Drag Reduction Steering Group, the Submarine R&D Advisory Group, Interagency Committee for Residual Stress Measurements, NAVSEA Advisory Committee for Fracture Control Technology, and the DOD/NASA Composites Interdependency Group. Joint research programs exist with the Air Force Office of Scientific Research, the Air Force Flight Dynamics Laboratory, the Air Force Armament Laboratory, the Army Missile Command, the National Aeronautics and Space Administration, and the Defense Nuclear Agency.

C. (U) Work Performed By: (Representative) Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; University of Southern California, Pennsylvania State University-Applied Research Laboratory, State College, PA; Johns Hopkins University-Applied Physics Laboratory, Baltimore, MD; Stanford University, Palo Alto, CA; University of Illinois, David Taylor Naval Ship R&D Center, Bethesda, MD; Naval Ocean Systems Center, San Diego, CA; and Naval Research Laboratory, Washington, DC.

(U) FY 1982 Accomplishments: Hydrodynamics The following advances in the understanding of transition to turbulence in boundary layer flows have been made which improve the ability to accurately determine drag and hydroacoustic self-noise, both of which impact the performance of underwater naval vehicles and weapons: experimental verification that the material of a surface has a profound effect on the laminar to turbulent transition of the boundary layer thus introducing surface chemistry and not just roughness as a surface parameter for underwater laminar flow vehicles; a new pseudo-spectral numerical technique has resulted in a fundamental advance in direct simulation of turbulence in boundary layer flows by removing the requirements for periodic flow conditions; a numerical simulation of the boundary layer transition process using pseudo-spectral techniques has demonstrated a secondary instability mechanism that is responsible for early transition observed in some flow experiments. Large amplitude and breaking waves are a major factor in Navy and Marine Corps problems such as surface ship motions, and seakeeping; amphibious operations in breaking surf; and classification of surface waves generated by underwater vehicles. Recent research results in numerical simulations of nonlinear surface waves have established onset criteria for breaking waves, making their theoretical estimation possible for the first time. Both experimental tow tank and theoretical research on shipwaves in shallow water have identified a largely two-dimensional, large amplitude solitary wave which is periodically generated at the ship bow. The wave grows and propagates faster than ship speed, thus producing a train of large amplitude waves preceding the ship into shallow water areas (harbors, beaches, etc.). Aerodynamics: High maneuverability for both surface and air launched Navy missiles becomes more critical as threats to the fleet become more sophisticated and severe. Significant accomplishments have been made in the past year on understanding and predicting aerodynamic effects for high speed missiles in a maneuvering environment. A computational aerodynamics method for calculating supersonic (inviscid) flow fields and aerodynamic forces on missiles with wings/tails was completed and published. Asymmetric vortex shedding from missile forebodies at high angles-of-attack were mapped using 3-dimensional laser doppler velocimetry and correlated with numerical estimates. Assuring lethality of air and surface launched anti-ship weapons is an increasingly difficult task and recent significant research on staged warhead changes has led to a potentially large improvement. Specifically, in weapon terminal effects research for target destruction, initial results for a staged warhead design showed excellent potential for improving the kinetic energy delivered to the warhead case. Rapid progress

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Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Mechanics  
Title: Defense Research Sciences  
Budget Activity: I - Technology Base

is continuing in computational transonic aerodynamics. Specifically, the ability to compute flowfields with strong shock effects, which is of special relevance to Navy aircraft in combat maneuvering, is improving at a significant pace. A new finite volume formulation of the 3-dimensional Euler equations for transonic flow has been computerized and is used in a number of applications for which previous more approximate equations are not suitable. Structural and Solid Mechanics: Advanced composite materials are rapidly becoming a major structural component of new Navy vehicles. It is essential that research provide the foundation for proper design and use of these materials in the severe naval operational environment. Composite structures research has produced the following significant results during the past year: Initial design and fabrication of woven composite structures for improved damage tolerance has been completed; Aeroelastic tailoring model for flutter suppression of advanced composite wings has been completed. Delamination models for composite airframe structures have been developed. Requirements for longer vehicle life and greater survivability necessitate continuing research in fracture mechanics and stress analysis. Significant progress is being made as indicated by the following accomplishments: The first non-singular finite stress solution for stress concentrations at crack tips has been formulated; Elastic-plastic dynamic fracture model has been developed for crack propagation predictions in naval materials. New applications in experimental photoelasticity have permitted hole shape optimization in naval structures. A critical area in structural dynamics for naval requirements continues to be shock loading of structures and media-structure interactions. Advanced numerical techniques for nonlinear media-structure shock interaction including effects of elastic-plastic deformation have been developed and used to investigate the interactions between an incident pressure wave and a submerged structure.

E. (U) FY 1983 Program: Hydrodynamics: A major new effort in hydroacoustics is being initiated in FY83. The research focuses on fundamental understanding of turbulent boundary layer flow noise and other near field hydrodynamic noise sources and how they interact with vehicle acoustic sensors. Requirements for improved detection capability and high speed sonar search make this research critical. New energy and performance requirements make it necessary to consider ship performance throughout its operating environment. There will be an overall increase in surface ship hydrodynamics research with emphasis on large amplitude motions and on research to directly relate ship geometry to its seakeeping performance. Drag reduction will remain as a major research thrust both for ships and weapons. New, potentially high payoff, areas such as microbubble injection will be examined as well as ongoing research in complaint coatings and laminar flow control. Added emphasis will be given propulsor research to meet increasing needs for efficient, high speed and quiet propulsors for ships and weapons. Increased understanding of cavitation and viscous effects on propellers will be sought. Aerodynamics: The Navy has unique requirements for special purpose air vehicles that operate in a low moderate Reynolds number range under severe environmental conditions. New research will be initiated on basic research in 3-Dimensional low Reynolds number aerodynamics to provide an understanding of the basic fluid physics associated with this problem. New requirements for low observable air vehicles for Navy missions generate some basic aerodynamic issues that are not well understood. New research will be initiated to address some of these aerodynamic issues. The potential for computing transonic flows remains high and important for naval applications and will continue to be pursued. Missile aerodynamics especially for high speed, highly maneuvering conditions remains important and a high priority. Foundational research in turbulence and flow separation applicable to numerous naval vehicle problems will be continued. Structural and Solid Mechanics: Radiated sound and target strength reduction remain high priority issues for the Navy. Research on acoustic energy radiation from underwater vehicles will continue with emphasis on both coated and uncoated vehicles. Advanced composite structures will play an increasingly important role in the Navy in aircraft, ship and ocean structures. Ongoing research in composite structures will be expanded to include: fundamental mechanics of damage tolerant composite structures, new analytical methods and concepts for composite structural configurations with reduced radar and infrared signatures, mechanics of composite materials with emphasis on failure modes and damage accumulation, and research on soil/structure interactions for composite structures in ocean platforms.

F. (U) FY 1984 Planned Program: Hydrodynamics: The thrusts and new initiatives in surface ship hydrodynamics and drag reduction described in the FY83 program will be continued. In addition, a new initiative in hull/propulsor hydrodynamic interactions will begin. The program will focus on the temporal and spatial structure of flow fields in the stern regions of ship, submarines and weapons. An understanding of this flow has broad implications for radiated sound, propulsor performance, selfnoise, and hull



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Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Mechanics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

vibrations. Multidisciplinary research in these areas will be integrated in a coordinated program. Aerodynamics: The initiative in low Reynolds number aerodynamics will be expanded through an extensive experimental program that will include multiple but coordinated experiments in different facilities, at different scales and in both steady and unsteady flow conditions. Compact rocket/ramjets are being considered for Navy applications in air-to-air missiles. Ramjet combustor instabilities possibly associated with large scale turbulent flow structure in the combustor have created the need for basic research to examine the source and potential solutions to this problem. This area will constitute a major new initiative in FY84 with an interdisciplinary effort between mechanics and energy conversion researchers. Structural and Solid Mechanics: Major efforts in target strength, radiated sound, advanced composite structures, and fracture mechanics will continue. In addition there are critical needs for solid mechanics research associated with machinery systems and manufacturing which will be addressed in new efforts. There are important Navy systems and operations that generate conditions of combined mechanical and thermal stresses. Research focusing in this area will begin in FY84.

Subelement: 24  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Energy Conversion  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: The capability of handling large quantities of potential energy and of efficiently and rapidly converting such energy into propulsive forces or other desired forms of energy is a significant factor in the performance of naval missions. This subelement undertakes research to establish scientific and engineering principles for the advancement of: energy sources and conversion processes for power and propulsion systems for aircraft, ship, and land vehicles; energetic materials for propellants, pyrotechnics and armaments; power sources for portable and fixed installations including buoys and deep ocean systems. The subelement is subdivided into three Projects: Electrical Power Generation is concerned with the processes of converting chemical and thermal energy directly to electrical energy and conditioning the electrical power output. Chemical Propulsion and Armaments emphasizes the limits of chemical energy storage and the rates and mechanisms by which chemical energy is released in such processes as combustion, deflagration, and detonation relative to solid propellants, fuels, pyrotechnics and explosive systems. Energy Utilization encompasses investigations of new and improved power and propulsion concepts for application to naval aircraft, missiles, ships, and underwater vehicles through interdisciplinary fundamental and applied research on the physical and chemical phenomena associated with conversion, transmission, and utilization of energy to obtain useful power and thrust.

B. (U) RELATED ACTIVITIES: Research programs within the Energy Conversion subelement are related to activities of the Army, Air Force, Department of Energy, National Aeronautics and Space Administration, Electric Power Research Institute, National Science Foundation, Department of Transportation, Maritime Administration, and Environmental Protection Agency, as well as industrial research and development. Formal coordination of the efforts within the Energy Conversion subelement takes place through joint participation in program sponsorship, and joint ONR, ARO, APOSF progress reviews by the Office of the Under Secretary of Defense for Research and Engineering. For example, programs within this subelement are jointly sponsored with the Army Research Office on the synthesis and characterization of interhalogen oxides at Rockwell International and on the ab initio quantum chemical calculation of explosive density and reactions pathways at Johns Hopkins University. Energy Conversion programs in tribology related to advanced mechanical seals are coordinated through jointly sponsored conferences, such as, the National Aeronautics and Space Administration/Navy Workshops on Liquid Lubricated Seals. Fundamental investigations in tribology are closely coordinated with other agencies through the joint sponsorship and conferences of the Mechanical Failure Prevention Group. Efforts in marine propulsion are reported and discussed with the Army, Air Force, National Aeronautics and Space Administration, and the Department of Energy through the Interagency Advanced Power Group. Certain aspects of our heat transfer research are coordinated through joint Navy/National Science Foundation sponsorship of conferences, including the Multi-Phase Flow and Heat Transfer Research and Applications Symposium. The Energy Conversion subelement monitor regularly participates in Air Force Office of Scientific Research program reviews on combustion processes. New energetic polymers are being evaluated in the Industrial Research and Development Program of propellant manufacturers as well as in Navy Missile Propulsion and Undersea Weaponry Exploratory Development Programs.

C. (U) WORK PERFORMED BY: Massachusetts Institute of Technology, Cambridge, MA; University of California, Berkeley, CA; University of Massachusetts, Amherst, Mass; Washington State University, Pullman, WA; Naval Surface Weapons Center, White Oak, Silver Spring, MD; Naval Weapons Center, China Lake, CA; Naval Research Laboratory, Washington, DC; University of Illinois at Chicago Circle, Chicago, Ill; Thiokol Incorporated, Brigham City, Utah; Lehigh University, Rocketdynamics Division of Rockwell International, Canoga Park, CA; University of New Mexico, Albuquerque, NM; Arizona State University, Phoenix, AZ; United Technology Research Center, E. Hartford, Conn; California Institute of Technology, Pasadena, CA; The Johns Hopkins University, Baltimore, MD.

D. (U) FY 1982 Accomplishments: Chemical Propulsion and Armaments: The scaleup of the copolymer of bis (azidomethyl) oxetane and tetrahydrofuran which is useful to increase the stored chemical energy density of strategic missiles, tactical missiles and explosives was successfully completed. This new energetic copolymer is now undergoing evaluation in the IR&D programs of the major U.S. solid propellant manufacturers as well as the Navy's missile propulsion and undersea weaponry (explosives) technology exploratory development programs. As a prerequisite to the design of energy coupling circuitry for explosive effectiveness

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Title: Energy Conversion  
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Budget Activity: 1 - Technology Base

enhancement in metal accelerating warheads, the first resistance measurements were made behind the detonation front of a detonating explosive at kilovolt/kiloamp power levels. These results indicate that it may be feasible to electrically augment the chemical energy output of detonating explosives. Electrical Power Generation: For pulsed magnetohydrodynamic electrical generation (for advanced weapon applications), the scaling of the power extraction has been shown to be proportional to the electrode area and the square of the magnetic field. A peak power of 3.75 gigawatts with a pulse length of 25 microseconds has been demonstrated. The electrical conductivities of strongly-coupled plasmas (as is pertinent to the MHD generator) have been expressed completely in terms of their charge states and equilibrium structure factors. Energy Utilization: Advanced non-intrusive diagnostics have been developed and are now being used in measuring temperature, velocity, and species concentrations in combustion environments of advanced propulsion systems. The formulation of an analytical model to predict two-phase (gas/liquid) flow in convergent-divergent nozzles for utilization in advanced high efficiency and compact marine turbines has been completed. Mechanisms and conditions by which catalysts in combustors in shipboard and aircraft gas turbines could inhibit or enhance alternate fuel ignition and flame extinction have been defined. A computational code for unsteady transonic flows with embedded shocks was developed for unstaggered cascades which will lead to prediction and avoidance of aircraft engine compressor blade failure from flutter. An antimony and sulfur containing solid lubricant has been synthesized that increases bearing load capacity by a factor of four, and the chemical mechanism responsible for the increase in grease lubricated ship and aircraft bearing durability has been identified. The effect of downstream pressure disturbances on the shock position in a ramjet inlet has been demonstrated.

E. (U) FY 1983 Program: Chemical Propulsion and Armaments: The energetic materials synthesis and behavior thrust area was expanded to include research to establish the processing science base of explosive particle composites necessary to continuously manufacture high energy missile and gun propellants and warhead explosives. The emphasis in the program is on explosives and propellants formulated with physically crosslinked melt castable energetic thermoplastic elastomers. The emphasis of the energetic polymer synthesis and characterization program was shifted to morphologically complex energetic thermoplastic elastomers. These energetic binders are tailored for melt cast or extrusion processing and with chemical and physical energy absorption mechanisms to optimize invulnerability of missile and gun Navy propellant and explosive formulations. Coherent Antistokes Raman and laser doppler velocimetry techniques are being used to nonintrusively investigate flow and chemical processes in subscale combustors of hypersonic ramjets being developed for surface launched missile fleet defense. Electrical Power Generation: In the final phase of the explosively driven MHD project, the dependencies of the power scaling and energy conversion efficiencies on the channel diameter are being determined. A self-consistent calculation of the equation-of-state and transport properties of strongly coupled dense plasmas is being performed. Due to the potential importance of high power, high repetition rate switches in the electrical power conditioning chain which would permit inductive versus capacitive storage; several innovative switching concepts are being examined. A model of the high-field, inhomogeneous, space-charge dependent period in the operation of a discharge switch is being developed. Energy Utilization: The design and assembly of a unique research facility to investigate heat transfer to aircraft and shipboard gas turbine blades, discs, and other components will be completed and the experimental program will begin. A complementary computational program for related flow field and heat transfer predictions has been formulated. Unsteady gas and thermodynamic processes operating in self-cooling wave rotors are being investigated to establish design criteria for their application in extended range cruise missiles. The investigation of the fluid dynamic mechanisms in spiral helices responsible for enhanced heat transport and unchanged flow energy losses in compact propulsion heat exchanger applications will be completed. The potential for newly synthesized solid lubricant additives to reduce contaminant induced abrasive wear in highly loaded Navy grease lubricated bearings in shipboard rotating machinery and Marine Corps vehicles is being initiated. An interdisciplinary research program to improve the quality of ramjet fuel spray dispersion and fuel chemical reactivity is being initiated.

F. (U) FY 1984 Planned Program: Chemical Propulsion and Armaments: Perfluorinated energetic monomer and polymer synthesis efforts will be initiated to provide advanced binders for aircraft deployed pyrotechnic decoy. The scaleup and transition of newly synthesized dense crystalline explosives/monopropellants to Navy Exploratory Development and Industrial Research and

Subelement: 24  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Energy Conversion  
Title: Defense Research Sciences  
Budget, Activity: 1 - Technology Base

Development Programs will begin. The extent of the augmentation of missile or torpedo warhead metal acceleration capability of detonating explosives by shaped multi-kilovolt/multi-kiloamp electrical pulses will be investigated using optical techniques. A research program thrust jointly organized with the Mechanics subelement to determine the fluid dynamic and chemical mechanisms responsible for combustion induced pressure oscillations and inlet shock disturbances in liquid fueled air launched tactical missiles will be initiated. Electrical Power Generation: The development of a self-consistent model for the equation-of-state and transport properties of strongly coupled dense plasmas will be completed. The examination of the heating of electron attaching species will continue. Mechanisms limiting the use of storage rings for power multiplication will be determined. Methods of circumventing the effects presently limiting thermoelectric and thermionic devices will be examined. Energy Utilization: Investigation of aeropropulsive unsteady jet effects to augment lift and thrust of VSTOL aircraft will be initiated. The potential to increase the wear resistance of bearing surfaces in Naval ship and aircraft rotating machinery using metallic surfaces treated with noncrystalline pulse plated alloys will be investigated. The fluid dynamic transport processes inherent in controlling the smooth ablation of preformed chemically crosslinked drag reducing polymeric surfaces will be investigated to improve the endurance and speed potential of torpedo propulsion systems.

Subelement: 31  
Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Oceanography  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) SUBELEMENT DESCRIPTION: The objective of research in the Oceanography Subelement is to provide knowledge of the environment for the design of future naval systems and the most effective use of present systems. Major emphasis is to support acoustic and non-acoustic undersea warfare. This includes research into the physical phenomena in the oceans (mesoscale eddies, fronts, shear currents, surface mixed layer, internal waves, fine structure and turbulence), sea floor research (bathymetry, sediment reflectivity, bottom benthic boundary layer, crustal structure, magnetism and gravity), analysis of the sound scatterers and bioluminescent biota in the ocean and their relation to the nutrients and trace elements so that the effects of these environmental conditions and phenomena on undersea warfare may be understood and predicted. Of particular importance is the investigation of satellite remote sensing techniques for synoptic monitoring of large ocean areas and the use of these data to determine internal ocean dynamics and to provide an input for ocean numerical models. Other phenomenological and background research areas include biochemical problems of pollution/fouling/corrosion; deflection of the vertical at sea for improved missile trajectories; improved sea/swell/weather forecasting and warship port design and maintenance concepts. This subelement represents a major portion of the nation's research effort in deep sea oceanographic disciplines which are vital to the Navy's technological superiority. Since this is primarily a deep sea oceanographic program, some funds are used to develop oceanographic instruments, recorders, computers and buoys; to operate, maintain and overhaul research vessels, including the purchase of winches, cranes, generators, bow thrusters etc.. The pertinent research is broadly defined under seven areas: Physical Oceanography, Chemical Oceanography, Marine Geology and Geophysics, Oceanic Biology, Ocean Science Engineering, Ocean Acoustics and Ocean Optics.

B. (U) RELATED ACTIVITIES: The program is coordinated through formally established interagency groups such as the Federal Oceanographic Fleet Coordination Council and a number of ad hoc and informal coordinating groups. Much of the research is formally coordinated also with related efforts of individual agencies including the National Oceanic and Atmospheric Administration, the Department of Energy, National Aeronautics and Space Administration, National Science Foundation, Environmental Protection Agency, Defense Advanced Research Projects Agency, Office of the Under Secretary of Defense for Research and Engineering, Naval Systems Commands and the Office of the Chief of Naval Operations.

C. (U) WORK PERFORMED BY: (Representative) Academic: Scripps Institution of Oceanography, La Jolla, CA; Woods Hole Oceanographic Institution, Woods Hole, MA; Oregon State University, Corvallis, OR; University of Washington, Seattle, WA; University of Hawaii, Honolulu, HI; University of Rhode Island, Kingston, RI; University of Miami, Miami, FL; Columbia University, Lamont-Doherty Geological Observatory, Palisades, NY; Texas A&M Research Foundation, College Station, TX; Industrial: Magnavox, Fort Wayne, IN; Non-Profit: National Academy of Sciences/Engineering, Washington, D.C.; In-House: Naval Research Laboratory, Washington, D.C.; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Postgraduate School, Monterey, CA.

D. (U) FY 1982 Accomplishments: Physical Oceanography: One year current meter moorings installed south of the Aleutians have been recovered. The data will allow description of the deep boundary currents and resolution of the discrepancy in flow direction between theory and previous observations. Direct measurements of the Gulf Stream volume transport at two-month intervals have continued. The purpose of these projects is to better understand the dynamics of deep boundary currents and the downstream increase in Gulf Stream transport. A better understanding of ocean dynamics is important to the prediction of sound speed profiles used to compute sonar ranges. Current meter moorings installed last year in the Kuroshio extension have been recovered. Mooring technology, hardware and instruments developed over the last two years have been used to establish several moorings at 340W 700W in a long term upper ocean investigation. This planned two-year mooring will provide data to relate local meteorology with currents and temperature structure of the upper 500 meters of the water column. Parameters to be measured include temperature, salinity (conductivity) and current. These significantly influence sound propagation as well as internal waves and shear currents which relate to upper ocean variability a key factor in non-acoustic ASW research. Chemical Oceanography: Continued emphasis has been placed on the biochemical interactions between nutrients, trace elements, phytoplankton and zooplankton, so that their short wavelength distribution may be understood and predicted. Knowledge of the short wavelength distribution, is a research field that only the Navy supports and is essential for evaluation various aspects of non-acoustic

Subelement: 31  
Program Element: 61153H  
DoD Mission Area: 510 - Defense Research

Title: Oceanography  
Title: Defense Research Sciences  
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ASW. Marine Geology and Geophysics: Data from the Atlantic geophysical transect have undergone initial analysis to examine sediment structure and crustal variation from the young mid-Atlantic Ridge crest to the older seafloor along the U.S. East Coast. A Seabeam (multibeam echo sounder) previously installed on the academic research vessel RV Thomas Washington was used in its first scientific cruise. Seabeam will eventually replace all the single beam echo sounders used heretofore. These have 20 simultaneous beams and map a swath of bottom bathymetry. This technology is expected to revitalize the examination of seafloor morphology and will be used in an extensive experimental program. A deep towed instrument package has been used to collect bathymetry, sub-bottom profile and side-scan sonar data for the Scotian Rise. These data were used to select a site for a major future experiment to investigate the high energy benthic boundary layer. Construction has continued on a deep towed geophysical array which is being built to provide a detailed measurement of the continuity of shallow seafloor sedimentary reflectors. Research into sediment structure and crustal variation and morphology will lead to increased understanding of the seafloor as an energy propagation medium which has applications in acoustic ASW. Oceanic Biology: Emphasis has continued on integrated research on all aspects of biodeterioration including fouling, boring and related marine corrosion research. Emphasis was also placed on bioacoustic problems, especially the distribution, composition and behavior of sound-scattering organisms (which cause volume reverberation). Research programs on "bioturbation" (the distribution and ecology of bottom organisms and their interaction with the sediment), microbiology, and the distribution, physiology, and interaction of bioluminescent organisms have been emphasized. The bioluminescence research has application to the non-acoustic ASW problem while the bacterial fouling work has the potential to lead to practical methods of reducing fouling on ships and structures. Work has continued in the application of recombinant DNA techniques to develop an understanding of the process by which surface-attaching marine bacteria foul fresh structure surfaces in the marine environment. If the bacteria can be prevented from forming an initial slime on a surface then the motile larvae of the fouling organisms can not settle and the fouling problem will be solved without the use of toxic anti fouling coating. Ocean Science Engineering: The ocean technology project has continued development and testing of an aircraft deployable oceanographic data gathering mooring for open ocean and Arctic applications. Transition of the technology of the open ocean version to 6.2/6.3 has continued. Data has been analyzed for sea tests of a high speed (10 kt) optical biological sampler. Basic research has continued in order to develop an understanding of natural processes causing shoaling and affecting flow in Navy harbors. A new concept has emerged for using natural forces to remove unconsolidated sediments from harbor areas with significant water flow and reduce or eliminate dredging requirements. Ocean Acoustics: Analysis of data resulting from a major ocean acoustic tomography experiment has allowed an evaluation of how well the acoustic time data can be inverted to give the physical oceanographic structure and therefore the sound velocity profiles of the intervening ocean. The experiment area was a 300 km square between the Bahamas and Bermuda. Four acoustic source moorings, four receiver moorings and three environmental moorings were used. The National Science Foundation and the National Oceanographic and Atmospheric Administration were participating agencies. Success of the tomography research will provide a tool by which we can remotely sense the three dimensional structure of dynamic ocean features which will benefit the acoustic ASW community. Analyses of the high frequency (5 to 20 Hz) marine seismic earthquake phases have been continued in an attempt to determine what in the structure of the ocean lithosphere makes these very efficient propagation phases possible. Presumably there is a low velocity layer serving as a propagation duct similar to the ocean's solar channel. This work has potential application to the long range ASW detection problem. Theoretical work has improved the performance of the parabolic equation solution to the wave equation making it possible to calculate high angle rays. Results have transitioned to exploratory development. Joint projects with the Oceanic Biology program have continued to investigate biological scattering in the frequency range from 40 kHz to 3 Hz. A model for simulation the ocean optical properties in depth and time is being developed. Planning and preparation for a major measurement program to support model development and evaluation have been conducted. This work has application to the non-acoustic ASW program.

E. (U) FY 1983 Program: Physical Oceanography: The major oceanographic mooring at 34°N 70°W will be serviced at periodic intervals for two years. Resulting data will be used to investigate long-term upper ocean variability including internal waves and shear currents. Data from the long-term current meter moorings in the Kuroshiro extension will be analyzed. Analysis experiments will continue to develop relations between synoptic satellite sensed sea surface temperature data and the internal ocean structure. Planning for major measurement programs in the South Atlantic will begin. The two long-term program goals in

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phenomena in the upper ocean for non-acoustic ASW and to develop ocean prediction methods for numerically modelling the ocean primarily for sound velocity or sonar predictions. Chemical Oceanography: New continuous flow chemical analytical methods using flow thru ocean samplers are being developed to define the sources, sinks and chemical speciation of the ocean trace elements of interest to non-acoustic ASW. Evaluations will continue for electrochemical sensors (anodic stripping voltammetry), atomic absorption spectroscopy, and gas chromatograph-mass spectrographs combined with trace element preconcentration schemes. These will be coupled to underway, multiport pumping systems for obtaining continuous water samples from the upper ocean. Marine Geology and Geophysics: An experiment will take place on the continental rise off Nova Scotia to study the high energy benthic boundary layer and its control of the seafloor morphology and the physical properties of seafloor sediments. The bottom lander for the benthic boundary layer experiment, with six-month recording capability, includes current meters to measure ocean currents from 1 cm to 100 m above the seafloor, nephelometers to measure the sediment load carried by the bottom currents, Reynolds stress meters to measure the forces at the seafloor and time lapse photography to record the erosion of the seafloor as a function of current velocity. Benthic boundary layer studies are important to a better understanding of the effects of deep currents and the resulting sediment transport on bottom moored or mounted structures. Ocean Biology: Investigation of attachment mechanisms of surface-fouling marine bacteria will continue by application of recombinant DNA techniques. Analyses will determine the effect of seafloor biota on the cohesive strength of bottom sediments. Emphasis will continue on biodeterioration which will investigate initial zooplankton metabolic deposits that initiate the corrosion process, and on bioacoustic problems such as false targets from whales. Ocean Science Engineering: Field tests of the Arctic air deployed oceanographic mooring system will be conducted. Basic research on warship ports for domestic and overseas operations will continue with emphasis on natural processing causing shoaling and on new concepts for piers. Theoretical experimental data on the effects of deep water breaking waves on ocean engineering design spectra will be established, and new theoretical insights on wave and current structure interaction will be published. Ocean Acoustics: A tomography experiment will be planned to test the applicability of the technique for measurement of physical oceanographic parameters such as currents and vorticity. This experiment will require major hardware developments including a broadband acoustic signal source, stiff moorings and satellite links for data relay. Ocean Optics: upper 100 m of the water column. Concurrent data describing solar irradiance, meteorological and physical oceanographic properties will be collected.

F. (U) FY 1984 Planned Program: Physical Oceanography: The major oceanographic mooring at 34°N 70°W will be recovered and data analysis will begin to determine the relationship between meteorological and upper ocean parameters. Investigation of current systems, internal waves, shear currents and fine structure in the South Atlantic will begin with initial mooring deployments and ship deployed sections. This extensive effort in the South Atlantic is designed to improve our knowledge of the ASW environment in this strategically important area. Chemical Oceanography: Instrumentation suites developed in prior years will be applied in investigation of patchy distribution of trace elements and relation of space and time scales of chemical patchiness to physical parameters. These investigations are directly relevant to defining background fields for non-acoustic ASW applications. Marine Geology and Geophysics: Data from the high energy benthic boundary layer experiment will be used to investigate relationships between seafloor geological communities, strong aperiodic near bottom currents and sediment structure. These results are needed to define the environment in which seafloor structures must survive and function. Direct impact is anticipated on ambient noise and structure survivability. Seafloor bathymetry and subbottom structure will be measured in the South Atlantic to define seafloor morphology, layering and lateral variability, all of which are important for prediction of bottom interacting sound fields. Oceanic Biology: Suites of instruments including high resolution biological sampling plankton nets, acoustic and optical images will be applied in investigations of biological patchiness, control by such patchiness by physical and chemical variables and relation of features to predictability of acoustic scattering, optical properties and bioluminescence. Ocean Science Engineering: The Arctic air deployed oceanographic mooring system and capabilities for using natural forces to maintain harbor depth and reduce dredging will transition. Ocean Acoustics: Results of the major scientific experiments relating physical oceanography and acoustic tomography will be analyzed and the results used in combination with satellite measured data to define the three dimensional sound speed field of the ocean for sonar predictions. Ocean Optics: Results of the major field experiment will be used to define the relationship between ocean physical and biological parameters and optical propagation. The resulting analysis will be used to evaluate a model for predicting optical properties useful in laser communication system performance prediction.

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Title: Terrestrial Sciences  
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Budget Activity: 1 - Technology Base

A. (U) Subelement Description: The objective of this research is to provide improved understanding and prediction capability of environmental and geophysical conditions which affect Navy and Marine Corps personnel, systems and operations in Arctic, inland, shallow water, coastal, deep ocean, atmospheric and geomagnetic environments. Research is conducted under the general headings of Coastal Sciences, Arctic Research, Earth Physics, Surface Wave Scattering, and Geophysical Processes.

B. (U) RELATED ACTIVITIES: Programs within the subelement are formally coordinated with the Army, Air Force, and the Office of the Under Secretary of Defense for Research and Engineering by means of apportionment and technology base reviews held by Office of the Under Secretary of Defense for Research and Engineering each year, and by formal reviews within the Navy. Government-wide coordination occurs through membership in several interagency and National Academy of Sciences Committees concerned with environmental problems. Interchange of information on coastal sciences, earth physics, and Arctic sciences and Navy lab programs is maintained with the Defense Intelligence Agency, Defense Mapping Agency, CIA, Naval Material Command, Naval Electronic Systems Command, Naval Air Systems Command, Naval Sea Systems Command, Naval Facilities Command, USAF (AF Office of Scientific Research), USA (Army Research Office), National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, Environmental Protection Agency, U.S. Geological Survey, National Science Foundation, U.S. Army Corps of Engineers, and the Defense Research Group and the Military and Science Committees of the North Atlantic Treaty Organization. The Surface Wave Scattering and Crustal and Geophysical Processes Programs of the Naval Research Laboratory are coordinated with Exploratory and Advanced Development projects within the Department of Defense, and with Naval Air Systems Command, Naval Material Command, Naval Electronic Systems Command, Defense Meteorological Satellite Program, and the National Aeronautics and Space Administration.

C. (U) WORK PERFORMED BY: (Representative) University of Virginia, Charlottesville, VA; Hawaii Institute of Geophysics, Honolulu, HI; University of Kansas, Lawrence, KS; Louisiana State University, Baton Rouge, LA; Oregon State University, Corvallis, OR; University of Washington, Seattle, WA; Columbia University (Lamont-Doherty Geological Observatory), Palisades, NY; Massachusetts Institute of Technology, MA; Scripps Institution of Oceanography, La Jolla, CA; Stanford University, Palo Alto, CA; Woods Hole Oceanographic Institute, Woods Hole, MA.

D. (U) FY 1982 Accomplishments: Arctic Program: Ice floe station (FRAM IV) was established and successfully concluded. This series of ice floe stations in the central Arctic ice pack will be discontinued as research focuses on the Marginal Ice Zone. Main thrust of FRAM IV was to obtain sufficient acoustic knowledge of the eastern arctic to construct propagation, ambient noise, reverberation and under ice scattering acoustic models for arctic ASW. Coastal Developed a model which predicts significant wave height in the surf zone to within 5 percent accuracy, given offshore wave heights at a 10 meter depth. Long-term measurements of various beaches have shown that three-dimensional variations in beach and bar topography occur within definable, repeating sequences; this appears to be the key to developing predictive models of bar formation and migration. Models have been developed for predicting mean atmospheric mixing heights in the coastal zone under a variety of conditions. All of the preceding directly relate to amphibious warfare. Earth Physics: Developed improved signal processing algorithm for location of seismic sources; published signal-to-noise characteristics of seismic vs. acoustic detection as part of investigation to help overcome acoustic surveillance deficiencies on the continental shelf. Developed accurate tide prediction model for Defense Mapping Agency. Geophysical Processes: Developed improved algorithm to calculate depth-to-magnetic source from observed field data. Demonstrated first successful feasibility investigation/field test of airborne gravity system from fixed-wing aircraft. Conducted pioneering efforts which led to state-of-the-art research into the interrelationship of magnetic and gravity field data and satellite altimetry measurements and their usefulness in predicting ocean bottom configuration, and other geophysical parameters. These data and algorithms are of direct value to help satisfy Defense Mapping Agency mapping/charting and geodesy requirements. Surface Wave Scattering: Development and evaluation of radar scattering models theory and experiments in current-wave and wave-wave interactions. Development of millimeter-wave radiometric imaging systems and performance of first airborne measurements of sea, and ice and coastal environments with millimeter-wave length electromagnetic imaging system which will increase all weather operational capability. Fabrication of basic 94 gigahertz radar and continuing the processes of establishing definitions and of developments toward its designed goal as a dual channel coherent interferometer radar.



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E. (U) FY 1983 Program: Arctic Program: Continue field acoustic experiments to investigate reverberation, ambient noise, propagation and sediment dynamics in the Barents Sea and eastern Arctic Marginal Ice Zone, as well as effects of the environment such as thermal fronts, ice and shallow water to improve Anti-Submarine Warfare capabilities in the Arctic. Commence new special emphasis field program in the Marginal Ice Zone to extend the horizon of knowledge of the sea-air-ice interaction and its interrelated dynamic processes, to increase capability to predict environmental effects on naval operations in and near the edge of ice covered oceans. These efforts will include investigations of an ice edge prediction model, ocean fronts and eddies, up and down welling effect on intermediate water formation, acoustic ambient noise and propagation, effect of the ice edge on synoptic weather, and optimum passive and active microwave remote sensing techniques and frequencies for observing synoptically key sea ice and ocean parameters. Continue programs in sea ice physics, electromagnetic transmission through sea ice, energy exchange processes, ice production, distribution and drift, geophysics, oceanography and meteorology, particularly Arctic aerosols (pollutants), all of which relate to increased naval operational capability in polar regions. Coastal Sciences: Continue basic research in coastal oceanography and remote sensing as they relate to amphibious warfare, mine warfare and shallow-water anti-submarine warfare. Research will focus on: nearshore hydrodynamics and morphodynamics, with particular emphasis on short-term (hours to days) variability; physics of coastally-trapped waves (edge waves, continental shelf waves, etc.); physics of the coastal marine planetary boundary layer; novel techniques of remote sensing of the coastal environment. Special emphasis will be placed on strategic straits and air remote sensing will expand as planned. Earth Physics: Develop tidal current models for complex shore lines to support amphibious operations; examine predictability and levels of geomagnetic noise levels for Mine Warfare and ASW. Geophysical Processes: Continue theoretical investigations on the dynamics of the Earth's crust and upper mantle with emphasis on the inversion of potential field data field data to ocean-bottom topography for prediction of geophysical parameters in poorly surveyed portions of the world's oceans. Develop a 2D spectral technique to statistically represent the ocean bottom for acoustic purposes. Complete error analysis and model components of the prototype airborne geophysical sensor suite and specify sensor requirements for potential use by Defense Mapping Agency as a survey technique. Surface Wave Scatterings: Maximize use of remote sensing tool to support Naval operations, by conducting: analysis of wave, current and radar scattering data taken by doppler radar, Delta-K radar and laser profilometer from Naval Research Laboratory Remote Sensing experiment July 1982. Initial field testing of 94 gigahertz radar for precision measurement of land, ice and ocean scattering characteristics. Data reduction of shipboard measurements of directional wave spectra with Remote Ocean Wave Spectrometer and Delta-K radar techniques.

F. (U) FY 1984 PLANNED PROGRAM: Arctic Program - Continue multidisciplinary research projects in the fields of ice physics, physical oceanography, geophysics, acoustics, biology and Arctic environmental remote sensing to enhance Naval operations in the Arctic environment. Program will continue to emphasize on the marginal ice zone regions of the Barents, Greenland and Norwegian and Bering Seas using satellite, aircraft, surface and subsurface data gathering platforms, leading to improved measurement and forecasting of sea ice, acoustic, bioluminescence, radiation balance, and other environmental and geophysical conditions for arctic submarine, ship and air operations. Continue arctic climatic research with focus on aerosols and prediction of sea ice distribution in order to predict effects on polar operations. Accelerate research in the marginal ice zone with major field program in FY 1984 in cooperation with other U.S. agencies and foreign countries (i.e., Norway and Germany). Continue research using a passive microwave imagery and radiometry radar to measure the properties and distribution of sea ice. Coastal Sciences - Initiate an expansion in program scope to include research of semi-enclosed coastal seas; candidate areas include the Sea of Japan, the Java Sea and the Gulf of California. Field a second series of major investigations of selected straits regions; candidate straits are Gibraltar, Caribbean Passes and straits of the Sea of Japan. Radar remote sensing will expand to include investigations of combined radar techniques in tandem, and studies of radar polarimetry. These will all relate to amphibious warfare, mine warfare and shallow water anti-submarine warfare. Earth Physics - Continue seismic detection and signal processing programs, combining seismic and statistical theoretical considerations both for shallow water and hostile artillery detection. Analyze theoretically the potential of gravity gradiometry for precise navigation, obstacle avoidance and geoid mapping. Develop modernized instrumentation and improved data processing for deep sea and shallow water tidal predictions, including analysis of satellite altimetry to enhance planning and operations in coastal environments. Improve models for marine related electromagnetic propagation, and solid earth properties. Expand effort in geomagnetic noise prediction in order to improve surveillance and navigation. Geophysical Processes Program - Continue theoretical research in crustal dynamics with emphasis on models to predict parameters of interest to naval operations e.g. ocean bottom topography, sediment thickness, and vertical deflection field

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gradients. Incorporate shallow subbottom data into statistical bottom representation for prediction of acoustic array response. Initiate examination of LaPlace Tidal Equation that include self-gravitation of the ocean mass, crustal loading effects, and continental boundaries. Conduct comprehensive field evaluation of integrated airborne geophysical sensor suite. Surface Wave Scattering Program - Optimize use of remote sensing tool to support naval operations by developing methods and techniques for determination of ocean parameters (orbital speed, wave spectra, currents, wind speed, and directional wave spectra). Complete reduction of data collected during NRL Remote Sensing Experiment July 1982. Plan and conduct follow-up experiment tentatively set for Sept 1984. Develop inversion algorithms for parameter retrieval from electromagnetic sensors. Initiate measurements, improve sensor performance model, and develop data processing system for measurement of ocean and terrestrial parameters with 94 gigahertz radar. Emphasize development of methods and techniques for determination of terrestrial/coastal parameters to meet U.S. Marine Corps amphibious warfare needs, and mapping, charting and geodesy requirements.

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Title: Atmospheric Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) Subelement Description: Research relates to atmospheric environment that affect naval operations and systems at various levels in the atmosphere from the marine boundary layer to the magnetosphere. Areas of emphasis are: marine boundary layer processes and aerosols, particularly as they affect atmospheric transmission and operation of electrooptic systems; cloud physics, icing, turbulence and lightning physics for improvement of flight safety, warning, and engineering design for new aircraft and weapons systems; developing and testing general circulation and tropical cyclone prediction models; for extending forecast range from 3 days to 10 days, examine solar dynamics by solar radiometry and high resolution spectroscopy; for predicting radiowave propagation condition; investigate relationships between geomagnetic response and variability of solar plasma and electromagnetic radiations; ionospheric plasma dynamics and man-made and solar control of the ionosphere including modeling of neutral and ionized atmospheres for improved prediction of electromagnetic wave propagation conditions affecting naval communications, navigation, and surveillance systems; remote sensing of lower and upper atmosphere and interplanetary media for rapid measurement of environmental conditions in support of naval operations; probes for rocket and satellite observations for ionosphere diagnostics.

B. (U) RELATED ACTIVITIES: Through scientific meetings, workshops, reviews and government channels, coordination is maintained with those agencies or activities having a mutual interest, including: Federal Aviation Administration regarding improvement of air operations against lightning hazards; Department of Defense Explosives Review Board for improvement of handling and assembly of munitions against hazards of atmospheric electricity; National Aeronautics and Space Administration for joint effort on research aboard Space Shuttle; coordination with Air Force Geophysics Laboratory to monitor Space Shuttle environment; coordination with Air Force Office of Scientific Research and Army Research Office in developing advanced cloud physics research instrumentation through coordination with Wright Patterson Air Force Base and the French Atomic Energy and Aerospace Establishment for research on triggered lightning; to develop realistic procedures to test composite material aircraft for lightning vulnerability; coordination with Defense Nuclear Agency and Air Force Geophysics Laboratories in pulsed probe study of aurora and ionosphere; National Science Foundation and National Aeronautics and Space Administration for coordination of cloud physics research in the cooperative Thunderstorm Research International Program. Coordination of programs of Army and Air Force occurs through annual reviews by the Office of the Under Secretary of Defense for Research and Engineering. Coordination also exists through the Navy Space Systems Review Panel, Nuclear Weapons Effects Planning Group, Defense Nuclear Agency and Defense Advanced Research Projects Agency. Contracts exist with some foreign investigators for obtaining data for certain programs on a global basis. These include the Commonwealth Scientific Industrial and Research Organization (Australia), the University of Manchester (England), the Physikalisch-Biochemische Forschungsstelle (Germany), the University of Galway (Ireland), and the National Research Council (Canada).

C. (U) WORK PERFORMED BY: (Representative) In-House: Naval Research Laboratory, Washington, DC; Naval Postgraduate School, Monterey, CA; Industrial: Atlantic Scientific Inc., Melbourne, FL; Lockheed Corp., Sunnyvale, CA; Academic: New Mexico Institute of Mining and Technology, Socorro, NM; University of Miami, Miami, FL; University of Arizona, Tucson, AZ; University of Maryland, College Park, MD; Pennsylvania State University, University Park, PA; Stanford University, Palo Alto, CA.

D. (U) FY 1982 Accomplishments: In the Marine Boundary Layer area a new prediction model for sea fog was tested successfully. Submicron aerosol size distributions were measured over the ocean and their impact on optical climates and performed on electrooptical weapons system investigated. In Cloud Physics depolarization effects of nonspherical hydrometers on mm-wave propagation was examined to explore new secure communication techniques. On Weather Forecasting stratospheric-tropospheric coupling of long planetary waves revealed importance of stratospheric dynamics on long term forecasting of importance to operations planning. The anomalous effect of "sudden stratospheric warmings" has been explained. A new hypothesis has been developed for a coupling mechanism between field aligned currents and zonal winds in the auroral midatmosphere and its influence on long term weather forecasting for fleet operations. In Ionospheric Research an interpretive understanding of ultraviolet emissions from the ionosphere has been achieved which will enable to chart ionospheric states in terms of wave propagation conditions. Computer simulations have shown feasibility to artificially excite the ionosphere for generating extremely low frequency waves for secure communication channels to submerged submarines. In Solar Research significant advances have been made

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in predictive understanding of coronal-hole magnetic flux evolution of the magnetic field sector structure of importance to space "weather" and geomagnetic noise. Quantitative improvements of space data of solar luminosity and ultraviolet irradiance have been made.

E. (U) FY 1983 Program: Marine Boundary Layer Physics will shift towards fundamental problems of turbulent fluxes, aerosol generation mechanisms and stability dynamics to assist assessment and forecasting of environmental factors in a battle group scenario. Weather Forecasting will explore analytical and data limitations to extending forecast range beyond five days by investigating stratospheric-tropospheric coupling. Ionospheric Physics will improve monitoring of irregularity structure for developing a prediction capability for communication systems. Develop new ideas for submarine communications using ionospheric excited extreme low frequencies. Complete on-orbit phase of Stimulated Emission of Energetic Particles Satellite Experiment. Improve microwave radiometric techniques to measure absorption and emission spectra of upper atmosphere atmospheric water vapor. On other Environmental Effects-continue measurements of worldwide radio noise and theoretical research on remote detection and classification of low altitude nuclear bursts at sea. Continue research on naval system vulnerability to nuclear burst effects.

F. (U) FY-1984 Planned Program: On Local Meteorology-respond to ongoing applied programs by developing concepts and understanding of marine boundary layer and cloud physics conditions to enable assessment and forecasting of operations and systems performance; of particular interest are specific variables not obtained through a centralized service system, e.g., water vapor structure, optical cloud properties, super cooled water content, infrared propagation conditions, and atmospheric electric hazard variables. On Weather Forecasting-examine coupling of long planetary waves and other subtle large scale forces on the global circulation system for increasing forecast skills beyond five days. On Ionospheric Physics-develop a UV remote sensing capability from satellites to deduce ionospheric properties of wave propagation with advanced space and time resolution. Plan and execute experiments to generate long electromagnetic waves in the ionosphere using ground-based equipment and prove their value as a communication technique. Perform satellite experiments to measure by microwave spectroscopy water vapor, temperature and pressure in the midatmosphere and assess their impact on performance of naval systems. On Solar Physics-perform analytical and space experiments to understand origin and mechanism of solar high-energy events and their interaction with the earth's atmosphere including the mechanism of geomagnetic substorm and magnetospheric magnetic reconnection.

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Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Astronomy and Astrophysics  
Title: Defense Research Sciences  
Budget Activity: I - Technology Base

A. (U) Subelement Description: Scientific investigations are made of earth-space environment to determine characteristics of natural backgrounds, effects of energetic radiation on space systems and personnel, and characteristics of man-made disturbances. Data and technology are provided for planning and assessment of improved systems for surveillance, communication, detection, precise time determination and transfer, missile guidance, and navigation. Research efforts can be categorized into: extraterrestrial radio backgrounds and techniques for precise location and time determination; radio spectroscopic measurement of mesospheric/stratospheric constituents; infrared atmospheric and celestial background limits; far ultraviolet, X-ray, and gamma-ray backgrounds; near earth energetic flux of heavy ions and their effects on humans and systems; characteristics of man-made disturbances; and supporting instrumentation and vehicle technology.

B. (U) RELATED ACTIVITIES: Department of Defense coordination is provided through Office of the Under Secretary of Defense for Research and Engineering Reviews. National Aeronautics and Space Administration and the U.S. Air Force have active collaborative efforts related to the work within this subelement. Navy funding at the Exploratory Development level is provided for follow-on investigation of unconventional surveillance techniques which employ instruments developed for astronomy, and for extensions of microwave remote sensing techniques. Proposals for experiments to be carried onboard Air Force satellites are coordinated with and approved by the Department of Defense Space Test Programs Committee; experiments launched on National Aeronautics and Space Administration space vehicles are coordinated by National Aeronautics and Space Administration in competition with others and reviewed by National Aeronautics and Space Administration evaluation procedures. A far-infrared sky survey is being conducted jointly with the Air Force Geophysics Laboratory.

C. (U) WORK PERFORMED BY: In-House: Space Science Division, Naval Research Laboratory, Washington, D.C.

D. (U) FY 1982 Accomplishments: Radio Extraterrestrial Backgrounds and Techniques: Observation of 188 compact extragalactic radio sources has been accomplished to establish a more precise inertial reference frame for time and position determination. Improved determination of universal time has been demonstrated through use of satellite time-linked observations of celestial radio sources. High resolution mapping (milliarc-second) of sources has been accomplished. Mechanisms controlling radio star source structure and formation, and the interstellar medium have been investigated. Daily and seasonal variations of the distribution of water vapor into the mesosphere have been observed for the first time. An initial demonstration has been made of use of the very large array (VLA) to determine accurate positions of satellites. Improved precision radio astronomy (astrometry) has application for Naval time and location determination especially by the Naval Observatory. Investigation of radio source mechanisms not only reveals new physics, but is essential to use of sources for astrometry and yields sensor and imaging technology of forefront applicability. Mesospheric constituent (water vapor, ozone) behavior is fundamentally related to lower atmospheric/climatic behavior, which imports world wide naval operations. Infrared Backgrounds: Far Infrared Sky Survey Experiment, (FIRSSE), a rocket-borne cryogenically-cooled infrared payload sensitive to emissions out to 120 microns, was successfully flown in a collaborative experiment with the Air Force to survey the accessible portion of the infrared sky. High-sensitivity far-infrared (40-250 micron) sensors were also prepared for balloon flights in two other collaborative investigations. The far infrared background of space is least well-known and, as for other spectral regions, must be thoroughly understood to assure effective functioning of military systems in space. Ultraviolet Backgrounds: Extreme ultraviolet stellar fluxes below 1300A were measured from rocket; new ultraviolet cameras and spectrographs together with electronic readout adaptation, are under test for DoD Space Test Program shuttle flight. High altitude oxygen and nitrogen emissions have been explained, and reliable theoretical techniques to analyze photo dissociation in the troposphere and stratosphere, and to assess light scattering by clouds, have been developed. Full interpretive capability has been achieved for the first time to image ionospheric weather in real time from space; such information could benefit any military ionospheric system. X-ray Backgrounds: Unique varying X-ray celestial phenomena were analyzed from galaxies, bursters, and binary pulsars. An imaging X-ray system was flown by rocket; an improved high-sensitivity imager has been developed. Flight configuration X-ray hardware was completed for first use in the shuttle-launched free-flyer SPARTAN system. Both X-ray and gamma-ray sensors and knowledge of the X-ray and gamma-ray background

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are essential to military detection of high energy events and sources in space. Gamma-Ray Backgrounds: Unique celestial gamma-ray phenomena have been detected, including cyclotron emission from the Crab pulsar flare and special events observed on the NASA Solar Maximum Mission. A balloon-borne hard X-ray observatory system suitable for long duration (global) flight has been prepared. This will contribute to improved world wide detection capabilities of nuclear events. Particle Radiation: High mass charged particle collection payloads have been designed for DoD Space Test Program flight on shuttle. Their data will update NRL models of the space particle background in use to assess harmful effects on space microelectronic and biological systems.

E. (U) FY 1983 Program: Radio Extraterrestrial Backgrounds and Techniques: Continue cooperation with U. S. Naval Observatory to develop more precise universal time (UT) determination and very long baseline interferometric (VLBI) time transfer. Finish determination of 100 radio sources to 5 milliarcsecond accuracy. Commence definition of operational system for interferometric satellite tracking. Conduct radio source observations, especially into the millimeter wavelength region to investigate stellar winds and stellar interaction with interstellar clouds. Investigate availability of low-cost satellite-link timing to permit VLBI precision astrometry without use of hydrogen masers. Precise definition of the radio source background and character is essential for use of observations in Navy timing, location and navigation. Commence by-product use of VLA observations to deduce ionospheric structure. Utilize ground-based radio monitoring to observe mesospheric carbon monoxide and investigate comparative mesospheric water and ozone behavior, which are associated with low level climate affecting naval operations. Infrared Backgrounds: Refly FIRSSE rocket instrument with analysis leading to publication of infrared celestial source catalog. Refly Balloon Infrared systems. Initiate sub-millimeter spectroscopic studies of interstellar medium in association with radio observations. The space infrared background must be known for potential military systems to operate in the infrared region. Ultraviolet Backgrounds: Conduct theoretical investigations of nitric oxide high altitude emissions, of stratospheric photo-dissociation, and of atmospheric flow on the radiation field. Refly rocket celestial ultraviolet camera, and fly the shuttle-borne extreme ultraviolet (SURE) spectrometer to observe the high atmosphere as a first step to global imaging of the ionosphere, essential to naval communication. Complete computer interfacing and test ultraviolet camera system with electronic (charge-coupled device) readout. X-ray Backgrounds: Complete extended 880-source X-ray map of celestial sources and investigate black-hole candidate sources using very fast timing data. Complete integration of SPARTAN shuttle frame-flyer payload for study of extended X-ray sources. Continue development of forefront efficient X-ray imager with photon counting capability. X-ray Background knowledge and sensors are necessary for military nuclear detection. Gamma-Ray Backgrounds: Conduct test flight of NRL hard X-ray observatory and modify it for long duration balloon flight (1 month). Test new sensitive gamma-ray detector for balloon flight. In related effort, begin hardware fabrication for major instrument to fly on NASA Gamma Ray Observatory (GRO) in 1988. Background knowledge and sensors are necessary for military nuclear detection. Particle Radiation: Assemble and deliver instruments for shuttle launch to measure high-mass charged particle fluxes at energies below geomagnetic cutoff in the magnetosphere. Develop a rigorous computational treatment of the propagation of such low energy nuclei in the earth's atmosphere. This is used to assess harmful effects on space microelectronics and biological systems.

F. (U) FY 1984 Planned Program: Radio Extraterrestrial Backgrounds and Techniques: Evaluate temporal behavior of compact radio sources, their fine structure and radio/optical position references; continue improvement of universal time determination and precise time transfer. Improve satellite radio tracking accuracy to 10 milliarcsecond level. Continue investigation of astrophysics of peculiar sources including the physics of jet-like sources, the nature of astrophysical masers, and the interaction of stars with the interstellar medium and clouds. Continue satellite-link time transfer development to achieve low cost capability. All these efforts advance astrometry and determination of time location and navigation for the Navy. Initiate mesospheric ozone temperature and wind determination by ground-level radio spectroscopy; mesospheric conditions link to surface climate, of importance to naval operations. Plan for use of a VLBI facility in space. Infrared Backgrounds: Continue infrared celestial balloon observations, and infrared sub-millimeter spectroscopy of stars and interstellar medium. Conduct focal-plane feasibility and design study for collaboration with Air Force in flight of a Large Aperture Infrared Telescope System (LAIRTS) on shuttle. Conduct preliminary assessment for a possible military space cold target detection system; infrared background determination is a requirement for such a system. Ultraviolet Backgrounds: Prepare ultraviolet spectrograph and camera for later

Subelement: 34  
Program Element: 61153M  
DoD Mission Area: STO - Defense Research

Title: Astronomy and Astrophysics  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

scheduled shuttle flight; develop camera payload for SPARTAN (free flyer) flight from shuttle. Develop detailed interpretive system capability for global ultraviolet monitoring of the ionosphere, and ultimate application to all military systems which transmit through or are affected by the ionosphere. X-ray Background: Fly first X-ray detector on SPARTAN free-flyer shuttle mission. Develop high-resolution X-ray/extreme ultraviolet spectroscopy instrument. Utilize map and timing research to interpret character of compact and extended X-ray sources. X-ray background knowledge and efficient sensors are necessary for military nuclear detection. Gamma-Ray Backgrounds: Conduct southern hemisphere long-duration balloon flight of hard X-ray observatory. Conduct first balloon flight of new gamma-ray detector. Continue hardware fabrication of instrument for NASA Gamma Ray Observatory. Gamma-ray background knowledge and efficient sensors are necessary for military nuclear detection. Particle Radiation: Fly emulsion-instrumentation to measure heavy ions on shuttle-launched Long Duration Exposure Facility (LDEF). Use other observational data to identify source regions of cosmic rays and extend calculation of cosmic ray composition and spectra to secondary particles down to the earth's surface. The charged particle environment must be known to calculate the probability of harmful effects to military microelectronics and biological systems.

Subelement: 41  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Biological and Medical Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) SUBELEMENT DESCRIPTION: The Biological and Medical Sciences Subelement provides the fundamental knowledge from which bioenvironmental and biomedical developments are derived. The research encompasses physiology, immunology, microbiology, biochemistry, biophysics, clinical medical sciences, and naval biology. The work addresses problems related to Navy/Marine Corps operations and emphasis is given to special areas of: Stress: such as heat, noise, pressure changes, electromagnetic fields, motion, escalation and fatigue, and toxic environments; Disease Prevention: related to specific diseases of potential naval importance in world-wide sea control and amphibious operations; HEALTH CARE: related to trauma, fluid and blood replacement, reconstructive surgery, and wound healing; Biotechnology: related to the use of modern genetic and biochemical techniques in genetic engineering; CBW/BW Defense: such as research on navy unique problems associated with detection, immunological antidotes, and collective protection.

B. (U) RELATED ACTIVITIES: This subelement is related to efforts of the Army, Air Force, Uniformed Services University of the Health Sciences, National Aeronautics and Space Administration, National Institutes of Health, and National Science Foundation. The Naval Biological and Medical Scientific Research Programs are coordinated government-wide through groups such as the Under Secretary of Defense for Research and Engineering Joint Medical Research Conference, the Armed Forces Biomedical Research Evaluation and Management Committee, the Armed Forces Pest Management Board, and the NATO Advisory Group for Aerospace Research and Development Medical Panel.

C. (U) WORK PERFORMED BY: (Representative) In-House: Naval Medical Research Institute, Bethesda, MD; Naval Medical Research and Development Command Laboratories; Naval Biosciences Laboratory, Oakland, CA; Out of House: Diagnostic Reagents, Inc., Dallas, TX; University of California-Berkeley; Johns Hopkins University, Baltimore, MD; Baylor University, Houston, TX; Stanford University, Palo Alto, CA; MIT, Cambridge, MA.

D. (U) FY 1982 ACCOMPLISHMENTS: During FY 1982 significant advances in stress included the isolation and characterization of a sleep inducing factor--this is important, for example, on submarines where sleep schedules are disrupted by watch requirements; the demonstration that sonar operator effectiveness can be reliably predicted using measurements of brain signals. In the area of disease prevention research included a definition of the characteristics of antigens that protect against malaria; determination that NAVY FUELS derived from refined shale or petroleum do not differ in toxic bioeffects. Important progress was made in health care with the development of new universal blood cell concepts where Type A and B blood are converted to Type O and the INITIATION of recombinant DNA techniques to produce the necessary enzymes to catalyze this conversion--the procedure is one that does not require extensive storage of blood, a problem in confined areas such as ships. In the area of CBW/BW Defense a new technique for growing human cells responsible for the immune response in a test tube was developed--this technique can be used to generate compatible immune cells and products without exposing the individual to toxic substances such as encountered on carrier decks, in submerged submarines, or in CBW attacks. The blood program and research on a blood factor that may increase membrane permeability were transitioned to 6.2. During FY 1982 decreases in funding were noted in the area of hazardous effects of non-ionizing radiation, in investigations of water structure and in infectious disease, a program transferred to the Army as a lead agency.

E. (U) FY 1983 PROGRAM: Several new programs will be initiated or greatly expanded in FY 1983. Several initiatives in CBW/BW Defense are: physiological defense, a new approach to alleviate the problem of exposure to stressful and toxic agents (CBW/BW Defense)--this approach is in progress only in the Navy where problems of extended exposure are more serious; another program in detection of CBW agents will be expanded--the approach is one of methods that operate in saline/high-humidity environments peculiar to Naval operations; a program in immunology will be expanded to examine novel non-toxic stimulatory substances suitable for increasing resistance to CBW agents of special concern to open-sea battle groups--these materials will also be of value to the



Subelement: 41  
Program Element: 61153M  
DoD Mission Area: 510 - Defense Research

Title: Biological and Medical Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

Army and Air Force; a joint program in learning and memory (stress) is being initiated that is multi-disciplinary and will be of use to other services as well as the Navy; another program being expanded that is of interest to all military services is the use of electromagnetic fields to accelerate tissue repair and regeneration.

F. (U) FY 1984 PLANNED PROGRAM: The major new thrust in FY 1984 will be Biomolecular Engineering (Biotechnology). This is unique in DoD since it is oriented toward the use of genetic engineering to produce new materials such as coatings and adhesives for naval use; to investigate the possibility of developing better electronic chips for use in computers; and to engineer better enzymes (more catalytically active) for a variety of uses. Increases are also expected in the CBW field, (CW/BW Defense), particularly in the development of means for at sea decontamination, protection, and treatment. The development of biological probes that can be used to detect no less than six different families of biological agents will be emphasized. The programs in learning and memory, and physiological defense will be expanded. It is anticipated that major contributions in understanding man in the marine environment will result from studies using the latest of biological techniques (stress).

Subelement: 42  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: Behavioral and Social Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

A. (U) SUBELEMENT DESCRIPTION: The objective of research in the Behavioral and Social Sciences subelement is to establish basic theories and techniques for assuring adequate quantity and quality of Navy/Marine Corps personnel, enhancing their performance, and improving the human factors aspects of equipment design and effectiveness. Major areas are: Personnel and Training, research on psychological measurement for selection, classification, and training, human information-processing abilities, training and training systems, cognitive and neural bases of skilled performance and skill acquisition; Engineering Psychology, the investigation of human performance variables and the formulation of principles, procedures and equipment design techniques for improving human performance in high technology systems; Organizational Effectiveness, focused on personnel characteristics, leadership and management techniques, and other factors that determine the productivity, morale, and retention of personnel.

B. (U) RELATED ACTIVITIES: Army, Navy and Air Force research activities in these areas are coordinated by reviews for the Office of the Under Secretary of Defense for Research and Engineering through Technical Advisory Groups in Manpower and Personnel, Education and Training, Human Factors Engineering, and Simulation and Training Devices. Interservice and international coordination is effected through special North Atlantic Treaty Organization Panels, through the Technical Cooperation Program, Subgroup U, and through the Annual International Symposium on Applied Military Psychology. Close relationship is maintained with efforts of the Defense Advanced Research Projects Agency and the National Science Foundation. Conferences and symposia in significant research areas, such as adaptive testing by computer, are cosponsored with appropriate Navy and Department of Defense activities. Interdisciplinary research efforts are jointly funded with ONR's Information Sciences, Mathematics, and Physiology Programs.

C. (U) WORK PERFORMED BY: (Representative) Carnegie-Mellon University, Pittsburgh, PA; University of Washington, Seattle, WA; Bolt Beranek & Newman, Cambridge, MA; Georgia Institute of Technology, Atlanta, GA; University of Pittsburgh, Pittsburgh, PA; Virginia Polytechnic Institute and State University, Blacksburg, VA; New Mexico State University, Las Cruces, NM; University of Colorado, Boulder, CO; University of California, Los Angeles, CA; and Naval Personnel Research and Development Center, San Diego, CA.

D. (U) FY 1982 ACCOMPLISHMENTS: Personnel and Training Research: use of an interactive theory of reading to formulate micro-computer-based instructional games for reading remediation; a Cognitive investigation of sources of difficulty in Navy Basic Electricity and Electronics training; formulation of a set of standards for planned computer-based adaptive versions of military selection tests. Engineering Psychology: a theory of supervisory control and a partial implementation in design of remotely-operated and semi-autonomous unmanned work vehicles; a theory of programming which facilitates software design by separating computational coding at the machine interface from dialogue design coding at the human interface; a book that integrates theory and research findings concerning intuitive heuristics and biases characteristic of human inference and judgement. Organizational Effectiveness: an innovative system for observing and evaluating leaders' behavior on the job; identification of factors influencing sailors' decisions to stay in or leave the Navy after 20 years; a comprehensive annotated bibliography and literature review on military family research; a model of the Navy's Hispanic recruitment program which was used to determine where and how potential Hispanic recruits are lost.

E. (U) FY 1983 PROGRAM: Research in Personnel and Training will explore techniques for more efficient computer-based adaptive testing for military selection through advanced mathematical models of test performance and dynamic methods of gathering data on test characteristics. Other work seeks improvements in individualized training through shorter and more precise diagnostic testing practices. Training research will capitalize on recent advances in discourse science to improve the effectiveness of training materials and documents. Research on advanced, computer-based instruction will address design issues in computer-based training for high-demand, time-driven jobs such as air intercept controller or aircraft pilot. Related work will investigate principles for computer-based tutoring systems for training in troubleshooting and other diagnostic skills. Cognitive analyses of advanced military relevant skills will include research on complex motor skills and problem-solving expertise. A new multi-disciplinary

Subelement: 42  
Program Element: 61153H  
DoD Mission Area: 510 - Defense Research

Title: Behavioral and Social Sciences  
Title: Defense Research Sciences  
Budget Activity: 1 - Technology Base

program will determine the neural basis of human information processing related to learning and memory functions. Research in Engineering Psychology will investigate decision behavior with emphasis on broadening its scope to encompass creative human contributions to problem formulation and structuring. New models for describing human decision behavior will be explored, e.g., production systems. Perceptual research will continue to explore the visual processes which bear on the interpretation of multi-dimensional displays, and the auditory and cognitive processes by which patterns of non-speech sound are recognized by a listener. Rationales and procedures for systematically including maintenance considerations into early system design activities will be developed. Software design methods which ease inter-designer communication and improve man-computer interface designs will be developed and experimentally tested. New display concepts for VTOL and STOL flight control will be investigated. Research in Organizational Effectiveness will complete a theoretical model to predict the effects of stressors over time; complete an anthropological investigation of the transitions of Hispanic sailors as they move from home, to Navy Recruiting Station, to basic training, and to their first ship assignment, to better understand the effects of organizational transitions; complete research on organizational factors that facilitate or impede utilization of basic behavioral research; begin to assess the utility of novel observational techniques in measuring the effectiveness of petty officers; and complete a comprehensive examination of variables which determine the effectiveness of organizational change programs.

F. (U) FY 1984 Planned Program: Personnel and Training research will include investigations of interactive, real-time computers and advanced person-computer interfaces to provide more valid testing for both selection and training. Research on training will examine motivational characteristics of various training environments and regimes. Related work will explore principles of computer gaming that can be applied to training. Other research on computer-based training will address conceptual issues in the design of student-computer and instructor-computer interfaces, use of artificial intelligence in training systems, and computer facilities for the development, support, and maintenance of training materials. Research on the basis of skilled performance will examine the role of mental models in skilled problem solving and the applicability of new kinds of network models to describe skilled performance and skill acquisition. In Engineering Psychology, multi-disciplinary research will be initiated into the dynamics of multi-person decision making under a range of organizational structures and doctrinal procedures; this work is expected to provide underpinning for design of Navy C2 systems which stress flexibility and decentralization. The use of mental models of cognitive tasks will be investigated as a source of interface design in complex task environments. Research into basic principles of visual perception will examine an information-processing model of vision; a new computational model of vision, now in initial form, has far-reaching potential implications for design of future displays which stress pictorial, imagery-based presentation. Research in human decision making and problem-solving processes will employ AI models of cognition (i.e., scripts, frames, schemes) and AI programming techniques (e.g., production systems) as potential representations of human procedures. Organizational Effectiveness research will initiate research on ways that phenomena at the individual and group levels impact on overall organizational effectiveness; experiment with novel techniques for improving the effectiveness and morale of work groups composed of minority and majority personnel; begin research on organizational responsiveness to rapid social and technological change; complete research on effective strategies to use in increasing the productivity of work groups; complete research on relationships between family factors and job performance; and complete research on ways that information seeking and information processing influence the effectiveness of individual managers, of work groups, and of the organization as a whole.

Subelement: 51  
Program Element: 61153N  
DoD Mission Area: 510 - Defense Research

Title: University Research Instrumentation  
Title: Defense Research Sciences  
Budget Activity: 1-Technology Base

A. Subelement Description: This subelement has been established to refurbish and upgrade research equipment in university laboratories that carry out research of interest to the Navy and DoD. These university research programs are responsible for the flow of new ideas and results which provide much of the basis for DoD's technology and development programs. In recent years these key university facilities have eroded to the point of alarm. An Interagency Working Group on University Research Instrumentation, of which the Under Secretary of Defense for Research and Engineering is a member, and with participation of Office of Management and Budget, and the President's Scientific Advisor, has concluded that the deterioration of research facilities at universities in this country has reached a crisis stage. The 1981 Defense Science Board Summer Study reached a similar conclusion. Some of the consequences of these conditions are: diminished research productivity and a slowing of development in the disciplines, reduced production of trained scientists, and decline in international competitive status. This subelement is part of the Navy's and Department of Defense's response to equipment crisis in universities. These special funds will be used to purchase needed equipment for university laboratories engaged in research of interest to the Navy and DoD.

B. Related Activities: Similar programs have been established by the Army and Air Force. These programs are coordinated at the Office of the Under Secretary of Defense for Research and Engineering. It is expected that other Federal agencies will be responding to the special equipment needs of the research universities. The total government activity is coordinated through the Interagency Working Group on University Research Instrumentation.

C. Work Performed By: This is a university program. All universities doing research of interest to the Department of Defense are eligible to compete for support of their equipment needs.

D. FY 1982 Accomplishments: Over 23,500 brochures announcing the new DoD tri service program have been distributed to colleges and universities giving them the opportunity to submit proposals for equipment purchases.

E. FY 1983 Program: Proposals submitted by universities will be rated and awards will be made based on DoD's need for the research, the potential for increased research productivity, and the potential to attract graduate students and thereby increase the pool of trained manpower. This equipment will be used to extend research capabilities in such areas as ship and weapons hydrodynamics, submicron electronic circuits and devices, materials synthesis performance and reliability, signal processing, laser applications in surface chemistry and metal working, oceanographic research, and artificial intelligence and robotics.

F. FY 1984 Planned Program: The DoD program is planned as a five year program. A new brochure will be issued each year.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62241N

Title: Aircraft Technology

DoD Mission Area: 523 - Engineering Technology

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.                      | Title                                              | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|----------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                                    | <b>25,109</b>  | <b>26,134</b>    | <b>27,236</b>    | <b>29,735</b>    | Continuing               | Continuing           |
| F41-411*                         | Aeronautical Concepts for Naval Applications       | 4,570          | 4,450            | 3,539            | 4,021            | Continuing               | Continuing           |
| F41-421*                         | Sea-Based Aerodynamics                             | 1,609          | 1,811            | 3,154            | 3,271            | Continuing               | Continuing           |
| F41-422*                         | Aircraft Structures                                | 3,039          | 3,595            | 3,499            | 3,920            | Continuing               | Continuing           |
| F41-423*                         | Flight Dynamics & Control for Maritime Aircraft    | 4,847          | 5,008            | 4,760            | 5,428            | Continuing               | Continuing           |
| F41-431*                         | Aircraft Electrical Machinery & Power Distribution | 1,085          | 995              | 907              | 977              | Continuing               | Continuing           |
| F41-432*                         | Aircraft Propulsion Technology                     | 3,893          | 4,146            | 4,071            | 4,530            | Continuing               | Continuing           |
| F41-433*                         | Aircraft Auxiliary Equipment                       | 1,248          | 1,238            | 1,324            | 1,489            | Continuing               | Continuing           |
| F41-435                          | Cartridges & Cartridge Activated Devices (CADS)    |                |                  | 434              | 468              | Continuing               | Continuing           |
| F41-451*                         | Flight Crew Habitability/Personnel Protection      | 1,401          | 1,459            | 1,212            | 1,298            | Continuing               | Continuing           |
| F41-454*                         | Shipboard Aircraft Electromagnetic Compatibility   | 704            | 443              | 394              | 426              | Continuing               | Continuing           |
| F41-461*                         | Naval Aviation Maintenance Engineering             | 1,845          | 1,999            | 1,754            | 1,892            | Continuing               | Continuing           |
| F41-462                          | Sea Based Aircraft Support Systems                 | 868            | 990              | 2,188            | 2,010            | Continuing               | Continuing           |

\*The changes in the FY 1984 Descriptive Summary Project titles from those in the FY 1983 Descriptive Summary were made to provide a more accurate description of the efforts being pursued in the project.

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NRED

- Develops technology to support unique Naval Aviation requirements for operations at sea where the need for improved readiness places a premium on capable and maintainable aircraft operating from highly mobile platforms with constrained space and logistic support
- Exploits innovative technology which fulfills distinct Navy needs for carrier and air capable ship operations; such as composite structures for reduced aircraft launch weight and elimination of salt water corrosion; low observable aerodynamic designs which must accommodate wing fold and other unique sea-based aircraft configuration requirements; improved flight control and display systems for all weather shipboard operations and weapon delivery, and, advanced aircraft engines with improved characteristics for longer life to reduce at sea replacement and spares inventory
- Provides the only source of funds for technology development of launch/recovery control systems, visual landing aids, and aircraft/ship platform interface; as well as for the development of Marine Corps Aviation technology
- Develops technology to support the Navy's mission to perform antisubmarine warfare with long endurance, land based patrol aircraft

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:
  - An increase of 812 in FY 1982 results from increased advanced fighter/attack aircraft (VFMX) effort and other minor changes distributed throughout the program element
  - Decreases of 1,280 in FY 1983 and 4,629 in FY 1984 are due to adjustments during budget development

Program Element: 62241N

Title: Aircraft Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                       | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>            | <b>28,637</b>  | <b>24,297</b>    | <b>27,414</b>    | <b>31,865</b>    | Continuing               | Continuing           |
| F41-411     | Concept Assessment of Platforms and Systems | 7,100          | 3,924            | 3,715            | 4,184            | Continuing               | Continuing           |
| F41-421     | Fluid Dynamics                              | 1,772          | 1,879            | 2,016            | 1,937            | Continuing               | Continuing           |
| F41-422     | Vehicle Structures                          | 4,626          | 3,690            | 3,905            | 4,969            | Continuing               | Continuing           |
| F41-423     | Vehicle Control                             | 3,733          | 3,944            | 5,378            | 6,884            | Continuing               | Continuing           |
| F41-431     | Electrical Machinery and Power Distribution | 936            | 1,085            | 1,095            | 1,186            | Continuing               | Continuing           |
| F41-432     | Air-Breathing Propulsion System Technology  | 4,558          | 3,899            | 4,516            | 5,741            | Continuing               | Continuing           |
| F41-433     | Auxiliary Machinery/Equipment               | 1,392          | 1,248            | 1,393            | 1,314            | Continuing               | Continuing           |
| F41-451     | Habitability and Personnel Protection       | 1,512          | 1,401            | 1,614            | 1,678            | Continuing               | Continuing           |
| F41-454     | Electromagnetic Compatibility               | -              | 420              | 498              | 514              | Continuing               | Continuing           |
| F41-461     | Maintenance Engineering                     | 1,932          | 1,845            | 2,189            | 2,272            | Continuing               | Continuing           |
| F41-462     | Sea Based Aircraft Support Systems          | 1,096          | 962              | 1,095            | 1,186            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Related to and coordinated with the advanced aircraft developments of the Army, Air Force, the National Aeronautics and Space Administration
  - Navy/Army joint participation on upgrading 15 year old flying quality specification for helicopters (MIL-8501A)
  - Navy/NASA joint development and evaluation of liquid crystal multi-function control panel
  - Air Force/NASA/Navy will evaluate Navy developed light emitting diode multi-function control panel
  - Navy/Air Force joint participation on upgrading flying quality specification for conventional aircraft (MIL-8785C)
  - Navy/Army/Air Force/NASA joint development of an advanced composites design guide for aircraft and the follow-on repair guide
  - Joint USN/USAF projects for flight crew personnel protection and habitability funded from both P.E. 62241N, Aircraft Technology and P.E. 62201F, Aerospace Flight Dynamics are controlled for duplication and commonality by regular meetings of the Tri-Service Life Support Equipment Steering Committee and the Joint Environmental Working Group (Flight)

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Air Development Center, Warminster, PA; Naval Air Engineering Center, Lakehurst, NJ; Naval Air Propulsion Center, Trenton, NJ; Naval Weapons Center, China Lake, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD
- INDUSTRIAL - CALSPAN, Buffalo, NY; Detroit Diesel Allison Division, Indianapolis, IN; General Electric, Binghamton, NY; General Electric, Lynn, MA; Grumman Aerospace Corporation, Bethpage, NY; Hughes, Culver City, CA; Lockheed California Company, Burbank, CA; McDonnell-Douglas Corporation, St. Louis, MO; Pratt-Whitney Engines, East Hartford, CT; Rockwell International, Columbus, OH; Vought Corporation, Dallas, TX; General Dynamics, Fort Worth, TX; Northrop, Hawthorne, CA; Garrett, Phoenix, AZ
- ACADEMIC - Lehigh University, Bethlehem, PA; Purdue University, Lafayette, IN; University of Dayton Research Institute, Dayton, OH; Stanford Research Institute, Stanford, CA

(65)

Program Element: 62241N

Title: Aircraft Technology

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F41-411, Aeronautical Concepts for Naval Applications:

- The project integrates selected technologies into promising aircraft systems concepts and technology demonstrators, translates mission/warfare needs into systems requirements, and develops the necessary technological data base for full-spectrum air systems options to meet respective mission needs in support of Navy acquisition programs establishment
- This project provides a continuing effort to effect the transition of aircraft, weapons, and avionics technologies into advanced development, acquisition, and/or product improvement
- Provides the only source of funds for the development of Marine Corps Aviation technology for V/STOL passive countermeasures, night close air support environment, airborne defense protection devices, and USMC systems/concepts definition

a. (U) FY 1982 Program:

- (1) Developed an asymmetric flow model of the exhaust plume to reduce thermal signature for Marine Corps V/STOL aircraft
- (2) Demonstrated, through wind tunnel testing, the aerodynamic potential of a significant increase in lift over drag for a joined wing in subsonic flight
- (3) Completed preliminary vehicle feasibility investigations associated with Lighter-than-Air, Over-the-Horizon targeting, advanced helicopter systems, and future fighter/attack aircraft (VPMX) requirements

b. (U) FY 1983 Program:

- (1) Test potential exhaust plume reduction techniques which minimize the associated adverse effect on available power
- (2) Initiate and complete joined wing transonic wind tunnel experiments with subsequent data analysis
- (3) Extend preliminary feasibility investigations of an advanced fighter/attack aircraft (VPMX) total system to industry (four contractors)

c. (U) FY 1984 Planned Program:

- (1) Perform Navy assessment of industry advanced fighter/attack aircraft feasibility results and transition this conceptual effort to advanced development under P.E. 63251N, Aircraft Systems (Advanced)
- (2) Evaluate promising remotely piloted vehicle concepts to meet fleet Anti-Air Warfare (long-range surveillance) and Anti-Surface Warfare (Over the Horizon targeting for HARPOON/TOMAHAWK) needs
- (3) Assess impact of Anti-Ship Missile Defense, Anti-Surface Warfare, and Battle Group Direct Support requirements on Air ASW systems (P-3, S-3, LAMPS MKIII, and new design)

d. (U) Program to Completion: This is a continuing program

2. (U) Project F41-421, Sea-Based Aerodynamics:

- This project provides the technical basis and options for Navy aircraft designs which span the flight spectrum from rotary wing through high performance fixed wing aircraft
- This research expands the aerodynamic technology base and prediction capabilities for both conventional and unique aircraft concepts
- Major program thrusts include aerodynamic analysis of high-lift and powered-lift concepts, development of analytical tools for computational and unsteady aerodynamics solutions and large/small scale wind tunnel verification programs of unique Navy concepts

Program Element: 62241N

Title: Aircraft Technology

- a. (U) FY 1982 Program:
    - (1) Completed aircraft wind tunnel evaluation of a yaw control thrust vector vane for improved maneuverability at angles of attack far above stall with results supporting full scale vane tests on an F-14 aircraft
    - (2) A static, full-scale demonstration of thrust vectoring capabilities of the upper surface blowing system was conducted and achieved engine thrust vectoring in excess of 100 degrees
    - (3) Commenced transonic wind tunnel tests of two circulation control rotor airfoil models
  - b. (U) FY 1983 Program:
    - (1) Conduct aircraft static test of a yaw control thrust vector vane and prepare for vane flight test using an F-14 aircraft
    - (2) Initiate investigation of high lift systems requirements and payoffs for conventional take-off and landing aircraft
    - (3) Complete analysis and documentation of the Circulation Control Rotor airfoil test program
  - c. (U) FY 1984 Planned Program:
    - (1) Initiate a major thrust to investigate the aerodynamics of carrier based low observable aircraft configurations
    - (2) Complete analysis of high lift system effects on aircraft performance
    - (3) Execute the yaw vane flight test program on an F-14 aircraft
  - d. (U) Program to Completion: This is a continuing program
3. (U) F41-422, Aircraft Structures:
- This project provides for the identification and evaluation of advanced structural design concepts, advanced material applications, service life management methods and airloads prediction techniques for future naval aircraft
  - Primary emphasis is the exploratory development of advanced composite structures for aircraft with improved performance, survivability and damage tolerance in the sea-based environment
  - Additionally, the project focuses on improved aircraft structural integrity, long life, low maintenance airframes for new aircraft, and service life extension options for current aircraft
- a. (U) FY 1982 Program
    - (1) Developed high load bolted joint designs as an alternative to the more complex and difficult to manufacture bonded step-lap joints currently being used
    - (2) Successfully demonstrated advanced composite repair procedures by fleet personnel
    - (3) Improved fatigue life cracking methods for fixed wing aircraft and helicopters were developed and introduced into service on the F/A-18 and SH-60B
  - b. (U) FY 1983 Program
    - (1) Complete the composite structure repair program for depot and organizational (field) maintenance level repair
    - (2) Transition stress vane riveting system to manufacturing technology
    - (3) Initiation of an airload analysis and measurement program for improved airload prediction
  - c. (U) FY 1984 Planned Program
    - (1) Complete component testing of a high strain composite wing and transition to advanced development



Program Element: 62241N

Title: Aircraft Technology

- (2) Initiate a thrust in aircraft advanced metal structures development to exploit new materials and processes
- (3) Continue efforts in composite defect/delamination detection criteria and repair
- d. (U) Program to Completion: This is a continuing program
- 4. (U) F41-423, Flight Dynamics & Control for Maritime Aircraft:
  - \* This project covers the technology base and equipment necessary to provide enhanced flight dynamics and control of all Navy aircraft throughout their intended flight envelopes
  - \* A multi-discipline project, it includes identification/improvement of deficiencies in stability, control and flying qualities criteria, development of techniques and equipment to reduce the complexity of flight control systems and associated sensors and actuators, and enhancement of multi-function displays and associated display technology for improved interaction between pilot and vehicle
  - a. (U) FY 1982 Program:
    - (1) Completed laboratory demonstration of flat panel advisory display and multi-function programmable keyboard using light emitting diode and liquid crystal technology integrated with voice interaction technology
    - (2) Developed control electronics for an electrically powered flight control actuator (SLIMLINE)
    - (3) Vertical/Short Take-off and Landing Stability and Control Manual updated with tilt-rotor configurations which allows for application to potential JVK aircraft configuration
    - (4) Commenced preliminary flight test system design for initiation of the maneuvering flight path guidance program in FY 1983
  - b. (U) FY 1983 Program:
    - (1) Laboratory evaluation of a standardized wide-band video bus which is essential for a totally integrated cockpit
    - (2) Complete development of the SLIMLINE electrically powered flight control actuator
    - (3) Develop Fly-by-light transducer elements and conduct flight test in an AH-1 helicopter
    - (4) Initial flight demonstration of the maneuvering flight path guidance system
  - c. (U) FY 1984 Planned Program:
    - (1) Continue development of the maneuvering flight path guidance program using FY 1983 flight demonstration results
    - (2) Continue joint efforts with the Army in updating the flying qualities specifications for helicopters
    - (3) Transition Electromagnetic Pulse tolerant flight control sensors/actuators to advanced development
  - d. (U) Program to Completion: This is a continuing program
- 5. (U) Project F41-431, Aircraft Electrical Machinery and Power Distribution:
  - \* This project provides a continuing effort to develop electrical power generation, control and distribution technology utilizing state-of-the-art advances in higher power solid state switching, power controllers, multi-plexing and high voltage dc power
  - \* In addition, this project seeks to develop improved techniques for interconnection of electrical, flight control, hydraulic and display systems to further reduce the complexity of installed systems and enhance the transition of new technology products

Program Element: 62241N

Title: Aircraft Technology

- a. (U) FY 1982 Program:
  - (1) Demonstrated a 270VDC, 45 kilowatt samarium cobalt generator with an efficiency of 90%
  - (2) Performed an electrical power distribution analysis for a composite airframe -- initial result indicates a two wire power distribution network will be required
- b. (U) FY 1983 Program:
  - (1) Fabrication of a 2AMP DC power controller for a 270VDC system which provides transient free electrical power switching for avionics
  - (2) Continue to design, evaluate, and integrate advance electrical power components required for a 270VDC aircraft power system with emphasis on generator and flat bus development
- c. (U) FY 1984 Planned Program:
  - (1) Complete flat bus electric power distribution components development and continue exploration of high energy magnetic materials applications in advanced generator designs
- d. (U) Program to Completion: This is a continuing program
- 6. (U) Project F41-432, Aircraft Propulsion Technology:
  - This project provides for the development of advanced turbine engine component technology and provides the design information necessary to incorporate significant improvements in performance, reliability, durability, and cost into future high performance propulsion systems
  - Development efforts under this project provide the technology base required to advance the state-of-the-art of the aircraft engine components that are mandatory to produce improved propulsion system installed thrust, fuel economy, operational capability, and cost effectiveness for future Navy aircraft
- a. (U) FY 1982 Program:
  - (1) Completed the design of a high pressure, highly durable compressor with all five stages configured as blisks (integral blade/disks)
  - (2) Completed testing of an advanced combustor using alternative and broad specification fuels and determined their effects on engine performance and life
  - (3) Initiated the development of a lightweight, high pressure rise fan with low observable characteristics
  - (4) Completed environmental testing of internal and external turbine blade coatings which were applied to directionally solidified turbine blades
- b. (U) FY 1983 Program:
  - (1) Complete design of an advanced, lightweight, alternate fuel capable combustor
  - (2) Assemble and test the high pressure, highly durable, five blisk stage compressor
  - (3) Continue design efforts on an advanced high pressure turbine for improved durability and a 25% reduction in turbine life cycle cost
  - (4) Complete preliminary design of the high pressure rise, lightweight fan with low observable characteristics

Program Element: 62241N

Title: Aircraft Technology

- c. (U) FY 1984 Planned Program:
  - (1) Complete tests on the high pressure, highly durable compressor and transition to advanced development
  - (2) Continue development of high speed counter-rotating bearings which are essential for advanced technology engines
  - (3) Complete fabrication of the advanced high pressure turbine designed for improved durability and reduced turbine life cycle cost
  - (4) Commence full-scale high pressure rig testing of the advanced, lightweight, alternate fuel capable combustor
- d. (U) Program to Completion: This is a continuing program
- 7. (U) Project F41-433, Aircraft Auxiliary Equipment:
  - \* This project provides for the development of the technology base and the feasibility exploration of applying the latest state-of-the-art for aircraft components in the fields of hydraulics, mechanics, and fluidics which are essential to the retention and improvement of naval aircraft operational performance, availability and readiness
  - a. (U) FY 1982 Program:
    - (1) Developed improved helicopter rotor bearings with demonstrated increased life of 300% to 600% — an application of these bearings to the CH-53 improved readiness by 13% with an attendant cost savings of \$350 thousand per year
    - (2) Completed coiled tubing design parameters for both 3,000 and 8,000 psi diameter tubing
  - b. (U) FY 1983 Program:
    - (1) Decision point on hydraulic versus pneumatic fluidic back-up flight control system
  - c. (U) FY 1984 Planned Program:
    - (1) Complete final design of coiled tubing
    - (2) Evaluate fluidic back-up flight control system
  - d. (U) Program to Completion: This is a continuing program
- 8. (U) Project F41-435, Cartridges and Cartridge Activated Devices (CADS) (New Start):
  - \* This project, a new start in FY 1984, provides for the development of aircrew escape systems components for improved safety of crew member ejection and reduced maintenance and improved performance in high performance naval aircraft armament systems, such as cartridges for store separation systems produced from low cost material
  - \* The cartridge activated device technology program is based on deficiencies and requirement for higher performance of subsystems for developmental and future aircraft
  - \* The responsibility for cartridge activated device technology was accepted by the Navy in July 1974 through a Tri-Service joint agreement
  - a. (U) FY 1982 Program: Not applicable
  - b. (U) FY 1983 Program: Not applicable

Program Element: 62241N

Title: Aircraft Technology

- c. (U) FY 1984 Planned Program:
  - (1) Complete design feasibility demonstration of a new primer system
  - (2) Verify self contained cartridge performance in a base line ejector system
- d. (U) Program to Completion: This is a continuing program
- 9. (U) Project F41-451, Flight Crew Habitability/Personnel Protection:
  - \* This project provides for the development of technologies in environmental control of vehicle spaces, escape from damaged and disabled aircraft, crashworthiness and restraint systems and aircrew parachute systems
  - a. (U) FY 1982 Program:
    - (1) Successfully concluded exploratory development on the microwave radiometry (MICRAD) vertical sensor and transitioned the effort to P.E. 63216N, Airborne Life Support System
    - (2) Commenced an investigation and design effort to improve high speed, low altitude ejections through the employment of deployable yaw stabilization control surfaces on ejection seats
  - b. (U) FY 1983 Program:
    - (1) Complete preliminary design of candidate deployable yaw stabilization control surfaces and conduct wind tunnel testing
    - (2) Initiate a major thrust to develop techniques and design criteria for the successful pre-ejection fracturing of aircraft stretched acrylic canopies
  - c. (U) FY 1984 Planned Program:
    - (1) Complete investigation of aircraft stretched acrylic canopy ballistic fracturing characteristics and commence design of optimum breaking pattern for improved inflight ejection safety
    - (2) Design, fabricate, and test a full scale ejection system equipped with deployable yaw stabilization vanes
  - d. (U) Program to Completion: This is a continuing program
- 10. (U) Project F41-454, Shipboard Aircraft Electromagnetic Compatibility:
  - \* This project develops improved assessment techniques and design methodology to ensure electromagnetic protection for existing and advanced composite aircraft against lightning and electromagnetic pulse (EMP) threats
  - \* Electromagnetic coatings, composite/metallic joint interactions, and material/structure properties are investigated under various electromagnetic threat levels
  - a. (U) FY 1982 Program:
    - (1) Developed preliminary electromagnetic compatibility design methodology and conducted full scale lightning tests on F-14A and F/A-18A aircraft

Program Element: 62241W

Title: Aircraft Technology

- b. (U) FY 1983 Program:
    - (1) Continue development of electromagnetic compatibility design methodology including a predictive model for SH-60B helicopter
  - c. (U) FY 1984 Planned Program:
    - (1) Complete electromagnetic compatibility design methodology and evaluate electromagnetic hardening of Navy helicopters
  - d. (U) Program to Completion: This is a continuing program
11. (U) Project F41-461, Naval Aviation Maintenance Engineering:
- This project provides the technology base for all aspects of Naval aircraft maintenance aboard ships as well as ashore
  - It encompasses avionics maintenance and automatic test equipment, and propulsion systems diagnostic and test equipment, as well as airframe maintenance and support equipment research effort
  - An essential part of this effort is directed toward identifying and evaluating support requirements as they relate to future weapon systems and technology advancements
  - Included in the project are improvements to the reliability and maintainability of the support equipment itself, reduced operator skill level, and determination of approaches that promise high potential payoff
- a. (U) FY 1982 Program:
    - (1) Continued testing of a dynamic turbine engine simulator for intermediate maintenance level test stand verification and fault detection
    - (2) Completed conceptual design of a Neutron Radiography Accelerator head for non-destructive inspection and transferred this technology to the Tri-Service Manufacturing Technology Program
    - (3) Accomplished laboratory demonstration of the Near-field antenna tester concept for aircraft installed antennas
  - b. (U) FY 1983 Program:
    - (1) Commence a broad investigation of relevant technologies, including artificial intelligence, which will enhance aviation maintenance support capability to maintain and repair advanced avionic systems
    - (2) Transition the dynamic turbine engine simulator to engineering development
  - c. (U) FY 1984 Planned Program:
    - (1) Transition the near field antenna tester for aircraft antennas to engineering development
    - (2) Complete investigation of candidate techniques for fiber optic avionics and cable testers
  - d. (U) Program to Completion: This is a continuing program
12. (U) Project F41-462, Sea Based Aircraft Support Systems:
- This project explores the interface between the air vehicle and the sea-based platform, including visual landing aid techniques, wind measurement systems, launch and recovery control systems, ship induced turbulence, and other interface requirements

Program Element: 62241N

Title: Aircraft Technology

a. (U) FY 1982 Program:

- (1) Transitioned an improved wind measurement system to advanced development
- (2) Established the feasibility of a completely automatic digital catapult launch control system

b. (U) FY 1983 Program:

- (1) Continue conceptual design for closed loop control of a digital catapult launch control system

c. (U) FY 1984 Planned Program:

- (1) Commence a major development effort to digitize existing aircraft carrier launch and recovery control system for improved survivability, reliability, durability, and reduce manning requirements

d. (U) Program to Completion: This is a continuing program

I. (U) PROJECTS OVER \$10 MILLION DOLLARS IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62331N  
DoD Mission Area: 523 - Engineering Technology

Title: Missile Propulsion Technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.                      | Title                                                      | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                                            | <b>9,084</b>   | <b>9,191</b>     | <b>12,014</b>    | <b>12,860</b>    | Continuing               | Continuing           |
| F31-330                          | Air-Launched Guided Missile Propulsion                     | 4,959          | 5,135            | 6,680            | 6,909            | Continuing               | Continuing           |
| F31-332                          | Surface/Submarine-Launched Solid Missile Propulsion        | 2,085          | 1,965            | 1,757            | 1,916            | Continuing               | Continuing           |
| F31-334                          | Surface/Submarine-Launched Airbreathing Missile Propulsion | 2,040          | 2,091            | 3,577            | 4,035            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Develop advanced technology for solid and liquid-fueled, air-breathing and rocket propulsion systems for air, surface, and subsurface-launched guided and unguided missiles, and gun systems.
- Develop new propulsion systems for hypersonic Wide Area Defense Missiles
- Continue development of new propulsion system technology to increase performance, decrease volume/weight, increase safety, decrease response time, reduce plume effects, increase survivability, increase reliability and reduce costs
- Develop improved propulsion systems for missiles with improved targeting flexibility to counter or survive increasingly hostile environments featuring high concentrations of a wide variety of sophisticated weapons and countermeasures
- Increase missile propulsion performance to successfully intercept higher performance airborne weapons platforms and to penetrate defenses to kill surface targets at greater ranges
- The Navy has been directed by the Under Secretary of Defense for Research and Engineering to implement an enhanced program in ramjet technology

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:
  - Decreases of -163 in FY 1982 and -425 in FY 1983 are the result of funding cuts, and the refinement of cost estimates including escalation
  - The requirement for new propulsion systems for Far Term Wide Area Defense of the fleet has resulted in an enhanced effort in FY 1984 for a hypersonic Dual Combustion ramjet ground demonstration, and Project F31-334 has been increased by 1,283 in FY 1984 accordingly
  - An enhanced coordinated program with the Air Force will demonstrate the utility of solid fueled ramjets for air launched air-to-surface missiles (Project F31-330, +1,190 in FY 1984)
  - F31-332 will decrease by 323 in FY 1984 to accommodate the change in program structure

Program Element: 62331N

Title: Missile Propulsion Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                                      | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                  | 9,349          | 9,247            | 9,616            | 9,864            | Continuing               | Continuing           |
| F31-330     | Air-Launched Guided Missile Propulsion                     | 5,183          | 5,045            | 5,410            | 5,490            | Continuing               | Continuing           |
| F31-332     | Surface/Submarine-Launched Solid Missile Propulsion        | 1,906          | 2,040            | 2,040            | 2,080            | Continuing               | Continuing           |
| F31-334     | Surface/Submarine-Launched Airbreathing Missile Propulsion | 2,260          | 2,162            | 2,166            | 2,294            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- In P.E. 61153N, Principles of Chemical Propulsion and Armaments, evaluate new high energy/low sensitivity compounds being synthesized by the Office of Naval Research as potential ingredients for an insensitive minimum-smoke rocket-propellant
- Related work in Strike Warfare Weaponry Technology (P.E. 62332N) in wide area defense, self-defense, and stand-off jammer application as well as in the utilization of low vulnerability propellants for the 5"/54 ammunition improvement program (propellant development is done in this program element)
- Related work in Aircraft Technology (P.E. 62241N) in materials and structures data for engine components and airframe designs
- In P.E. 62302F, Rocket Propulsion, the Navy and the Air Force are jointly funding development of a methodology designed to provide a realistic assessment of the explosive hazards associated with the use of more energetic propellants in air-launched tactical missiles
- A cooperative program with the Air Force will demonstrate hydro-carbon fueled, Solid Fueled Ramjets for air launched applications
- Propulsion technology for the Advanced Common Intercept Missile Demonstration is coordinated with P.E. 63308N, Air-to-Air Missile Technology Demonstration and P.E. 62332N, Strike Warfare Weaponry Technology
- A joint program with DARPA is being developed for a solid fuel integral rocket ramjet flight demonstration technology program
- A joint program with DARPA is being developed for a supersonic combustion ramjet technology program
- National coordination of missile propulsion programs is accomplished via the Joint Army, Navy, NASA, and Air Force Interagency Propulsion Committee consisting of technical program managers from Naval Air Systems Command, Naval Sea Systems Command, Army, Air Force, and NASA with the Under Secretary of Defense for Research and Engineering as an ex-officio member; the efforts of these agencies are coordinated through technical symposia, exchange of program plans, research and technology reviews, and contracting information exchange
- International coordination of programs with Canada, the United Kingdom, Australia, and New Zealand is accomplished through The Technical Cooperation Program (TICP) panel W-4 for Propulsion Technology
- International coordination is also accomplished through Data Exchange Agreements on Rocket and Ramjet technologies with France and Germany

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Ordnance Station, Indian Head, MD; Naval Surface Weapons Center, Dahlgren, VA and White Oak Laboratory, White Oak, MD; and Naval Weapons Center, China Lake, CA
- INDUSTRIAL - Applied Physics Laboratory, Johns Hopkins University, Silver Spring, MD; Atlantic Research Corporation, Gainesville, VA; Chemical Systems Division of United Technologies, Sunnyvale, CA; Convair Dynamics, San Diego, CA; Ford Aerospace, Newport Beach, CA; Marquardt/ASL, Cumberland, MD; Marquardt Company, Van Nuys, CA; Martin Marietta, Orlando, FL; McDonnell-Douglas Corporation, St. Louis, MO; Rocketdyne Corporation, Canoga Park, CA; Allied Chemical Corporation, Morristown, NJ; Carrett Air Research, Los Angeles, CA; and Ridgecrest Engineering, Ridgecrest, CA
- ACADEMIC - Naval Postgraduate School, Monterey, CA



Program Element: 62331N

Title: Missile Propulsion Technology

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F31-330, Air-Launched Guided Missile Propulsion:

- Defines future propulsion requirements and develops the predictive tools needed in the analysis, design, and assessment of propulsion concepts for Air-Launched Missiles
- Develops the necessary solid rocket propulsion technology to solve present day and future deficiencies in current Navy Air-to-Air and Air-to-Surface missiles; emphasis on safety, cost, reliability/maintainability and reduced plume observables
- Develops, in conjunction with the Air Force, integral rocket/ramjet technology for use in air-launched missiles
- Develops the necessary ramjet inlet, combustor, fuel management, and integral booster technology required for small diameter, lightweight Air-to-Air interceptor missiles for fleet air defense

a. (U) FY 1982 Program:

- (1) Initiated testing of the combustor for the Advanced Common Intercept Missile Demonstration; this is a small diameter, liquid fueled ramjet for potential use in a long range Air-to-Air missile
- (2) Initiated experimentation directed at adapting stealth technology for use on tactical ramjet-powered air-to-surface missiles
- (3) Successfully completed initial testing of a solid-fueled ramjet engine design under a joint Navy-Air Force program
- (4) Completed technology assessment of pulsed, solid rocket motors for medium range, air-to-air missiles; determined little pay-off for this mission
- (5) Initiated fuel fire testing (cook-off) of a new fire-safe metal strip-laminated rocket-motor case design based on United States and United Kingdom technologies
- (6) Initiated technology transfer of low vulnerability extrudable gun propellants to unguided solid rocket motors to reduce cost and improve quality control

b. (U) FY 1983 Program:

- (1) Complete development and initial testing of the high performance, stably burning combustor and the stable high angle-of-attack inlet for the Advanced Common Intercept Missile
- (2) Extend studies of ramjet stealth technology into full-scale analytical modeling of a proposed Air-to-Surface vehicle design
- (3) Initiate, in cooperation with the Air Force, a comprehensive test program on the solid fueled ramjet based on the prior, joint exploratory program
- (4) Initiate structural testing of the new, fuel-fire safe, rocket motor case design for a variety of air launched missile applications
- (5) Complete hazard testing of the low vulnerability rocket propellant formulations

c. (U) FY 1984 Planned Program:

- (1) Perform semi-free jet ground testing of the inlet, turbo-pump and combustor technologies in flight-weight hardware for the Advanced Common Intercept Missile demonstration; program to be completed in FY 1985
- (2) Complete the general assessment of ramjet stealth technology for cost-effective, tactical air-to-surface missiles preparatory to incorporation into specific missile concepts
- (3) Continue ground testing of the joint Navy/Air Force solid-fueled ramjet demonstration program at an enhanced level. This accounts for the increase in funding from FY 1983 to FY 1984.
- (4) Demonstrate fuel-fire safe, strip laminate rocket motor case and address problem of bonding attachments
- (5) Complete technology development on the low vulnerability rocket propellant formulations

d. (U) Program to Completion: This is a continuing program.

Program Element: 62331N

Title: Missile Propulsion Technology

2. (U) Project F31-332, Surface/Submarine-Launched Solid Missile Propulsion:

- Develops new high-energy propellants and evaluates their mechanical properties with a long term goal of increasing performance and safety for missile and gun systems
- Develops and evaluates a restartable solid rocket motor for advanced area defense
- Develops and evaluates the propulsion control for the vertical-launch booster concept
- Identifies propulsion ingredients that are or may be in a short or unavailable supply condition

a. (U) FY 1982 Program:

- (1) Candidate compounds for propellant ingredients for Low-Hazard, High Performance propellants were evaluated; Bisazidomethylloxetane/Tetrahydrofuran (BAMO/THF) and Gilligan's high energy polymer were selected for further study
- (2) Completed initial evaluation of a dual movable-nozzle design for a thrust vector control for the vertical launch system
- (3) Completed initial studies of a restartable rocket motor for a low to medium altitude surface-to-air missile; results showed minimal gain from a multi-pulsed system
- (4) Completed measurement of plume signature interference from surface-launched motors on ship's search and detection and fire control system
- (5) Design initiated for a booster for the Dual Combustion Hypersonic Ramjet
- (6) Completed evaluation of the effect of scarce propellant ingredient availability

b. (U) FY 1983 Program:

- (1) Complete the evaluation of new candidate compounds and loaded polymer/binders for a low-hazard, high-performance propellant
- (2) Design and fabricate a dual thrust motor and demonstrate advanced thrust cut-off for propulsion control for a vertical launch booster system
- (3) Restartable solid rocket pulse motor technology will be investigated for potential application to the advanced area defense missile system as a means of providing the trajectory, impulse versatility, terminal velocity and maneuverability for intercepting high-altitude, high speed, long range air-to-surface missile systems
- (4) Motors containing Class 1.1 (higher energy, higher sensitivity) propellants will be subjected to hazard tests and compared to similarly tested Class 1.3 (lower energy, lower sensitivity) propellants for possible incorporation in advanced motors
- (5) Complete baseline design of a booster for the Dual Combustion Ramjet
- (6) Complete the small-scale ballistic, ignition and erosion tests, and select a Navy low vulnerability gun propellant

c. (U) FY 1984 Planned Program:

- (1) Conduct investigations of techniques to modify rates and optimize the chemical structure of bonding agents in nitramine propellants
- (2) Initiate thrust vector control development and select a propellant grain design for the Dual Combustion Ramjet booster motor
- (3) Conduct initial full-scale test-weight static-tests of the restartable rocket motor
- (4) Develop a hazard risk assessment model for Class 1.1 propellant motors
- (5) Complete development of a low vulnerability gun propellant and initiate a pilot scale-up manufacturing process

d. (U) Program to Completion: This is a continuing program.

Program Element: 62331N

Title: Missile Propulsion Technology

3. (U) Project F31-334, Surface/Submarine Launched Airbreathing Missile Propulsion:

- Develops the technology for and evaluates components for airbreathing missile propulsion systems including inlets, combustors, nozzles, fuel, and fuel control for high sustain speed, long range tactical missiles for the Advanced Area and Wide Area Defense missions
- Integrates propulsion system components and demonstrates propulsion performance in appropriate ground test facilities

a. (U) FY 1982 Program:

- (1) Demonstrated [ ] of a combustor configuration for the hypersonic Dual Combustion Ramjet at simulated [ ]
- (2) Completed the chin inlet design for the hypersonic Dual Combustion Ramjet
- (3) Initiated a program with Martin Marietta and McDonnell-Douglas to evaluate rocket versus ramjet propulsion concepts for application to a potential hypersonic wide area defense missile
- (4) Completed short combustor tests with an in-stream flame holder for the Multiple Launch Platform Anti-Ship Missile (MLP/ASM) and demonstrated [ ]

b. (U) FY 1983 Program:

- (1) Complete the low Mach number combustor tests of the Dual Combustion Ramjet and design, fabricate and set up a combustor for the high Mach number [ ] case
- (2) Initiate and complete the first test series of a scoop inlet design for the Dual Combustion Ramjet
- (3) Complete the Martin Marietta, McDonnell-Douglas Rocket versus Ramjet propulsion feasibility study
- (4) Complete work on a short combustor using swirlers for the Multiple Launch Platform Anti-Ship Missile (MLP/ASM) and investigate performance potential at [ ]
- (5) Complete initial evaluation of a solid-fueled ramjet versus an advanced Multiple Launch Platform Anti-Ship Missile concept

c. (U) FY 1984 Planned Program:

- (1) Pending the results of the rocket versus ramjet propulsion feasibility study, complete fabrication of the high Mach number direct-connect combustor for the hypersonic Dual Combustion Ramjet and initiate tests; design and initiate fabrication of combustor for a demonstration ground test engine of a hypersonic wide area defense missile
- (2) Complete the second test series on the hypersonic split flow inlets and design the inlet for the demonstration ground test engine
- (3) Issue flight hardware design contract on an electric motor driven fuel pump and controls for the ground test engine
- (4) Design and fabricate an air inlet for the [ ] Multiple Launch Platform, Anti-Ship Missile [ ]
- (5) Design, fabricate, and initiate tests of a direct-connect combustor for the Multiple Launch Platform Anti-Ship Missile
- (6) Evaluate a boron based solid fueled ramjet applied to the Multiple Launch Platform Anti-Ship Missile baseline configuration; select a solid fuel combustor configuration
- (7) The increase in funding from FY 1983 to FY 1984 is due to the requirement for new propulsion systems for Far Term Wide Area Defense of the fleet which results in enhanced effort for a hypersonic Dual Combustion ramjet ground demonstration.

d. (U) Program to Completion: This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

DoD Mission Area: 523 - Engineering Technology

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                         | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>              | <b>21,116</b>  | <b>26,375</b>    | <b>29,188</b>    | <b>34,225</b>    | Continuing               | Continuing           |
| F32-375     | Automatic Infrared Target Classification      | 127            | 100              | 0                | 0                | Continuing               | Continuing           |
| F32-391     | Ship-Launched Anti-Surface Warfare Technology | 1,992          | 2,433            | 2,944            | 3,276            | Continuing               | Continuing           |
| F32-392     | Surface-to-Air Warfare Technology*            | 5,807          | 6,515            | 9,806            | 10,379           | Continuing               | Continuing           |
| F32-393     | Marine Corps Weaponry Technology              | 3,217          | 4,006            | 3,264            | 6,223            | Continuing               | Continuing           |
| F32-394     | Air-to-Air Warfare Technology                 | 6,015          | 7,485            | 9,319            | 9,575            | Continuing               | Continuing           |
| F32-395     | Air-to-Surface Warfare Technology             | 3,158          | 4,191            | 3,058            | 3,907            | Continuing               | Continuing           |
| F32-396     | Theater Nuclear Warfare Technology            | 80             | 795              | 797              | 865              | Continuing               | Continuing           |
| F32-399     | (Classified Program)                          | 720            | 850              | 0                | 0                | Continuing               | Continuing           |

\* Surface-to-Air Warfare Technology project number changed from F32-399 to F32-392.

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Addresses technology for advanced tactical weaponry for the functional warfare tasks of Anti-Air, Anti-Ship, Strike and Amphibious warfare using the capabilities of surface combatants, amphibious forces, and carrier air forces
- Technologies are identified through the analytical evaluation of conceptual systems which address stated deficiencies and projected needs
- Specific technologies addressed are in the areas of targeting/fire control, launchers, missiles and guns, guidance, fuse/warhead and airframe

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:
  - The net increase of 716 in FY 1982 was due to the addition of a classified program (+720) and (-4) in budgetary adjustments
  - In FY 1983 the net reduction of 3,433 results from a Congressional reduction of 2,808 and budgetary adjustments of -625
  - The net decrease of 2,293 in FY 1984 is the result of escalation changes, refinement of cost estimates, and realignment to higher priority programs

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                         | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                     | 31,130         | 20,400           | 29,808           | 31,481           | Continuing               | Continuing           |
| F32-300     | Marine Corps Weaponry Technology              | *              | *                | *                | *                | Continuing               | Continuing           |
| F32-375     | Automatic Infrared Target Classification      | 0              | 130              | 100              | 0                | Continuing               | Continuing           |
| F32-389     | Pulse Power Technology                        | 2,870          | **               | **               | **               | Continuing               | Continuing           |
| F32-390     | Advanced Weapons Concepts                     | 0              | 0                | 0                | 400              | Continuing               | Continuing           |
| F32-391     | Ship-Launched Anti-Surface Warfare Technology | 2,318          | 2,081            | 3,466            | 3,189            | Continuing               | Continuing           |
| F32-392     | Medium/Long Range Surface-to-Air Technology   | ***            | ***              | ***              | ***              |                          |                      |
| F32-393     | Marine Corps Weaponry Technology              | 6,425          | 3,170            | 4,324            | 5,195            |                          |                      |
| F32-394     | Air-to-Air Warfare Technology                 | 6,195          | 6,040            | 8,663            | 9,053            | Continuing               | Continuing           |
| F32-395     | Air-to-Surface Warfare Technology             | 4,953          | 3,171            | 5,332            | 5,325            | Continuing               | Continuing           |
| F32-396     | Theater Nuclear Warfare                       | 0              | 80               | 1,000            | 1,200            | Continuing               | Continuing           |
| F32-399     | Surface-to-Air Warfare Technology ***         | 8,369          | 5,728            | 6,923            | 7,119            | Continuing               | Continuing           |

\* Marine Corps Weaponry project number changes from F32-300 to F32-393 in FY 1981

\*\* Transferred to Directed Energy Technology (P.E. 62768N) in FY 1982 and subsequent years

\*\*\* Medium/Long Range Surface-to-Air Technology. Project F32-392 (\$5,916), was combined into Surface-to-Air Warfare Technology, Project F32-399, in FY 1981 (\$7,453)

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Many elements of weaponry are common to the other services; therefore, close coordination with the Army, Air Force, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency, and Defense Nuclear Agency is maintained to avoid duplication or overlap and to exchange information
- Coordination of work in this program element is maintained in the following areas:
  - Weaponry exploratory development technology (U.S. Army, P.E. 62303A and U.S. Air Force, P.E. 62602F)
  - Missile radome materials technology (Defense Advanced Research Projects Agency)
  - Propulsion (Joint Army, Navy, NASA, and Air Force Committee on Propulsion; Low Vulnerability (LOVA) propellant work is coordinated with PE 62331N, Missile Propulsion Technology; and Air-to-Air Missile Concepts are coordinated with Program Elements 62331N, Missile Propulsion Technology and 63308N, Air-to-Air Missile Technology Demonstration)
  - Infantry Weapons Technology (Army Infantry Man-Portable Anti-Armor Assault Weapons Program and Joint Services Small Arms Program)
  - Fuzing (Joint Logistics Commander Fuze Management Organization)
  - Missiles and Rockets, Fire Control, and Warheads (Working Panels of the Joint Logistics Commanders' Technical Coordinating Group for Munitions Development)
  - Air/Surface Target Vulnerability and Weapon Effectiveness (Working Panels of the Joint Logistics Commanders' Technical Coordinating Group for Munitions Effectiveness)
  - Aerodynamics and Structures (Navy Aeroballistics Committee and National Aeronautics and Space Administration)
  - Tactical Nuclear Warfare Technology (Department of Energy, Army Ballistic Missile Defense Command, SANDIA, and Air Force)
  - Target infrared and radio frequency signatures (U.S. Army, U.S. Air Force, and NATO Countries)
- Efforts in this Program Element are closely coordinated with ongoing technology efforts under PE 62331N, Missile Propulsion Technology; PE 62712N, Surface and Aerospace Target Surveillance; PE 62633N, Undersea Warfare Weaponry Technology (explosives development, effects, and safety) and PE 62761N, Materials Technology (tactical portions)

(82)

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

- Efforts in this program are also coordinated with technology demonstration efforts under PE 63303M, Electromagnetic Radiation Source Elimination System Technology; PE 63306N, Advanced Air-Launched Air-to-Surface Missile Systems; and PE 63308N, Air-to-Air Missile Technology Demonstration
- Efforts are also coordinated through The Technical Coordination Program (TTCF)

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Air Development Center, Warminster, PA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA and White Oak Laboratory, Silver Spring, MD; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA
- CONTRACTORS - Aerojet Corporation, Azusa, CA; Bell Brothers Research Corporation, Boulder, CO; Honeywell, Inc., Minneapolis, MN; Hughes Aircraft Corporation, Culver City, CA; Martin-Marietta, Orlando, FL; McDonnell-Douglas Corporation, St. Louis, MO; Motorola, Scottsdale, AZ; North American Rockwell, Inc., Columbus, OH; Sylvania, Mt. View, CA; Texas Instruments Corporation, Dallas, TX; Johns Hopkins University, Applied Physics Laboratory, Silver Spring, MD

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F32-375, Automatic Infrared Target Classification:

- This project develops signal processing concepts and algorithms for efficient real-time autonomous classification of ship targets from infrared imagery
- This program terminates in FY 1983; however, the work will be subsumed and expanded in FY 1983-85 in the Office of Naval Research Non-Cooperative Target Recognition (NCTR) program for eventual transition to Naval Air Systems Command programs

a. (U) FY 1982 Program:

- (1) Algorithms developed using simulation local feature recognition concepts

b. (U) FY 1983 Program:

- (1) Feature extraction algorithms will be evaluated at Naval Research Laboratory using available data base of ship imagery

c. (U) FY 1984 Planned Program:

- (1) None.

d. (U) Program to Completion: This is a continuing program

2. (U) Project F32-391, Ship-Launched Anti-Surface Warfare Technology:

- This project comprises the shipborne systems-oriented technology for defeating surface ships, small craft, and land targets
- Major thrusts are long range anti-surface missiles and improved gun systems -- long-range anti-surface missile technology focuses on improved penetrability and increased lethality
- This project also develops the gun system technology to provide increased effectiveness at lower cost for medium caliber and Close-in Weapon System (CIWS) within five years

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

a. (U) FY 1982 Program:

(1) Anti-Surface Ship Missile Systems

- (a) A computer model was developed to determine the number of missiles needed to achieve various levels of effectiveness for a TOMAHAWK-type missile
- (b) Small scale testing of explosives [ ]

(2) Gun Systems

- (a) An evaluation of the feasibility of incorporating a multi-function fuse setter in existing fire control system was completed
- (b) Feasibility demonstration of high-performance propellant that allows reduced gun barrel wear and blast and eliminates muzzle flash (stick propellant) was completed
- (c) Safety/vulnerability testing of low-vulnerability projectile propellant was completed

b. (U) FY 1983 Program:

(1) Anti-Surface Ship Missile Systems

- (a) Determine theoretical sensitivity of advanced anti-ship missile performance to variations in subsystem (e.g., guidance, warhead, propulsion, etc.) performance
- (b) Develop a realistic ship target model for evaluating damage caused by advanced anti-ship warhead

(2) Gun Systems

- (a) Identify the key technology needed to improve accuracy and lethality of Close-In Weapon System and 5"/54 systems
- (b) Complete design [ ]
- (c) Initiate evaluation of ship vulnerability [ ]
- (d) Evaluate performance of experimental projectile fuse which has multi-function capability that can be automatically selected (Multi-Function Fuse)
- (e) Complete ignitor study for low vulnerability (LOVA) projectile propellant
- (f) Complete characterization of high performance propellant which reduces gun barrel wear and blast and eliminates muzzle flash (stick propellant)

c. (U) FY 1984 Planned Program:

(1) Anti-Surface Ship Missile Systems

- (a) Initiate and pursue airframe design approaches that will provide acceptable survivability of advanced anti-surface missiles
- (b) Initiate and pursue design for advanced warhead which is based on distributed energy [ ]

(2) Gun Systems

- (a) Complete evaluation [ ]
- (b) Establish a baseline design for a multi-function fuse in preparation for transitioning to Engineering Development
- (c) Define low vulnerability (LOVA) propellant charge applications and characterize most promising approaches

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

d. (U) Program to Completion: This is a continuing program

3. (U) Project F32-392, Surface-to-Air Warfare Technology

- This project comprises shipborne technology for defeating missiles and aircraft targets
- Major thrusts are Wide Area Missile, Area Defense Missile, and Self Defense Missile
- Wide Area Missile technology focuses on the technology necessary to develop a missile with increased speed and the ability to engage stand-off jammers at extended ranges (guidance: high temperature compatible RF and electro-optic components; fuse and warhead: effectiveness over a wide range of intercept velocities; aerodynamic and structural: dual combustion hypervelocity ramjets)
- Area Defense Missile technology focuses on the technology necessary to develop an effective affordable missile system, for other than major combatants, and to provide improvements to the STANDARD missile family (guidance: high altitude intercepts; fuse and warhead: higher intercept velocities and larger miss distances; aerodynamic and structural: increased maneuverability and reduced airframe time constants).
- Self Defense Missile technology focuses on the technology necessary to provide for a quick reaction high firepower electronic countermeasure resistant anti-missile system (guidance: RF and Electro-Optic fire control technology leading to affordable multi-target systems; airframe: increased maneuverability)

a. (U) FY 1982 Program:

(1) Wide Area Missile Systems

- (a) Due to anticipated very high intercept velocities, warheads with very high fragment velocities are required -- Design efforts have been initiated in this area
- (b) A mid-course guidance technique to enable the missile to resolve multiple targets has been proposed, analyzed, and found to have potential
- (c) Initiated effort to compare cost/performance/risk of rocket versus ramjet propulsion

(2) Area Defense Missile Systems

- (a) Alternative approaches for increasing airframe maneuverability and reducing reaction times were identified
- (b) ]

(3) Self Defense Missile Systems

- (a) ]
- (b) A radar fire control effort based on "mirror antenna" technology is being pursued due to its potential for a low cost design that can support multiple target engagements in a countermeasure environment -- Fabrication of critical components has been initiated

b. (U) FY 1983 Program:

(1) Wide Area Missile Systems

- (a) Complete rocket versus ramjet comparison
- (b) Perform a parametric analysis of very high velocity warhead design factors and define performance requirements
- (c) ]



Program Element: 62332N

Title: Strike Warfare Weaponry Technology

(2) Area Defense Missile Systems

- (a) Approaches for increasing airframe maneuverability and reducing reaction time will be further analyzed to select the most promising approaches and quantify the improvements
- (b) ]

(3) Self Defense Missile Systems

- (a) Investigate technical trade-offs and define performance characteristics for missile system which eliminates high cost missile guidance hardware by depending on fire control supplied data for guidance information (command-all-the-way guidance)
- (b) ]
- (c) ]

- c. (U) FY 1984 Planned Program: The increase in funding from FY 1983 to FY 1984 is for a new start in Surface Launched Missile Technology to accelerate critical technologies in surface weapons.

(1) Wide Area Missile Systems

- (a) Initiate efforts to define, design, and test critical airframe components that are stressed by the anticipated environment of the conceptual high performance missile
- (b) Define alternative design approaches for very high velocity warheads, define capabilities, and select candidates for experimental hardware fabrication and testing
- (c) ]

(2) Area Defense Missile Systems

- (a) The two most promising approaches for increasing maneuverability and reducing reaction time will be defined and detailed analyses performed to quantify improvements over a variety of flight conditions
- (b) If FY 1983 efforts define a need, design efforts will be initiated for an advanced guidance approach for area defense missiles

(3) Self Defense Missile Systems

- (a) Define technology requirements for command-all-the-way guidance and initiate design efforts in indicated areas
- (b) The mirror antenna radar investigation will be completed with a thorough evaluation of the dual band antenna and antenna control
- (c) A laboratory version of the Anti-Jamming Missile seeker will be fabricated and tested

- d. (U) Program to Completion: This is a continuing program

4. (U) Project F32-393, Marine Corps Weaponry Technology

- This project comprises Marine Corps applicable weaponry technology and includes associated efforts required to interface Marine Corps needs to equipment developed by other services
- Major thrusts are Gun System technology, Infantry Weapons for embassy guards and an air Defense Missile system
- Gun System technology focuses on technology to mount a high impulse gun system on light armored vehicles as well as to produce lightweight howitzer systems in the 1990 timeframe

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

- Infantry Weapons focuses on weapons for use in the urban environment and special purpose weapons technology with capability to disrupt, disorient, or incapacitate
- Air Defense Missile System technology focuses on the technology to provide an air defense system with the Marine Corps unique aspects of low/medium altitude capabilities applicable to the amphibious environment

a. (U) FY 1982 Program:

(1) Gun System

- (a) Major caliber lightweight howitzer technology demonstration model has completed evaluation
- (b) Conceptual design for application of this technology to a future 155 mm gun has been completed
- (c) Models to predict vehicle response to high impulse gun recoil have been constructed and validated

(2) Infantry Weapons

- (a) Two conceptual designs of a lightweight flame weapon have been completed
- (b) Feasibility of utilizing small (less than five pound) fuel-air explosive warheads has been established
- (c) Conceptual design of an incapacitating weapon has begun

(3) Air Defense Missile System

- (a) Through laboratory testing, a waveform was identified that allows successful guidance of the HAWK missile using interrupted continuous wave illumination

b. (U) FY 1983 Program:

(1) Gun System

- (a) Vehicle response to high impulse gunfiring will be extended to the tracked amphibious vehicles
- (b) Conceptual designs of modular vehicle turrets will be completed

(2) Infantry Weapons

- (a) A feasibility demonstration model of a flame weapon will be fabricated and evaluated
- (b) Conceptual design of an assault weapon for use in the urban environment as well as an incapacitating weapon will be completed

(3) Air Defense Missile System

- (a) A flyover demonstration of the HAWK missile in conjunction with a multi-function fire control radar will be conducted

c. (U) FY 1984 Planned Program:

(1) Gun System

- (a) A feasibility demonstration model of the modular vehicle turrets will be fabricated and evaluated
- (b) Integration of hypervelocity rocket systems will be considered

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

(2) Infantry Weapons

- (a) Feasibility demonstration models of an urban assault weapon as well as an incapacitating weapon will be fabricated and demonstrated
- (b) Filter clogging materials will be evaluated

(3) Air Defense Missile System

- (a) In conjunction with Army and Navy developers, pursue the development of an Advanced Common Intercept Missile for use in air-to-air as well as surface-to-air applications

d. (U) Program to Completion: This is a continuing program

5. (U) Project F32-394, Air-to-Air Warfare Technology

- This project comprises airborne systems-oriented technology for defeating aircraft and missiles
- Major thrusts are the Outer-Air Battle Missile, airborne anti-air targeting/weapon control and new technology to improve SIDEWINDER capabilities to meet day/night acquisition requirements
- Outer-Air Battle Missile focuses on technologies to support a higher firepower, higher performance missile capable of operating in an all-weather environment
- Airborne anti-air targeting/weapon control technology to develop jammer-resistant targeting radars and stand-off jammer localization capability (multi-sensor integration)
- Technology to improve SIDEWINDER

a. (U) FY 1982 Program:

(1) F

(2) F

- (3) Prediction codes for full-up system signal patterns and trans/reflector performance have been developed for the cassegrain antenna concept, and these have been found to be in good agreement with experimental data.
- (4) A state variable feedback flight control concept has been developed that shows successful means of effecting bank-to-turn control of a twin axially symmetric inlet missile airframe over a wide range of supersonic flight conditions during closed-loop terminal homing
- (5) Encounter simulation tests of the single quadrant model of the long wave length infrared fuse concept indicated feasibility and the potential to provide the needed operational range. This concept will provide target azimuth information and has the potential for less backscatter and transmission losses in aerosols than the shorter infrared wave length fuse concepts
- (6) Usefulness of a helmet mounted display with sensors in off-boresight applications has been confirmed by the testing of a (juggling) seeker with a helmet mounted sight/display
- (7)

(8) F

Program Element: 62332H

Title: Strike Warfare Weaponry Technology

b. (U) FY 1983 Program:

- (1) Complete feasibility evaluation of differential canard roll controlled low drag airframe concept for transition to AIM-9M Product Improvement Program
- (2) Evaluate infrared focal plane array technology and develop algorithms for imaging day/night air intercept missile seeker
- (3) Complete development of technology for small aperture RF seeker flat plate cassegrain antenna
- (4)
- (5)
- (6) Complete technology development of high power X-band transmit/receive modules
- (7) Complete technology development of Simultaneous Transmit and Receive radar concept for targeting avionics
- (8) Start development of targeting technology for standoff jammer localization concept
- (9) Continue technology development for Coherent Frequency Multiplex Radar for countermeasure resistant targeting avionics
- (10) Continue the special focus efforts to develop and demonstrate guidance, ordnance and airframe technology for Advanced Common Intercept Missile flight demonstrations under P.E. 63308H
- (11) Continue preparations for evaluation of advanced targeting technology and concepts in the special focus Fighter/Attack Avionics Targeting Demonstration

c. (U) FY 1984 Planned Program:

- (1) Complete evaluation of infrared focal plane array and associated algorithms for a day/night capable imaging air intercept seeker
- (2)
- (3)
- (4) Start technology development for small aperture multi-spectral seeker dome
- (5) Continue development of targeting technology and demonstration of feasibility for stand-off jammer localization concept
- (6) Complete technology development for Coherent Frequency Multiplex Radar countermeasure resistant targeting avionics
- (7) Complete special focus program Advanced Common Intercept Missile guidance, ordnance, and airframe technology development and feasibility demonstration under P.E. 63308H
- (8) Conduct evaluation of advanced targeting technology and concepts in the Fighter/Attack Avionics Targeting Demonstration special focus program

d. (U) Program to Completion: This is a continuing program

6. (U) Project F32-395, Air-to-Surface Warfare Technology

- This project comprises airborne systems-oriented technology for defeating surface ships, small craft, and land targets
- Major thrusts are the advanced air launched tactical missile and airborne anti-surface targeting/weapon control

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

a. (U) FY 1982 Program:

(1) [

(2) ]

(3) [

(4) A comprehensive and versatile set of software has been developed for adaptive penetration fuzing. Software and hardware have been integrated, debugged, and tested

(5) ]

(6) [

(7) Completed subsystem hardware/software development, system level integration, and conducted rooftop test/evaluation preparatory to final aircraft integration and flight testing of a Laser Inertial Aided Synthetic Aperture Radar targeting avionics concept demonstration

(8) ]

b. (U) FY 1983 Program:

(1) [

(2) Start technology development, in conjunction with DARPA, of an advanced scanning infrared focal plane array anti-ship missile seeker, including advanced autonomous ship classification algorithms

(3) [

(4) ]

(5) ]

(6) ]

c. (U) FY 1984 Planned Program:

(1) Complete technology development and demonstrate feasibility of advanced scanning IR focal plane array anti-ship missile seeker concept

(2) Complete development and evaluation [

(3) Complete technology development and evaluation of adaptive penetration fuse concept

(4) Complete technology development and evaluation of low radar cross section missile airframe structure concepts

(5) Complete development and validation of launch dynamics prediction model

(6) Complete technology development and evaluation of low cost missile mid-course guidance ring laser gyros

(7) Complete development and evaluation of advanced missile control device technology

(8) ]

Program Element: 62332N

Title: Strike Warfare Weaponry Technology

(9)

(10) Start technology development of in-line safe and arm concept, advanced missile submunition warhead, and an advanced IR focal plane array concept

(11)

d. (U) Program to Completion: This is a continuing program

7. (U) Project F32-396, Theater Nuclear Warfare Technology

• This project provides the nuclear warfare technology to provide the technology base to support the development of more effective and safer tactical nuclear air and surface weapons

a. (U) FY 1982 Program:

- (1) The optimum nuclear warhead yield for a specified air threat was defined
- (2) An existing data base on the construction of threat ships was reviewed -- this will be used to define an optimum anti-ship warhead yield
- (3) An effort to determine the need for upgraded or new nuclear weapon support subsystems (Permissive Action Links) for unique Navy applications was initiated

b. (U) FY 1983 Program:

(1)

(2)

(3)

c. (U) FY 1984 Planned Program:

(1)

(2) Initiate development of improved nuclear fuse components

(3)

(4) Initiate design of advanced nuclear weapon support subsystems (e.g., permissive action links)

d. (U) Program to Completion: This is a continuing program

8. (U) Project F32-399, (Classified Program)

•

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 52542R  
DoD Mission Area: 523 - Engineering Technology

Title: Nuclear Propulsion Technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.                      | Title                                       | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|---------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                             |                |                  |                  |                  |                          |                      |
| F42-441                          | Submarine Nuclear Propulsion (old title)    | 15,180         | 19,000           | ---              | ---              | Continuing               | Continuing           |
| F42-441                          | Nuclear Plant Technology (new title)        | ---            | ---              | 19,024           | 19,425           | Continuing               | Continuing           |
| F42-442                          | Surface Ship Nuclear Propulsion (old title) | 8,190          | 9,000            | ---              | ---              | Continuing               | Continuing           |
| F42-442                          | Plant Material Technology (new title)       | ---            | ---              | 12,682           | 13,177           | Continuing               | Continuing           |
| F42-443                          | Multipurpose Nuclear Propulsion (old title) | 24,206         | 25,624           | ---              | ---              | Continuing               | Continuing           |
| F42-443                          | Reactor Component Technology (new title)    | ---            | ---              | 15,351           | 16,119           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- The Nuclear Propulsion Technology program element effort is directed toward the development, testing, and application of advanced technology for potential use in the design and improvement of nuclear propulsion plants for submarines and surface ships. Focus is directed toward the objectives of higher performance, longer life, reduced operating noise, reduced space and weight requirements, better reliability and safety assurance, and increased standardization and maintainability of naval nuclear plants.
- Beginning in FY 1984, Nuclear Propulsion Technology will have three new subproject categories replacing the present subproject categories. This realignment better reflects the scopes of work being performed. The funding level required in FY 1984 is less than that required for FY 1983.
- Research and development efforts will include work scopes such as the following:
  - Investigate metallurgical characteristics of materials in order to develop new materials as well as to determine the long term reliability of existing materials
  - Work on advanced instrumentation and control equipment with the aim of improved accuracy, reliability, and compatibility with existing systems
  - Develop and implement structural design and analysis procedures to eliminate potential propulsion plant component structural failures
  - Develop methods to eliminate noise generated within the reactor plant which may contribute to the detectability of operational ships
  - Conduct tests to confirm the adequacy of reactor components subjected to shipboard shock and vibration
  - Develop improved control drive mechanisms
  - Evaluate component designs to determine the least margin to failure
  - Develop techniques for service inspection of components

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The change between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary (a decrease of 11,678 in FY 1984) is a result of the realignment of work and shifting of funds to Program Element 63570N, Advanced Nuclear Reactor Components and Systems Development, in FY 1984.

Program Element: 62542N

Title: Nuclear Propulsion Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                            | FY 1981<br>Actual | FY 1982<br>Estimate | FY 1983<br>Estimate | FY 1984<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|-------------|----------------------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>44,639</b>     | <b>47,576</b>       | <b>53,624</b>       | <b>58,735</b>       | Continuing                  | Continuing                 |
| F42-441     | Submarine Nuclear Propulsion     | 14,400            | 15,183              | 19,000              | 19,000              | Continuing                  | Continuing                 |
| F42-442     | Surface Ship Nuclear Propulsion  | 10,000            | 8,190               | 9,000               | 9,000               | Continuing                  | Continuing                 |
| F42-443     | Multipurpose Nuclear Propulsion  | 20,239            | 24,203              | 25,624              | 30,735              | Continuing                  | Continuing                 |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- This program element is a part of the Naval Nuclear Propulsion Program which is an integrated research and development program funded by both Department of the Navy and Department of Energy (DOE), with the bulk of the funds provided by DOE
- Research and development work on nuclear propulsion plants conducted under this program is closely coordinated with the Department of Energy's Office of Naval Reactors
- The overall research and development program is dedicated to the continued development of safe, reliable, high performance, long life, advanced nuclear propulsion plants and components

G. (U) WORK PERFORMED BY

- IN-HOUSE - None
- INDUSTRIAL - Westinghouse Electric Corporation, Battis Atomic Power Laboratory and Plant Apparatus Division, Pittsburgh, PA; and, General Electric Company, Knolls Atomic Power Laboratory and Machinery Apparatus Operation, Schenectady, NY
- ACADEMIC - None

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984: Not applicable

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984

(A) (U) Project F42-441, Submarine Nuclear Propulsion:

1. (U) DESCRIPTION (Requirement and Project):

- R&D within the submarine nuclear propulsion project provides the technical base required for the initiation of advanced development projects
- The objectives of this effort include developing submarine nuclear propulsion plant systems and components with emphasis on higher performance, longer life, reduced operating noise, and reduced space and weight requirements, as well as better reliability, safety assurance, maintainability, and standardization
- Technology developed in this program has materially contributed to technical advances in submarine propulsion plants

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

(1) ✓



Program Element: 62542M

Title: Nuclear Propulsion Technology

(2) [

(3)

(4)

(5)

(6)

(7)

(8)

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(10)

(11) Continued research and development efforts to enhance valve performance and reliability

(12)

(13)

(14)

b. (V) FY 1963 Program:

Design and test submarine instrumentation, control, and electrical equipment, and related detectors and diagnostic test equipment using the latest technology in electronics

(1) Perform compatibility tests, under laboratory conditions, upon improved equipment such as rod drive and reactor coolant pump power supplies, and nuclear instrumentation

(2) [

(3)

(4)

(5) [

Program Element: 62542M

Title: Nuclear Propulsion Technology

(6) ]

(7) ]

(8) ]

(9) ]

(10) ]

(11) ]

Evaluate and test new materials for use in nuclear propulsion plant components to improve performance and meet naval requirements for shock resistance and endurance. Develop analytic methods, including mathematical models, to assess component performance and evaluate data obtained from simulated plant operation. These analytic methods are being evaluated:

(12) ]

(13) ]

(14) ]

(15) ]

Conduct design and analysis of improved valves, pumps, pressurizers, steam generators and other heat exchangers. The design effort matches the components to the planned operational requirements.

(16) ]

(17) ]

(18) ]

(19) Continue tests and evaluations of component characteristics such as structure, corrosion resistance, and shock endurance, with the goal of improving their performance, reliability, and maintainability.

(20) Continue to test and evaluate improved techniques for non-destructive testing of components, design and evaluate the development of lead unit reactor servicing equipment and procedures for initial refueling of submarine nuclear propulsion plants

(21) Continue development and testing of reactor servicing equipment

Program Element: 62542N

Title: Nuclear Propulsion Technology

Research and analyze data on deep ocean characteristics to establish the feasibility and environmental impacts of disposal of defueled submarines into the ocean

- (22) Continue tests and evaluation of deep ocean characteristics to establish fundamental parameters of potential disposal sites for nuclear submarines
- (23) Continue tests to determine the corrosion rates of various metals in deep ocean environments

Conduct testing and analysis of improved primary and secondary plant water chemistries

- (24)
- (25)
- (26)
- (27)

c. (U) FY 1984 Planned Program:

- (1) In FY 1984 and beyond, Nuclear Propulsion Technology work has been realigned under new project titles. See Project F42-441, Nuclear Plant Technology

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

(B) (U) Project F42-441, Nuclear Plant Technology:

1. (U) DESCRIPTION (Requirement and Project):

- \* Nuclear Plant Technology includes all technological development efforts to improve propulsion plant performance and operation through development, testing and evaluation of nuclear propulsion plants, components and systems for submarines and surface ships. Work is underway to provide for greater plant performance, standardization, and operating life. Data obtained from shipboard operating plants regarding performance and problem areas are incorporated into the development process.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- (1) Not applicable -- See Project F42-441, Submarine Nuclear Propulsion

b. (U) FY 1983 Program:

- (1) Not applicable -- See Project F42-441, Submarine Nuclear Propulsion

c. (U) FY 1984 Planned Program:

The Nuclear Plant Technology project, for FY 1984 and beyond, results from the realignment of Nuclear Propulsion Technology work under new project titles

Program Element: 62542H

Title: Nuclear Propulsion Technology

Test advanced concepts with the goal of developing improved designs for nuclear propulsion plant applications. Among the items to be tested are developmental components, new materials, instrumentation, and plant systems. Testing will provide the data base necessary for development and qualification of new analytical procedures and design concepts.

(1) Continue plant operations and modifications for testing of advanced concepts and improved components

(2) [

(3) ]

Develop computer programs for use in design analysis and propulsion plant modeling

(4) [

(5) ]

(6) ]

(7) ]

(8) Develop, qualify, and implement structural design analysis methods into design procedures for nuclear propulsion plant components

(9) [

(10) ]

Research and analyze data on deep ocean characteristics to establish the feasibility and environmental impacts of disposal of defueled submarines into the ocean

(11) Continue tests and evaluation of deep ocean characteristics to establish fundamental parameters of disposal study areas

(12) Continue tests to determine the corrosion rates of various metals in deep ocean environments

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

(.) (U) Project 642-442, Surface Ship Nuclear Propulsion:

1. (u) DESCRIPTION (Requirement and Project):

- This project is directed toward the development, testing, and application of advanced technology needed to support the design and improvement of nuclear propulsion plants for surface warships over a wide range of power ratings.
- The objectives of this project include continuing the development of advanced nuclear propulsion plant and system concepts, and improving propulsion plant and component performance in the areas of higher performance, longer life, and better reliability, safety assurance, maintainability, and standardization.

Program Element: 62542N

Title: Nuclear Propulsion Technology

Test advanced concepts with the goal of developing improved designs for nuclear propulsion plant applications. Among the items to be tested are developmental components, new materials, instrumentation, and plant systems. Testing will provide the data base necessary for development and qualification of new analytical procedures and design concepts.

(1) Continue plant operations and modifications for testing of advanced concepts and improved components

(2) [

(3) [

Develop computer programs for use in design analysis and propulsion plant modeling

(4) [

(5) [

(6) [

(7) [

(8) Develop, qualify, and implement structural design analysis methods into design procedures for nuclear propulsion plant components

(9) [

(10) [

Research and analyze data on deep ocean characteristics to establish the feasibility and environmental aspects of disposal of defueled submarines into the ocean

(11) Continue tests and evaluation of deep ocean characteristics to establish fundamental parameters of disposal study areas

(12) Continue tests to determine the corrosion rates of various metals in deep ocean environments

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

(.) (u) Project FA2-442, Surface Ship Nuclear Propulsion:

1. (u) DESCRIPTION (Requirement and Project):

- This project is directed toward the development, testing, and application of advanced technology needed to support the design and improvement of nuclear propulsion plants for surface warships over a wide range of power ratings
- The objectives of this project include continuing the development of advanced nuclear propulsion plant and system concepts, and improving propulsion plant and component performance in the areas of higher performance, longer life, and better reliability, safety assurance, maintainability, and standardization

Program Element: 62542N

Title: Nuclear Propulsion Technology

e. (U) Milestones: Not applicable.

(D) (U) Project F42-442, Plant Materials Technology:

1. (U) DESCRIPTION (Requirement and Project):

- New and improved materials are being developed for use in nuclear propulsion plants. Materials are being developed to solve needs identified in current generation nuclear propulsion plants and for use in future plants. The long term reliability of operating plant materials is essential to the continuity of power plant operations. This effort investigates metallurgical characteristics involving heat treatment, corrosion, and mechanical properties of materials. These materials undergo extensive testing and analysis under controlled conditions and environment to qualify them for plant applications. This effort also develops the materials engineering expertise needed to assure the satisfactory performance and reliability of materials and components in naval nuclear propulsion plants.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

(1) Not applicable -- See Project F42-442, Surface Ship Nuclear Propulsion.

b. (U) FY 1983 Program:

(1) Not applicable -- See Project F42-442, Surface Ship Nuclear Propulsion.

c. (U) FY 1984 Planned Program:

The Plant Materials Technology project, for FY 1984 and beyond, results from the realignment of Nuclear Propulsion Technology work under new project titles.

The long term reliability of operating plant materials is essential to the continuity of power plant operations. This effort involves investigation of metallurgical characteristics involving heat treatment, corrosion, and mechanical properties of materials. Data obtained from short term accelerated material tests is extrapolated to actual service conditions at lower temperatures.

- (1) Conduct corrosion and mechanical property tests of plant materials to provide assurance of the long-term reliability in long lived naval core applications, including in-reactor corrosion tests to determine materials characteristics such as [ ]
- (2) Continue to develop materials with improved corrosion [ ] behavior for use in advanced naval nuclear propulsion plants
- (3) Evaluate performance of plant materials [ ] to determine design changes required
- (4) Develop and qualify manual and automatic welding and cutting procedures for plant materials
- (5) Perform testing of propulsion plant materials and prepare specifications for these structural materials as well as process requirements to develop materials compatible with long-life reactors
- (6) Continue corrosion tests for optimizing zircaloy-4 advanced cladding material

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

Program Element: 62542H

Title: Nuclear Propulsion Technology

(E) (U) Project F42-443, Multipurpose Nuclear Propulsion:

1. (U) DESCRIPTION (Requirement and Project):

- The Multipurpose Nuclear Propulsion Program provides for the development of technology applicable to a broad range of propulsion plant systems and components designs
- This program incorporates areas of nuclear propulsion technology that are not primarily directed toward either submarine or surface ship propulsion plants, but apply to both types of propulsion plants
- The objectives of this effort include continuing the development of advanced nuclear propulsion plant and system concepts and designs, with emphasis in the areas of greater plant performance, longer life, improved reliability, safety assurance, maintainability, and advanced instrument and control system concepts

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- (1) Continued materials development and analysis to qualify alternate materials having improved corrosion or mechanical properties for nuclear propulsion plant applications.
- (2)
- (3) Continued the stress corrosion cracking test program
- (4) Continued investigations into the cause and prevention of stress corrosion cracking
- (5) Continued testing of advanced concepts and improved component designs
- (6) Continued development of manufacturing techniques for pipings and fittings of Alloy 600
- (7)
- (8) Continued evaluation of the corrosive effects of primary coolant on propulsion plant components
- (9)
- (10)
- (11)
- (12)
- (13)

b. (U) FY 1983 Program:

Test advanced concepts with the goal of developing improved design for nuclear propulsion plant applications. Among the items to be tested are developmental components, new materials, instrumentation, servicing systems and plant systems. Testing will provide the data base necessary for development and qualification of new analytical procedures and concepts

Program Element: 62542N

Title: Nuclear Propulsion Technology

- (1) Continue to perform testing of advanced nuclear propulsion concepts
- (2) Perform analytical evaluations and testing to gauge the impact of emerging technology on core component and control rod drive mechanism designs
- (3) Continue to develop servicing systems and design lead unit servicing equipment
- (4) Continue work on shield design concepts and shield design analysis

New component designs are continually sought to meet naval requirements for noise reduction, shock resistance, and endurance. Models are developed to assess reactor component performance and to analyze data obtained from simulated plant operation. Test components are subjected to extensive testing and evaluation.

- (5) [
- (6)
- (7)
- (8)
- (9) Develop structural design analysis methods and criteria to incorporate into design procedures for naval nuclear propulsion plant components
- (10) ]
- (11)
- (12)
- (13) Develop improved methods of designing and qualifying new valves
- (14) Develop advanced valves with greater service life and reliability
- (15) [

Materials testing and development is carried out to meet identified needs and assure the satisfactory performance and reliability of materials and components in naval nuclear propulsion plants

- (16) Continue materials development, performance testing of materials, and preparation of specifications for structural materials and process requirements
- (17) [
- (18)
- (19)

Electrical components and related instrumentation and systems are designed and tested using the latest technology in electronics

- (20) [
- (21) Continue to develop microprocessors and microprocessor-based equipment for submarine and surface ship application
- (22) Initiate development of advanced propulsion plant detectors to provide increased accuracy and reliability



Program Element: 62542N

Title: Nuclear Propulsion Technology

c. (U) FY 1984 Planned Program:

(1) In FY 1984 and beyond, Nuclear Propulsion Technology work has been realigned under new project titles. See Project F42-443, Reactor Component Technology

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

(F) (U) Project F42-443, Reactor Component Technology:

1. (U) DESCRIPTION (Requirement and Project):

Reactor Component Technology supports the development of nuclear propulsion plant components including instrumentation, control, and electrical equipment, valves, pumps, pressurizers, and heat exchangers. The design and analysis of improved components is conducted, and the design effort matches the components to the planned operational requirements.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

(1) Not applicable -- See Project F42-443, Multipurpose Nuclear Propulsion

b. (U) FY 1983 Program:

(1) Not applicable -- See Project F42-443, Multipurpose Nuclear Propulsion

c. (U) FY 1984 Planned Program:

The Reactor Component Technology project, for FY 1984 and beyond, results from the realignment of Nuclear Propulsion Technology work under new project titles.

Design and test nuclear propulsion plant instrumentation, control, and electrical equipment and systems using the latest technology in electronics and control concepts

(1) Continue to develop new instruments and detectors based on the latest circuit technology, and investigate alternate technology such as new displays, detectors, and data transmission techniques for improving instrumentation

(2) Evaluate and test new concepts in instrumentation and control for compatibility with existing protection components and systems,

(3) Develop new power distribution and control elements, ] to improve reliability and shock resistance

Conduct design and analysis of improved pumps, pressurizers, steam generators, and other heat exchangers. The design effort matches the components to the planned operational requirements. Prototype components are subjected to extensive testing and evaluation.

Program Element: 62542N

Title: Nuclear Propulsion Technology

(4) ☐

(5) Conduct flow tests on components in test loops under simulated nuclear propulsion plant conditions

(6) ☐

(7) ☐

(8) ☐

(9) Perform plant component testing to provide data on specific plant component characteristics

(10) ☐

(11) Develop improved methods of designing and qualifying new valves

(12) Develop advanced valves with greater service life and reliability

(13) ☐

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62543N  
DoD Mission Area: 523 - Engineering Technology

Title: Ships, Submarines, and Boats technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                 | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Estimated Cost |
|-------------|-------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                      | <b>39,026</b>  | <b>32,491</b>    | <b>39,146</b>    | <b>47,852</b>    | Continuing               | Continuing     |
| F43-393     | Countermine Systems/Amphibious/Light Armored Vehicles | 0              | 0                | 294              | 293              | Continuing               | Continuing     |
| F43-411     | Concept Assessment of Platforms and Systems           | 3,556          | 3,130            | 3,715            | 4,806            | Continuing               | Continuing     |
| F43-421     | Fluid Dynamics                                        | 2,891          | 2,350            | 2,260            | 2,736            | Continuing               | Continuing     |
| F43-422     | Vehicle Structures                                    | 5,384          | 5,040            | 8,903            | 11,243           | Continuing               | Continuing     |
| F43-431     | Electrical Energy Conversion and Distribution         | 6,704          | 3,400            | 2,750            | 3,664            | Continuing               | Continuing     |
| F43-432     | Propulsion/Engines/Turbines/Related Technology        | 3,581          | 3,002            | 3,960            | 4,487            | Continuing               | Continuing     |
| F43-433     | Auxiliary Machinery/Equipment                         | 1,741          | 1,600            | 1,586            | 2,645            | Continuing               | Continuing     |
| F43-434     | Propulsor Technology                                  | 0              | 1,900            | 2,905            | 4,300            | Continuing               | Continuing     |
| F43-451     | Survivability/Habitability/Damage Control             | 2,909          | 2,300            | 2,307            | 2,736            | Continuing               | Continuing     |
| F43-452     | Acoustic Silencing                                    | 6,483          | 4,900            | 5,019            | 5,081            | Continuing               | Continuing     |
| F43-453     | Surface Ship Magnetic Silencing                       | 861            | 800              | 0                | 0                | Continuing               | Continuing     |
| F43-454     | Ship Electromagnetic Compatibility                    | 1,243          | 1,000            | 979              | 1,161            | Continuing               | Continuing     |
| F43-455     | Marine Corps Surface Mobility                         | 3,673          | 3,069            | 4,468            | 4,700            | Continuing               | Continuing     |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- This element is a comprehensive research and development program directed towards the development and application of the technology base necessary to achieve significant advances in Naval ships, submarines, and boats in terms of military performance and acquisition and support cost reductions
- Program provides performance improvement through application and demonstration of emerging and existing technologies to provide better combat capability, reduced vulnerability, enhanced survivability, and greater endurance
- Program provides reductions in life cycle costs of naval vehicles through the exploratory development of new vehicle concepts design techniques, systems, and components exhibiting significant improvements in acquisition costs, maintenance costs, and operating costs
- Program provides reduced developmental risk for advanced vehicles, systems, and components through integration, experimental demonstration, validation, and assessment of new technology applications early in the development process with a low level of investment
- Program provides direct fleet support in the form of new technology applications to correct technical deficiencies in existing fleet systems as they arise

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands). The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:

- Total program element resources were reduced 11,665 in FY 1983 and 9,155 in FY 1984 due to a FY 1983 Congressional action and subsequent programming adjustments in FY 1984 and FY 1985 necessitated by reduced, delayed, and terminated tasks in FY 1983
- In FY 1983, various tasks previously funded in F43-421, F43-422, F43-432, and F43-452 for development of improved marine propulsors and propulsor technology base were combined under a new project, F43-434, to provide better integration and coordination of these tasks and increase their effectiveness toward resolution of serious propulsor technology deficiencies — Project F43-434 is not a new start

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- F43-393, Countermine Systems/Amphibious/Light Armored Vehicles, is a new project to fund a portion of a special focus effort initiated in F34-393, USMC Land Mine Countermeasures, to address Marine Corps vehicle technology requirements in countermine warfare
- Additional changes in funding are the result of escalation changes and refinement of cost estimates

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY**

| Project No. | Title                                          | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>               | <b>35,016</b>  | <b>38,231</b>    | <b>44,156</b>    | <b>48,501</b>    | Continuing               | Continuing           |
| F43-411     | Concept Assessment of Platforms and Systems    | 2,464          | 3,734            | 5,476            | 5,270            | Continuing               | Continuing           |
| F43-421     | Fluid Dynamics                                 | 3,488          | 3,100            | 3,496            | 3,840            | Continuing               | Continuing           |
| F43-422     | Vehicle Structures                             | 5,002          | 4,450            | 6,335            | 9,288            | Continuing               | Continuing           |
| F43-431     | Electrical Energy Conversion and Distribution  | 4,619          | 6,861            | 3,828            | 4,248            | Continuing               | Continuing           |
| F43-432     | Propulsion/Engines/Turbines/Related Technology | 3,168          | 3,000            | 3,402            | 4,190            | Continuing               | Continuing           |
| F43-433     | Auxiliary Machinery/Equipment                  | 3,059          | 1,800            | 2,208            | 3,140            | Continuing               | Continuing           |
| F43-451     | Survivability/Habitability/Damage Control      | 3,937          | 3,000            | 3,212            | 4,300            | Continuing               | Continuing           |
| F43-452     | Acoustic Silencing                             | 5,282          | 6,660            | 9,700            | 8,100            | Continuing               | Continuing           |
| F43-453     | Surface Ship Magnetic Silencing                | 500            | 880              | 1,100            | 0                | Continuing               | Continuing           |
| F43-454     | Ship Electromagnetic Compatibility             | 1,000          | 1,258            | 1,275            | 1,365            | Continuing               | Continuing           |
| F43-455     | Marine Corps Surface Mobility                  | 2,497          | 3,508            | 4,124            | 4,760            | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** None.

**F. (U) RELATED ACTIVITIES**

- Related work is being sponsored by the Maritime Administration, Argonne National Laboratory, U.S. Coast Guard, U.S. Army Tank and Automotive Command, United Kingdom, Canada, and selected North Atlantic Treaty Organization (NATO) countries through International Exchange Agreements
- Work in this element has provided the technical foundation for many advanced and engineering development program elements/projects such as:
  - 63508N - Ship Propulsion Systems (Advanced)
  - 63508N - SSBN Subsystem Technology Program
  - 63514N - Shipboard Damage Control
  - 63569N - SSN Cost Reduction
  - 63531N - HY-130 Steel
  - 11228N - TRIDENT Program
  - 63533N - Surface ASW
  - 63589N - DDG-31 Program
  - 63561N - Advanced Submarine Control Program (ASCOF)
  - 63502N - Mine Sweeping/Hunting
  - 63562N - Submarine Tactical Warfare Systems (Advanced)
  - 63573N - Electric Drive
  - 63564N - Ship Development (Advanced)
  - 63513N - Shipboard Systems Component Development
  - 63724N - Navy Energy Program

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

G. (U) WORK PERFORMED BY

- IN-HOUSE - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Sea Systems Command, Washington, DC; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Sea Systems Command Detachment, Norfolk, VA; Naval Ship Systems Engineering Station, Philadelphia, PA; Naval Surface Weapons Center, White Oak, MD; Naval Underwater Systems Center, Newport, RI; Naval Weapons Center, China Lake, CA; Naval Air Development Center, Warminster, PA
- INDUSTRIAL - Bath Iron Works, Bath, ME; Battelle Memorial Institute, Columbus, OH; Boeing Aircraft Corporation, Seattle, WA; Gibbs & Cox, Arlington, VA; Chandler Evans, Chicago, IL; Chicago Pneumatics, Chicago, IL; Desmatics, State College, PA; Electric Boat, Groton, CT; General Electric Company, Schenectady, NY; Gould, Inc., St. Paul, MN; Grumman Aircraft, Bethpage, NY; Ingalls Shipbuilding, Pascagoula, MS; Johns Hopkins University/Applied Physics Laboratory, Baltimore, MD; M. Rosenblatt and Sons, New York, NY and Arlington, VA; McDonnell-Douglas, Huntington Beach, CA; Mechanical Technology, Inc., Schenectady, NY; ORI, Inc., Silver Spring, MD; Southwest Research Institute, San Antonio, TX; Hydronautics, Inc., Laurel, MD
- ACADEMIC - Arizona State University, Tucson, AZ; Duke University, Durham, NC; Massachusetts Institute of Technology, Cambridge, MA; Pennsylvania State University, State College, PA; Stevens Institute of Technology, Hoboken, NJ; Syracuse University, Syracuse, NY; University of Illinois, Urbana, IL; U.S. Naval Academy, Annapolis, MD; Navy Postgraduate School, Monterey, CA; Webb Institute, Glen Cove, NY; Virginia Polytechnic Institute, Blacksburg, VA

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F43-393, Countermine Systems/Amphibious/Light Armored Vehicle:

- A new start in FY 1984 to fund a portion of a special focus effort initiated in F34-393, USMC Land Mine Countermeasures to address Marine Corps vehicle technology requirements in countermine warfare

a. (U) FY 1982 Program: Not applicable

b. (U) FY 1983 Program: Not applicable

c. (U) FY 1984 Planned Program:

- (1) Investigate various blast resistant technology concepts developed by the Army during the 1970's for application to a light armored amphibious vehicle
- (2) Identify most promising blast resistant technology concepts for incorporation into a feasibility demonstrator

d. (U) Program to Completion: This project should complete in FY 1988

2. (U) Project F43-411, Concept Assessment of Platforms and Systems:

- This project is directed toward the identification, evaluation, and verification of new vehicle technology concepts for naval platforms in terms of: determining the impact of emerging technologies on existing ships and near term ship designs; reducing costs and manning for future ships; integrating combat systems with the ship platform; potential contribution of improved or new capabilities of new ship/vehicle concepts to the fleet
- This project is directed toward evaluating new platform and systems concepts in terms of single unit, task force, and battle group capability improvement to counter present and projected threats in all warfare areas

a. (U) FY 1982 Program:

- (1) Completed capability assessment of a carrier battle group and identified system deficiencies and technology shortfalls

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- (2) Correlated R&D initiatives with mission needs and developed measures for determining priorities
- (3) Completed initial version of technology impact assessment tool (ASSET) — ASSET will eventually incorporate all major technologies developed in the program element and analyze their effects on ship characteristics such as size, cost, manning and powering
- (4) Completed an interim cost evaluation tool for evaluating impact of new technology on acquisition and life cycle cost of ships
- (5) Completed model tests of surface effect catamaran hull, confirming performance predictions indicating potential for a 30% increase in maximum speed over PFG-7 when configured for the same mission
- (6) Established ability to model multi-threat combat engagements for anti-air warfare point defenses, greatly increasing capability for realistic evaluation of ships' combat capabilities and deficiencies in this environment
- (7) Evaluated and reported the potential of robotics to reduce cost in three areas of ship construction and maintenance

b. (U) FY 1983 Program:

- (1) Establish data base and planning for analytical tools to assess the potential for ship manning reduction through emerging technology and changes in ship arrangements and operational doctrine
- (2) Assess potential of advanced vehicle and propulsion system option to reduce acquisition costs
- (3) Develop multi-threat combat capability assessment methods to permit optimum combat system design and integration of combat system requirements with platform capabilities
- (4) Apply cost models to identify cost drivers and cost reduction potential of emerging technologies
- (5) Develop analytical tools to assess combat capability effects of degraded material conditions, navigation system errors, and system saturation
- (6) Assess technology shortfalls of surface action groups based on updated threats, operational situations, and technology projections
- (7) Extend and verify analytical tools for assessment of potential impact of emerging technologies on ship weight, size, cost, and operational effectiveness

c. (U) FY 1984 Planned Program:

- (1) Perform quantitative analysis of potential cost reduction measures
- (2) Develop and apply analytical tools to assess the potential for ship manning reduction through the application of emerging technologies and changes in ship arrangements and operational doctrine
- (3) Continue evaluation of integrated machinery, advanced propellers, and contrarotation for potential cost reductions
- (4) Assess technology shortfalls of amphibious assault groups based on updated threats, operational situations, and technology projections
- (5) Update and apply technology impact assessment tools to establish development priorities for highest pay-off technologies
- (6) Integrate technology output from other subprojects to develop new vehicle alternatives for the year 2006 and beyond
- (7) Provide overall evaluation of the surface effect catamaran concept leading to decision on future development
- (8) Determine technical feasibility, mission application, and cost reduction potential of new surface and submarine vehicle concepts
- (9) Develop ship motion model combining responses to sea and maneuvering to evaluate impact on combat system performance
- (10) Define error analysis requirements to improve intership fire control designation

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F43-421, Fluid Dynamics:

- The objectives of this project are to improve the seakeeping, maneuverability, and propulsive efficiency of surface ships in order to enhance operational effectiveness, increase fuel conservation and reduce ship operating costs

Program Element: 62543H

Title: Ships, Submarines, and Boats Technology

- The project is also directed to improving the military effectiveness of submarines through improved resistance, propulsion, stability, and control
- Other objectives include development of hydrodynamic design capability for advanced hull forms offering attractive alternatives to conventional hulls, and development of new stern forms to enhance advanced electric propulsion systems

a. (U) FY 1982 Program:

- (1) Identified surface ship hull forms having potential for significant fuel savings over current combatant designs
- (2) Provided design methods for advanced propulsion and improved designs for submarine control and powering
- (3) Provided analysis techniques for superior seakeeping and maneuvering performance, with resultant improved ship and weapons effectiveness
- (4) Establish fundamental hydrodynamic characteristics and design methods for advanced vehicles
- (5) Developed numerical prediction techniques having potential, if confirmed, for greatly improved propeller performance
- (6) Developed program to determine rudder size and location for SWATH ships for optimum powering, seakeeping, and control
- (7) Provided method to improve prediction of submarine propeller RPM to avoid potential turbine blade rate problems
- (8) Developed instrumentation to collect ship motion information toward better seakeeping criteria and performance

b. (U) FY 1983 Program:

- (1) Investigate techniques and designs to improve safety and stability of submarine action operations
- (2) Develop hull and appendage designs having lower resistance and superior seakeeping for greater speed, fuel economy, and personnel and weapons performance
- (3) Reduce design costs through development and application of improved predictive methods for hydrodynamic performance
- (4) Correlate experiments with theory promising improved performance
- (5) Validate hull-propulsor vibration excitation theory to reduce vibration and noise problems and promote propulsion arrangements of higher efficiency
- (6) Evaluate bearing-in-rudder-post propeller shaft design having potential for 15% increase in propulsion efficiency
- (7) Identify and assess technology innovations of foreign submarines for potential adoption to U.S. designs
- (8) Improve low speed maneuvering characteristics of SWATH ships and other advanced and conventional hulls requiring a high degree of station-keeping, course-keeping, or tight maneuverability
- (9) Investigate contrarotation and other means to increase speed and propulsive efficiency of SWATH ships

c. (U) FY 1984 Planned Program:

- (1) Complete evaluation of high-efficiency bearing-in-rudder-post propulsion concept
- (2) Complete development of design procedures to minimize propulsor-induced hull vibration
- (3) Continue development of technology for improved prediction of surface ship and submarine resistance
- (4) Develop hull forms having superior seakeeping and maneuvering characteristics
- (5) Complete design methods for control, seakeeping, resistance, and powering of SWATH ships
- (6) Verify the design theory of contrarotating propellers for potential major gains in propulsion efficiency
- (7) Develop technology for improved stability, control,
- (8) Complete experimental evaluation of optimum resistance/seakeeping hull
- (9) Complete evaluation of a rudder roll stabilization system for surface ships
- (10) Combine resistance factors into seakeeping performance measure of merit
- (11) Define weapon degradation due to motion in a seaway and investigate benefits of roll stabilization and superior seakeeping hulls
- (12)
- (13) Conduct submarine experiments to verify methods to improve control during astern operations

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

d. (U) Program to Completion: This is a continuing program.

4. (U) Project F43-422, Vehicle Structures:

- Objectives of this project include development and feasibility demonstration of new concepts of surface ship and submarine structures, use of new structural materials, and new and more accurate analytical procedures for the design of hulls, foundations, superstructures, and appendages
- A special effort of the project is to develop the technology for use of titanium in submarine hulls -- Titanium hulls would permit deeper diving, faster submarines having low magnetic signatures -- However, titanium raises some unique concerns, such as the potential of creep collapse, and has extremely high fabrication costs -- Technology to address these problems must be developed
- Special thrusts for surface ships include reduced weight of topside structures and concepts to accommodate the introduction of advanced electric propulsion machinery
- Emphasis is on reduced cost of construction and maintenance and improved performance (speed, payload, range, depth, and reliability)

a. (U) FY 1982 Program:

(1) [

- (2) Identified a deckhouse concept and integrated structural system having potential for reduced weight of surface ship superstructures
- (3) Developed design procedures for axisymmetric submarine hulls offering potential for more efficient designs, reduced costs, and better volume utilization
- (4) Developed analytical capability to predict structural response of surface ships in a realistic seaway
- (5) Demonstrated feasibility of new materials and fabrication methods for reduced cost of hydrofoil strut/foil systems
- (6) Developed approaches for reduced local reinforcement of submarine structures, for reduced fabrication costs, and improved space utilization
- (7) Confirmed that small rigid vinyl hull fabrication models can adequately represent complex submarine hulls, permitting the assessment of effects of internal submarine structures on pressure hull strength without costly construction and testing of metal models
- (8) Completed life-cycle evaluation of large scale aluminum ship model to establish design, fabrication, inspection, and maintenance procedures for naval aluminum ship structures
- (9) Assessed analytical methods for predicting distortions and residual stresses in titanium structures
- (10) Procured material for fabrication of titanium iselastic general instability models

b. (U) FY 1983 Program:

- (1) Assess feasibility of alternate submarine pressure hull materials
- (2) Simplify structural design, fabrication, and inspection methods
- (3) Investigate methods of reducing fabrication costs of titanium hulls
- (4) Establish critical structural loads and design procedures for bearing-in-rudder-post propulsor concept
- (5) Evaluate alternative concepts for lightweight surface ship topside structures
- (6) Reduce design costs through development and application of improved prediction methods for structural performance
- (7) Develop structures technology in support of advanced electric propulsion machinery
- (8) Develop technology to improve the performance of high strength steel submarine pressure hulls and minimize cost of construction, surveillance, and repair
- (9) Improve submarine hull strength and failure mode calculation methods
- (10) Initiate construction of titanium models to investigate creep collapse characteristics

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Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- (11) Evaluate creep-fatigue performance of simple titanium structural elements
- (12) Complete tests of titanium frame-to-shell joints to evaluate structural integrity characteristics
- (13) Complete development of new hull opening reinforcement designs for reduced construction costs
- (14) Demonstrate structural adequacy of lightweight composite materials for submarine foundations, bow planes, and ha fairings

c. (U) FY 1984 Planned Program:

- (1) Update evaluation of Soviet surface ship structures technology
- (2) Develop candidate structural geometry options for a cost-effective glass-reinforced plastic, non-magnetic warfare ship
- (3) Evaluate impact on cost of improved plating effectiveness criteria for grillage structures
- (4) Initiate fatigue testing of alternate structural details that are less costly to install
- (5) Evaluate advanced deckhouse concept for strength, integrity, producibility, and cost
- (6) Fabricate and test representative lightweight panels and joint details for topside structures
- (7) Validate collapse prediction methods for complex submarine hull structures offering potential for substantial weight reduction
- (8) Complete strength-weight-cost trade-off analyses for composite non-pressure hull concepts
- (9)
- (10) Complete prediction method for hull collapse due to local imperfections to reduce design conservatism
- (11) Initiate development of titanium weld acceptance criteria
- (12) Complete creep collapse tests of titanium models and evaluate prediction accuracy of existing analytical procedures
- (13) Initiate procurement of titanium models in two sizes to determine creep collapse scaling laws
- (14) Modify existing procedures to include creep effects in titanium on prediction for crack initiation
- (15) Develop requirements of high pressure test facility for titanium hulls
- (16) The increase in funding from FY 1983 to FY 1984 is due to continuation of the special technology program for titanium submarine structures; initiation of a new special technology program in composites for naval applications; continuation of an unnamed program requiring special access

d. (U) Program to Completion: This is a continuing program.

5. (U) Project F43-431, Electrical Energy Conversion and Distribution:

- Objectives are to improve electric power generation, storage, and distribution systems for reduced weight, efficiency and greater reliability and survivability, and to establish the technology base for and demonstrate feasibility of advanced electric propulsion systems having potential for major advances in surface ship size, speed, and fuel savings for the same combat capability
- Additional objectives are to develop the technologies of contrarotating electric machinery, propulsion-derived service power and advanced auxiliary electrical subsystems, and to improve machinery instrumentation, monitoring, control systems in order to reduce ship construction, manning, maintenance, and operating costs
- Results from Navy evaluation of 3,000 horsepower machinery systems and supporting technology developments in the advanced electric propulsion program will be used to select the optimum system concept for transition to advanced development full-size system development and demonstration

a. (U) FY 1984 Program:

- (1) Successfully tested a 3,000 horsepower single shaft electric drive system consisting of a rectified attenuator superconducting motor, controls, switch-gear, and cryogenic refrigeration system in automatic mode
- (2) Received and set up second rectified alternator, switch-gear, and twin shaft control system for testing

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- (3) Completed initial performance testing of AiResearch 3,000 horsepower superconducting motor
  - (4) Assembled and prepared for testing a 30,000 ampere coaxial switch, braking resistor, and controller
  - (5) Performed tests on a screw-type helium compressor, an advanced design helium liquefier, and a shock resistant counterflow heat exchanger for cryogenic refrigeration
  - (6) Identified alternative system concepts and technical approaches for the development of propulsion-derived ship's electrical power, and selected system for model development
  - (7) Established technical feasibility of an advanced design tank level indicator
  - (8) Continued testing of liquid metal current collection for advanced electric machinery
  - (9) Conducted stability and rapid cooldown tests on various types of superconducting magnets
- b. (U) FY 1983 Program:
- (1) Recommend advanced electric machinery design concepts for full-scale construction
  - (2) Complete construction, factory test, and laboratory evaluation of second single-shaft G.E. superconductive motor system
  - (3) Complete similar installation and test of Westinghouse 3,000 horsepower single shaft segmented magnet system
  - (4) Select equipment design concepts for full-scale construction beginning in 1983
  - (5) Develop solder-alloy liquid metal current collector and evaluate performance in testing
  - (6) Fabricate and evaluate cryogenic-helium temperature cooldown characteristics of 36-inch diameter composite coil with copper conductors
  - (7) Transition component technology development for full-scale magnet systems with niobium-titanium superconductive wire to advanced development; same for full-scale coaxial transmission lines and cryogenic refrigeration systems with oil-flooded compressor
  - (8) Evaluate feasibility of high-pressure high-efficiency compact helium refrigerator and diaphragm-type oil-free compressor
  - (9) Complete concept development of a full-scale propulsion-derived ship service power system
  - (10) Complete analytical model and experimental calibration of variable speed constant frequency generator system
  - (11) Determine feasibility of DC electric power generation and distribution systems
  - (12) Complete concept development of an uninterruptible power supply system
- c. (U) FY 1984 Planned Program:
- (1) Complete initial twin-shaft performance evaluation of Westinghouse segmented magnet 3,000 horsepower generator and motor
  - (2) Test and evaluate performance of 3,000 horsepower G.E. acyclic generator in normal mode
  - (3) Complete first 3,000 horsepower system demonstration aboard test craft
  - (4) Complete testing and evaluation of all presently contracted segmented magnet and superconducting machinery in as-built configurations
  - (5) Complete tests of superconductive acyclic motor take-home capability
  - (6) Develop liquid metal fiber brush design current collector
  - (7) Complete solder alloys compatibility evaluations
  - (8) Procure, test, and define electrical and mechanical characteristics of stabilized niobium-titanium superconducting wire
  - (9) Complete feasibility analysis of active superconductive shielding for large motors
  - (10) Complete evaluation of high performance superconducting materials
  - (11) Test and evaluate high pressure helium liquefier
  - (12) Test and evaluate helium refrigeration system performance with oil-free compressor
- d. (U) Program to Completion: This is a continuing program.

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

6. (U) Project FA3-432, Propulsion/Engines/Turbines/Related Technology:

- This project is directed toward development of new concepts in main propulsion machinery which will extend the endurance, quietness, and reliability of ships and submarines while reducing cost and manpower requirements
- Surface ship cost reduction is sought through waste heat recovery from gas turbines and development of technology for 10-year life systems
- Submarine performance improvement involves technology for greatly increased steam plant thermal efficiency, reduced machinery weight and size, and deeper depth operation
- Surface ship performance improvement includes highly flexible and reliable propulsion transmission concepts

a. (U) FY 1982 Program:

- (1) Completed cycle calculations and regenerator evaluations for a high-efficiency 20,000 horsepower intercooled, regenerated gas turbine engine
- (2) Initiated development of a dynamic model of an intercooled, regenerated cruise gas turbine
- (3) Identified critical levels of cobalt, nickel, manganese, and zinc for reduced corrosion of gas turbine blades
- (4) Analyzed vertical and horizontal tube condensers for a minimum weight and volume seawater system for submarines
- (5) Conducted tests of augmented heat transfer tubes for a titanium condenser
- (6) Awarded contract to determine critical nozzle performance characteristics of a high-efficiency two-phase engine for submarine propulsion
- (7) Completed laboratory evaluations of composite shafts and concepts of couplings for a lightweight shafting system
- (8) Demonstrated operation of a composite shaft in a patrol craft (YP)
- (9) Completed investigations of bending pad thrust bearing and contracted to develop advanced sliding and roller bearing designs for deep submergence application
- (10) Identified preliminary explosivity limits for boiler explosion prevention

b. (U) FY 1983 Program:

- (1) Initiate manufacturers' assessments of intercooled, regenerated gas turbines
- (2) Complete engine dynamic performance assessment through simulations
- (3) Provide technology to support coating modifications for longer-life gas turbine blades
- (4) Complete investigation of hot corrosion effects of yttrium, magnesium, and silicon in gas turbine blades
- (5) Initiate analysis of improved transient response characteristics of an advanced diesel generator
- (6) Analyze main sea water system for high-performance submarine machinery
- (7) Complete performance evaluation of two-phase engine nozzles and determine feasibility of the concept
- (8) Develop technology and reliable data for reliable design of compact, lightweight gears
- (9) Initiate repair and condition monitoring assessment of lightweight composite shafting
- (10) Conclude shipboard demonstration and plans for transition of composite shafting technology to Advanced Development
- (11) Evaluate and determine additional propulsion alternatives and promising areas of investigation
- (12) Complete determination of boiler explosion limits and provide prevention guidance to the fleet

c. (U) FY 1984 Planned Program:

- (1) Complete manufacturers' assessments of regenerated gas turbines
- (2) Perform fouling tests on a test model regenerator in an existing gas turbine
- (3) Conduct evaluations of the adequacy of component technology to support regenerated gas turbines
- (4) Determine feasibility and cost effectiveness of regenerated engines
- (5) Determine need for and initiate development of boiler explosion monitoring and warning devices or systems
- (6) Contract for critical components demonstration of advanced, high-efficiency ship service generator engine

Program Element: 62543N

Title: Ship, Submarines, and Boats Technology

- (7) Complete technology readiness demonstration of model tubes for an augmented, lightweight titanium condenser for submarines
- (8) Investigate technology availability and requirements for a high-performance auxiliary diesel engine
- (9) Continue development and demonstration of technology in support of compact, lightweight gears for submarines

d. (U) Program to Completion: This is a continuing program.

7. (U) Project F43-433, Auxiliary Machinery/Equipment:

- Objectives are to develop technology and feasibility models for auxiliary machinery and systems having lower life cycle costs, lower manning and maintenance requirements, reduced weight and space, higher efficiency and reliability, longer life and extended overhaul intervals
- Approaches include simplified design concepts, use of new high-strength materials, and modular construction
- Additional objectives are to enhance submarine combat capability through improved life support systems [
- Specific goals include 50 percent increase in reliability, 33 percent reduction in maintenance, and 50 percent reduction in space and weight

a. (U) FY 1982 Program:

- (1) Completed feasibility evaluation of improved shaft seal for deep diving submarine application
- (2) Completed technology development for a highly reliable, lightweight fuel oil pump
- (3) Completed technology development for a lightweight fuel oil purifier
- (4) Completed technology development of water-lubricated bearing for a simplified, reduced size air compressor
- (5)
- (6) Selected candidate test bearings and lubricants for feasibility test of long-life deuterated lubricant bearings
- (7)
- (8)
- (9) Completed tests of self-lubricated bearings for submarine torpedo tube door, to improve reliability ]

b. (U) FY 1983 Program:

- (1) Continue development and test of water-lubricated bearings and rotors for a lightweight, reliable high pressure air compressor
- (2) Complete corrosion and stress tests for high pressure single-screw seawater pump for submarines
- (3) Complete technology demonstration of a high-efficiency variable breadth impeller pump ]
- (4)
- (5) Test and evaluate potential of a compliant seal to extend life of submarine shaft seals
- (6) Initiate experiments on single ring seal for potential use in submarine shaft seals
- (7)
- (8)
- (9) Perform accelerated bearing life tests with deuterated lubricants
- (10) Initiate analysis of closed-cycle vaporization cooling (heat pipe) system for submarine

c. (U) FY 1984 Planned Program:

- (1) Complete laboratory evaluation of rolling element thrust bearings and rotor materials for high pressure air compressor
- (2) Complete technology demonstration of single-screw high pressure seawater pump for submarines

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- (3) Initiate technology development for lightweight single-screw high pressure oil pump
- (4)
- (5) Complete evaluation of a single ring, compliant submarine shaft seal, using fresh water for long-life
- (6) Proof test selected bearings with deuterated lubricants to confirm long-life performance
- (7) Initiate feasibility model fabrication of a conceptual heat pipe cooling system
- (8) Select most promising hull penetration and distribution concepts for development of advanced sea water systems
- (9) Investigate technology and concepts for improved weapons handling system
- (10)

d. (U) Program to Completion: This is a continuing program.

8. (U) Project F43-434, Propulsor Technology:

- This project combines and focuses efforts related to the development of submarine and surface ship propulsors that were formerly carried on in four separate projects: F43-421 (Fluid Dynamics), F43-422 (Vehicle Structures), F43-432 (Propulsion Technology), and F43-432 (Acoustic Silencing)

a. (U) FY 1982 Program: Not applicable

b. (U) FY 1983 Program:

- (1) Conduct wtc. tunnel tests
- (2) Develop design technology and fabricate and test pre-swirl propulsors
- (3)
- (4) Analyze and document submarine hull response
- (5) Conduct water tunnel tests of forward skew and banded propulsor
- (6)
- (7) Confirm adequacy of fabrication technology for a seven-bladed composite material propeller
- (8) Develop prediction of the effects of reduced and varying stiffness on propeller blade deflections
- (9) Complete water tunnel tests of scale model propellers for propulsion

c. (U) FY 1984 Planned Program:

- (1) Fabricate and test a pre-swirl propulsor for a surface ship
- (2) Complete evaluation and confirmation of technology principles of contrarotating propellers
- (3) Begin development of quiet product propulsors for surface ships
- (4) Investigate effects of manufacturing variations
- (5) Develop technology to minimize bearing loads
- (6) Test and evaluate pre-swirl propulsor
- (7) Initiate development of alternative advanced propulsor concepts
- (8)
- (9) Develop load prediction technology for open, banded and ducted compound propulsors
- (10) Evaluate propeller tracking edge treatments
- (11) Conduct scale model evaluation of internal treatment of ducted propellers
- (12) Complete water tunnel tests of scale model propellers

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

(13) Complete analysis of blade attachment technology for a seven-bladed experimental composite materials propeller and procure attachment model for test

d. (U) Program to Completion: This is a continuing program.

9. (U) Project F43-451, Survivability/Habi-ability/Damage Control:

- This project improves submarine and surface ship combat effectiveness and survivability by reducing non-acoustic observables so as to thwart detection by hostile forces and targeting by weapons, by reducing effects of weapon hits, and by improving capability to service and recover combat capability following damage
- Technology includes protection system and armor for magazines, superstructure and mission-essential spaces against warheads of mines, missiles and torpedoes, including predictive theory for hit probability and weapon effects; effects of shock due to weapons and measures to alleviate them; and methods to control fire and damage resulting from weapon hits

a. (U) FY 1982 Program:

- (1) Developed means of cleaning up salt water used in firefighting
- (2) Evaluated applicability and fire retardant characteristics of ceramic-metallic coatings
- (3) Determined methods of fire suppression by nitrogen pressurization
- (4) Developed water mist concept for fighting fires
- (5) Developed improved models for predicting damage from various weapons
- (6) Developed procedures for assessment of ship vulnerability and for rapid selection of optimum protection features
- (7) Investigated concepts and systems for lightweight protection of topsides of naval ships
- (8) Investigated means to improve resistance of submarine equipment to shock from underwater explosions
- (9) [
- (10) Assessed priorities and reduction goals for the control of various ship signatures
- (11) Developed quantitative assessment of pay-offs for various submarine hardening concepts

b. (U) FY 1983 Program:

- (1) Investigate controlled environments as fire zones and develop integrated fire protection system concept
- (2) [
- (3) Validate radar cross-section prediction model with actual ship survey data
- (4) [
- (5) Continue investigation of new materials for fire resistance
- (6) Develop predictive models for scaling fires using realistic small scale testing
- (7) Complete development of technology for knockdown of smoke and for fighting fires
- (8) Assess effects of oxygen partial pressure and concentration on fire extinguishment and explosions
- (9) Investigate technology and applicability of fully sprinklered ships for fire protection
- (10) Develop improved, coordinated techniques for quick recovery from fire damage
- (11) Continue development of armor protection of magazines against effects of above water weapons

c. (U) FY 1984 Planned Program:

- (1) Continue development of analytical model and physical scale model combined techniques for calculation of ship non-acoustical signatures
- (2) Complete non-acoustical signature design guidelines

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- (3) Complete development effort on fire spread, smoke, and damage control process model to predict the longer term effects of weapon hits on ships
- (4) Continue development of anti-misting additives for fuels and hydraulic fluids to reduce the chance of explosion and rapid spread of fire
- (5) Complete armor systems to protect ships against the specific effects of current threat warhead hits
- (6) Continue development of protection systems for ship magazines against both underwater and above water delivered warheads
- (7) Continue development of design tools and concepts for improved dynamic strength of submarine hulls against underwater explosion attack
- (8) Complete exploration of more efficient and effective means of designing equipment to withstand loadings from underwater explosion

d. (U) Program to Completion: This is a continuing program.

10. (U) Project F43-452, Acoustic Silencing:

- This project is directed toward the development of hardware technology and analytical methods to reduce ships' radiated noise so as to reduce their susceptibility to detection and targeting by acoustic means
- Other major objectives include reduction of ships' self-noise interference with their sonars, to improve sonar performance, and reduction of ships' acoustic target strength so as to make them less detectable by active sonar devices

a. (U) FY 1982 Program:

- (1) Developed technology for predicting
- (2) Developed technology for
- (3)
- (4)
- (5) Evaluated vibration absorber for submarine machinery structures
- (6) Developed optimization techniques
- (7) Determined effectiveness of damping/decoupling treatment
- (8) Developed techniques for avoiding
- (9) Investigated technology to reduce
- (10) Developed objectives for

b. (U) FY 1983 Program:

- (1)
  - (2)
  - (3) Initiate development of internal coating concepts
  - (4) Initiate development of combined
  - (5) Evaluate radiation reduction
  - (6) Analyze and report results
  - (7) Develop technology for increasing local hull noise impedance
  - (8)
  - (9) Analyze and report radiated noise trial related to incomplete hull treatment
  - (10) Reach decision point
- sonar domes and windows

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Title: Ships, Submarines, and Boats Technology

c. (U) FY 1984 Planned Program:

- (1) Develop techniques for predicting and controlling
- (2) Develop high temperature resilient mounts
- (3) Complete investigation
- (4) Complete evaluation of
- (5) Perform experiment and theoretical analysis of combined decoupler/damping treatment
- (6) Reach decision point for new techniques for hull vibration measurement
- (7) Demonstrate new techniques on full scale platform
- (8) Complete data base examination and issue criteria
- (9) Establish data bank
- (10) Initiate development of concepts
- (11) Develop sonar dome boat design
- (12) Based on two-phase flow experiment and theoretical knowledge,

d. (U) Program to Completion: This is a continuing program.

11. (U) Project F43-453, Surface Ship Magnetic Silencing:

- \* This project is directed toward development of a data base to determine the vulnerability of surface ships from weapons actuated by magnetic and low frequency electromagnetic ship signatures
- \* This project will complete exploratory development in FY 1983 and will transition to advanced development in FY 1984 under Program Element 63502N

a. (U) FY 1982 Program:

- (1) Performed ship signature measurements from instrumented ranges in San Diego and Fort Monroe
- (2) Developed data books and made assessments of ship signature data
- (3) Began investigation of available information on mine threats to surface ships
- (4) Prepared preliminary threat summary

b. (U) FY 1983 Program:

- (1) Perform dedicated ship signature measurement data analysis
- (2) Develop and analyze
- (3) Perform comprehensive vulnerability assessment
- (4) Complete underwater systems to determine sources
- (5) Define countermeasures

c. (u) FY 1984 Planned Program: Not applicable

d. (U) Program to Completion: This is a continuing program.

12. (U) Project F43-454, Ship Electromagnetic Compatibility:

- \* This project is directed towards developing technology to minimize undesired electromagnetic radiation effects on electronic systems installed on Navy ships and to identify and minimize Electromagnetic Environmental Effects on Navy systems prior to ship installation



Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

- This technology will maximize the combat effectiveness and availability of electronic systems through control of electromagnetic interference and reducing electromagnetic pulse effects, and will reduce life cycle costs by providing analysis and prediction tools to avoid electromagnetic environmental problems prior to equipment and ship construction and installation
- a. (U) FY 1982 Program:
  - (1) Developed a general numerical modeling capability for antennas operating at UHF and above
  - (2) Developed plan for capability to predict performance of radar and electronic warfare systems in topside electromagnetic environment
  - (3) Completed and demonstrated method to predict electromagnetic pulse vulnerability of ships and systems
  - (4) Developed concept for an advanced filter to suppress electromagnetic interference in audio, power, and non-radio frequency lines
  - (5) Quantified requirements for suppression of electromagnetic interference in existing transmission lines by means of conductive coatings
  - (6) Acquired data base of shipboard powerline transient sources and susceptibilities
  - (7) Develop preliminary recommendations for electromagnetic interference control of below-decks equipment and systems
  - (8) Developed techniques to increase compatibility of shipboard combat systems with the electric power system
  - (9) Initiated development of measurement techniques to determine the performance of power processing systems
- b. (U) FY 1983 Program:
  - (1) Implement capability to predict radar and electronic warfare performance in topside electromagnetic environment
  - (2) Develop approaches for electromagnetic pulse data base to implement method to predict electromagnetic pulse vulnerability
  - (3) Identify requirements of future Navy broadband systems and approaches for incorporating them into current analytical capabilities
  - (4) Develop feasibility demonstration model concepts for advanced electromagnetic interference suppression filters and cable hardening coatings
  - (5) Develop plan to establish feasibility of cancelling electromagnetic interference by signal processing techniques
  - (6) Develop analytical model of shipboard powerline transient sources and susceptibility
  - (7) Validate electromagnetic compatibility prediction program as a tool to automate electromagnetic interference test selection and reduce testing
  - (8) Validate electromagnetic interference data base and control procedures
  - (9) Complete and validate techniques to measure performance of power processing systems
- c. (U) FY 1984 Planned Program:
  - (1) Complete analytical program to predict electronic performance in topside electromagnetic environment
  - (2) Complete data base for prediction of electronic performance in topside electromagnetic environment
  - (3) Complete coding for analysis of future broadband systems
  - (4) Complete electromagnetic pulse data base for prediction of electromagnetic pulse vulnerability
  - (5) Develop feasibility demonstration model for cancellation of electromagnetic interferences by signal processing
  - (6) Develop and validate improved electromagnetic interference models for low frequency radiated emission and conducted emission from internal systems
  - (7) Complete establishment of electromagnetic interference data base and maintenance procedures
  - (8) Document electromagnetic compatibility prediction product for automation of test selection
- d. (U) Program to Completion: This is a continuing program.

Program Element: 62543N

Title: Ships, Submarines, and Boats Technology

13. (U) Project F43-435, Marine Corps Surface Mobility:

- This project provides a technology base of demonstrated components and innovative feasibility models to provide the Marine Corps multiple options for future generations of versatile, lightweight, cost effective, and operationally superior amphibious vehicles
- A special focus effort within this project is to develop the basic technology and demonstrate technical feasibility, through a Technology Demonstrator, of an advanced light armored/amphibious vehicle capable of high water speed (20+ mph)

a. (U) FY 1982 Program:

- (1) Evaluate four concepts for an advanced high water speed amphibious system
- (2) Initiated concept and towing tank model tests of a high water speed Technology Demonstrator
- (3) Completed preliminary analyses and feasibility assessment of a lightweight band track for a high speed amphibian
- (4) Fabricated and completed test installation of clear armor inserts for enhanced visibility for vehicle operations
- (5) Completed concept development and model tests of a small amphibian vehicle
- (6) Completed concept and performance analyses for an improved hydraulic drive train
- (7) Evaluated test of single hydropneumatic suspension unit as sound basis for multiple drive demonstration
- (8) Fabricated and tested lightweight metal matrix track blocks offering 40% weight savings
- (9) Fabricated, tested, and demonstrated technology on laboratory models of lightweight fiber reinforced plastic cargo doors for amphibious vehicles

b. (U) FY 1983 Program:

- (1) Continue concept development and model tests for a high water speed Technology Demonstrator
- (2) Contract for fabrication of feasibility demonstration model of a lightweight band track for a high speed amphibian
- (3) Fabricate and test smaller clear armor inserts and continue to evaluate alternatives
- (4) Prepare and utilize existing amphibian vehicles as test platforms for high speed components
- (5) Fabricate and install test model of hydraulic drive train in surrogate test vehicle
- (6) Install and test multiple drive hydropneumatic suspension
- (7) Fabricate and test lightweight polyurethane track pads
- (8) Fabricate and test full-scale fiber-reinforced plastic cargo doors for reduced weight

c. (U) FY 1984 Planned Program:

- (1) Fabricate full-scale mock-up of selected concept of high water speed Technology Demonstrator and begin design
- (2) Mock-up and evaluate feasibility of two family-of weapons stations for an amphibian vehicle
- (3) Fabricate, install, and test a lightweight band track on a surrogate vehicle
- (4) Test and evaluate feasibility model of hydraulic drive train in surrogate vehicle
- (5) Test and evaluate retractable hydropneumatic suspension for an amphibian vehicle
- (6) Fabricate and test improved metal matrix blocks for a lightweight track
- (7) Fabricate and test novel design track bushings offering 30% increase in life

d. (U) Program to Completion: This is a continuing program.

1. (U) PROJECTS OVER \$0 MILLION IN FY 1984: Not applicable

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# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62633M  
DoD Mission Area: 523 - Engineering Technology

Title: Undersea Warfare Weaponry Technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                           | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                | <b>24,837</b>  | <b>25,423</b>    | <b>29,093</b>    | <b>31,929</b>    | Continuing               | Continuing           |
| F33-311     | Concept Assessment for Weaponry                 | 742            | 509              | 587              | 660              | Continuing               | Continuing           |
| F33-321     | Torpedo Components and Subsystems               | 11,339         | 10,730           | 12,567           | 14,485           | Continuing               | Continuing           |
| F33-322     | Mine Warfare Technology                         | 2,617          | 3,000            | 2,935            | 3,127            | Continuing               | Continuing           |
| F33-323     | Undersea Weapons Combat Control                 | 2,555          | 1,354            | 2,054            | 2,443            | Continuing               | Continuing           |
| F33-324     | Advanced Underwater Weaponry                    | 580            | 730              | 875              | 499              | Continuing               | Continuing           |
| F33-326     | Underwater Weapon Simulation and Target Devices | 1,000          | 1,000            | 1,174            | 1,368            | Continuing               | Continuing           |
| F33-327     | Warheads and Fuzes                              | 3,585          | 5,500            | 5,967            | 6,442            | Continuing               | Continuing           |
| F33-337     | Explosives Development, Effects, and Safety     | 2,419          | 2,670            | 2,934            | 2,905            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- The primary missions are Anti-Submarine, Anti-Ship, and Mine Warfare. Thus torpedoes, mines, warheads, explosives, and combat control are among the principal product lines. This is one of several Category 6.2 Program Elements that address only Navy unique needs.
- Improves undersea warfare weapons and weapon systems, and develops technology related to these weapons and their sub-systems such as guidance and control, propulsion, hydrodynamics, countermeasure protection, target acquisition, mine sensors, fire control, batteries, warheads, fuzes, propellants, explosives, and related chemistry.
- The funding for FY 1984 is requested to address the following rapidly emerging Soviet Threat advances:

- Appearance/deployment of higher speed, deeper diving, submarine targets such as ALFA, OSCAR, and TYPHOON
- Reduction in submarine
- Operations in

These factors require the acceleration of certain current tasks and the initiation of new efforts -- for example:

- weapons are needed ... such as a future high performance, half length torpedo that would allow submarines to carry more weapons ... some performance goals are:
- Increased attention for technologies such as guidance and control, terminal homing and payload placement, propulsion, warheads, and combat control
- Advances in these technologies will transition into improvements of current fleet weapons (such as the MK-48 torpedo, CAPTOR mine, etc.) or be used to establish the basis for continued development of future weapons (such as Advanced Lightweight Torpedo (ALWT), Submarine Advanced Combat System (SUBACS), Stand-off Weapon (SOW), etc.)

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

Changes in the Program Element and Project funding profile between the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:

- FY 1982: Slight differences between FY 1982 estimate and actual expenditures (net of -183) are due to variances in planning, scheduling, and estimating
- FY 1983: A reassessment of the submarine threats, resulted in Increased emphasis) latest estimates of the Soviet ALFA, TYPHOON, and OSCAR ]-- Several other areas were necessarily de-emphasized
- -- Total element funding increased some (+359)
- FY 1984: The overall program element funding was reduced by 1,986 as a result of prioritization among all programs in exploratory development -- Emphasis was maintained in the Warhead and Fuse area resulting in reductions in other areas

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                           | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                       | 21,526         | 25,022           | 25,064           | 31,079           | Continuing               | Continuing           |
| F33-311     | Concept Assessment for Weaponry                 | 881            | 750              | 600              | 800              | Continuing               | Continuing           |
| F33-321     | Torpedo Components and Subsystems               | 10,658         | 11,288           | 11,269           | 14,979           | Continuing               | Continuing           |
| F33-322     | Mine Warfare Technology                         | 2,725          | 2,720            | 2,585            | 3,300            | Continuing               | Continuing           |
| F33-323     | Undersea Weapons Combat Control                 | 800            | 2,575            | 2,324            | 3,380            | Continuing               | Continuing           |
| F33-324     | Advanced Underwater Weaponry                    | 770            | 495              | 495              | 500              | Continuing               | Continuing           |
| F33-326     | Underwater Weapon Simulation and Target Devices | 1,050          | 1,050            | 1,050            | 1,050            | Continuing               | Continuing           |
| F33-327     | Warheads and Fuses                              | 2,198          | 3,700            | 4,080            | 4,380            | Continuing               | Continuing           |
| F33-337     | Explosive Devices Effects Safety                | 2,444          | 2,444            | 2,661            | 2,690            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Undersea Target Surveillance (P.E. 62711N), cooperate on development of sensors and detection schemes; Ocean and Atmospheric Support (P.E. 62759N), share environmental data; Countermasures (P.E. 62734N), mining concerns; and, Defense Advanced Research Project Agency (DARPA), work together on batteries and propulsion concepts

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Ocean Systems Center, San Diego, CA; Naval Underwater Systems Center, Newport, RI; Naval Coastal Systems Center, Panama City, FL; Naval Undersea Warfare Engineering Station, Keyport, WA; Naval Ordnance Station, Indian Head, MD; David W. Taylor Naval Ship Research and Development Center, Carderock, MD; Naval Air Development Center, Warminster, PA; Naval Weapons Center, China Lake, CA
- INDUSTRIAL - Raytheon, Bedford, MA; McDonnell Douglas, Huntington Beach, CA; Westinghouse, Annapolis, MD; Morrison Analytics, Chicago, IL; Texas Instruments, Dallas, TX; Singer Co., Librascope Division, Glendale, CA; General Electric Co., Syracuse, NY; Pacific-Sierra, Palo Alto, CA; Sundstrand, Rolling Meadows, IL; Tracor, Inc., Rockville, MD; Honeywell, Minneapolis, MN; Lockheed Aerospace Corp., Palo Alto, CA; GTE, Waltham, MA; Gould, Cleveland, OH
- ACADEMIC - Applied Physics Laboratory, University of Washington, Seattle, WA; Applied Research Laboratory, Pennsylvania State University, State College, PA; Applied Research Laboratory, University of Texas, Austin, TX

Program Element: 62633M

Title: Undersea Warfare Weaponry Technology

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F33-311, Concept Assessment for Weaponry:

- Work under this subproject will allow the Navy to benefit from operational analysis and systems studies to define the impact of problems/Navy needs on future ASW and mine warfare weapons characteristics and assess technology shortfalls. Broadly, tasks in this project will consist of analysis on the Advanced Submarine Launched Torpedo (ASLT), the Post-ALMT lightweight torpedo, minefield options and a comprehensive multi-mission warfare suit

a. (U) FY 1982 Program:

- (1) Completed large scale engagement modeling [ ] with current fleet search and approach tactics for an Advanced Submarine Launched Torpedo (ASLT)
- (2) Completed analytic evaluation of Torpedo MK-48 Advanced Capability (ADCAP) torpedo [ ]
- (3) Developed point designs for [ ] sonar systems, with [ ]
- (4) For the ASW Stand-Off Weapon, examined alternate weapon concepts, defined target localization accuracies, and evaluated performance sensitivities to tactical and threat parameters

b. (U) FY 1983 Program:

- (1) Continue mission level and requirement sensitivity studies for Advanced Submarine Launched Torpedo (ASLT) to determine effect of acoustic countermeasures on propulsion and guidance requirements
- (2) Develop requirements analyses for a torpedo [ ]
- (3) For Advanced Submarine Launched Torpedo (ASLT) define acoustic performance requirements and weapon homing system acoustic characteristics [ ] in a variety of environments
- (4) For future torpedo designs, conduct studies of [ ] capability and expand counter-countermeasure performance goals
- (5) For undersea mines, assess the impact of new technologies [ ] on mine warfare
- (6) Develop techniques and methodologies to permit quantitative assessments of mining missions and the impact of mine technology

c. (U) FY 1984 Planned Program:

- (1) Finalize Advanced Submarine-Launched Torpedo (ASLT) performance requirements (including countermeasure resistance)/ design studies; begin follow-on weapon configuration analysis; and evaluate potential sub-systems
- (2) Investigate the impact of acoustic countermeasure considerations on propulsion system size and weight for Advanced Submarine-Launched Torpedo (ASLT) missions; complete notional systems requirements studies
- (3) Update propulsion performance requirements for Advanced Submarine-Launched Torpedo (ASLT)
- (4) For Advanced Submarine-Launched Torpedo (ASLT) redefine [ ] significant changes in threat definition -- establish criteria for trade-offs with other performance goals
- (5) For future torpedo designs determine propulsion performance sensitivities to [ ]
- (6) Identify and prioritize mine technology thrust options -- provide cost effectiveness assessment of particular mining concepts and associated required technology

d. (U) Program to Completion: This is a continuing program.

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Program Element: 62633H

Title: Undersea Warfare Weapons Technology

2. (U) Project F33-322, Mine Warfare Technology:

- New mine technology is urgently needed to counter the growing Soviet undersea and surface threat. The technology base must be maintained and ultimately for a CAPTOR follow-on system. This work includes:

- Assess the capabilities of new and improved mine sensors
- Examine stand-off and covert mine delivery techniques to reduce the exposure of high value aircraft and submarine delivery vehicles to enemy fire and acoustic and non-acoustic methods of controlling mines after they are planted
- Extend minefield theory and planning methodology to aid designers of new mines and to improve efficiency of minefields
- Examine various countermeasure resistance proposals for the purpose of decreasing the susceptibility of planted mines to enemy countermeasures and thus increase the mine's in-water life

a. (U) FY 1982 Program:

- (1) Completed initial tests which indicated detection at ranges in excess of feasible. Established limits of sensitivity, power, and signal-to-noise ratio
- (2) Made advances in the development of
- (3) The first mine warfare master plan was generated and submitted to Director, Naval Warfare
- (4) Numerous proposed designs for a were evaluated; four were selected for further consideration
- (5) Completed at-sea test of a transmitter and receiver
- (6) Initiated planning in FY81 for a joint U.S./NATO field program to obtain at-sea data in NATO waters
- (7) Field tests at the Fort Monroe, VA test facility have been completed for applicability of
- (8) Completed laboratory tests of components of
- (9) target characteristics of 90 ship encounters were analyzed. Two years of have been recorded and statistically analyzed

b. (U) FY 1983 Program:

- (1) Devise methodology for achieving a variable computer assisted minefield site selection
- (2) Test experimental
- (3) Continue development of minefield situations theory of the behavior of
- (4) Study the four concepts with emphasis on survivability, navigation and cost
- (5) Identify requirements for
- (6) Initiate development of a as an alternative
- (7) Complete additional field tests and algorithm development work and analysis of field test results
- (8) Complete targets and
- (9) Complete background characterization
- (10) Continue environmental data recording and analysis

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

c. (U) FY 1984 Planned Program:

- (1) Complete methodology dealing with assets allocation between multiple minefields
- (2) Complete theory for multiple mine theory asset allocation
- (3) Define concepts for mine delivery
- (4) Transition design for an sensor for mines
- (5) Conduct sea-test of sensor for mines
- (6) Verify capability to predict detection ranges
- (7) Complete documentation for transitioning to advanced development
- (8) Fabricate brassboard mine Target Detection Device (TDD), field test, and document, for transition to advanced development

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F33-323, Undersea Weapons Combat Control:

- This effort will provide combat control techniques for subs and surface ships that will permit rapid and accurate weapon targeting and weapons setting/control compatible with future engagement scenarios — The work will:
  - Develop rapid and accurate target localization and motion analysis capabilities
  - Develop improved data management and man-machine interface capabilities to enhance command decision making without increasing the underwater combat control (UCC) operators
  - Develop improved targeting and control of weapons
  - Develop system for surface ship combat control

a. (U) FY 1982 Program:

- (1) Developed and tested a new target motion analysis technique for submarines which improves accuracy and reduces fire control solution time
- (2) Developed Target Motion Analysis (TMA) techniques which improve the solution quality  
Technology transitioned to advanced development program
- (3) Developed advanced operator display and torpedo guidance concepts for the MK-48 Advanced Capability Torpedo.  
Technology transitioned to advanced development
- (4) Developed search techniques for homing weapons which compensate for target location uncertainty
- (5) Developed a tracking algorithm with automatic track initiation
- (6) Analyzed forward area sensor test data to investigate key technical issues relative to subsurface localization techniques
- (7) Designed prototype Surface Ship Underwater Combat Control System
- (8) Defined Target Motion Analysis (TMA) model
- (9) Defined combat control system data flow

b. (U) FY 1983 Program:

- (1) Demonstrate and evaluate Target Motion Analysis (TMA) technique
- (2) Complete targeting concept analysis
- (3) Assess the potential contribution of off-board sensors to fire control improvement
- (4) Construct surface ship Underwater Combat Control (UCC) prototype system
- (5) Complete initial simulation studies of prototype data association algorithms
- (6) Complete Target Motion Analysis (TMA) algorithm assessment for surface ships

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Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

c. (U) FY 1984 Planned Program:

- (1) Develop [ ] Target Motion Analysis (TMA) concepts which account for environmental factors
- (2) Complete test of surface ship Underwater Combat Control (UCC) system
- (3) Develop sea test plan for surface ship [ ] Target Motion Analysis (TMA) and localization capabilities
- (4) Conduct studies to categorize the decision support techniques necessary to reduce operator decisions
- (5) Implement data association algorithms into prototype surface ship Underwater Combat Control (UCC)
- (6) Develop and test algorithms for operator decision support and man-machine interface
- (7) Develop [ ] surface ship Target Motion Analysis (TMA) algorithms, tactics, and [ ] communications requirements
- (8) Complete fire control reacquisition sensor concept design
- (9) Develop [ ] ASW targeting concepts/techniques for submarine launched ASW missiles

d. (U) Program to Completion: This is a continuing program.

4. (U) Project F33-324, Advanced Underwater Weaponry:

- Projections of future countermeasure capability and reductions in enemy submarine [ ]

[ ] system and this work includes:

- Development of a [ ]
- Development of a [ ]
- Development of a [ ]
- Development of the necessary guidance system

- To counter projected [ ] delivery system suitable for the lightweight torpedo will be developed -- This concept is termed GLITOR

a. (U) FY 1982 Program:

- (1) Utilized [ ] to evaluate candidate [ ]
- (2) Developed and evaluated a successful [ ]
- (3) Completed field experiment [ ] demonstrating its utility for torpedo demonstration purposes
- (4) Completed comparison of [ ] algorithms and selected [ ] as higher payoff approach, and developed [ ]
- (5) Quantified military usefulness of [ ]
- (6) Completed [ ] algorithm design to minimize sensor design requirements
- (7) Developed and tested prototype [ ]

b. (U) FY 1983 Program:

- (1) Continue development of [ ]
- (2) Establish requirements for the [ ]

c. (U) FY 1984 Planned Program:

- (1) Complete preliminary design of [ ]



Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

- (2) Complete development of algorithm
- (3) Evaluate
- (4) Complete concept demonstration

d. (U) Program to Completion: This is a continuing program.

5. (U) Project F33-326, Underwater Weapon Simulation and Target Devices:

- The Navy seriously needs a technology base for the development of to provide a cost effective means of meeting the Navy's research and development and training requirements -- The following effort is being performed to solve this severe problem:

- Develop a data base for use in ASW threat definition; algorithm development for a detection, classification and homing system
- Develop simulation techniques and artificial targets which accurately duplicate the

a. (U) FY 1982 Program:

- (1) An was measured for active target strength levels
- (2) Extracted close range steering angle data from at-sea field data investigations for use in exploratory development, Advanced Lightweight Torpedo (ALMT) and Torpedo MK-48 Advanced Capability (ADCAP) programs
- (3) Exchanged computer submarine target models and experimental data with United Kingdom engineers and scientists under The Technical Cooperation Program (TTCP)
- (4) Completed comparison of with United Kingdom model (joint U.S./U.K. effort)
- (5) Analyzed U.S. SSN FLASHER data obtained
- (6) Conducted at-sea tests on real targets to develop data base
- (7) Parametric models for array stability comparison and projection completed
- (8) Started detailed analysis of real target characteristics to define design parameters for mobile targets
- (9) Developed and tested an instrumented towed target array to quantify array stability and motions

b. (U) FY 1983 Program:

- (1) Complete measurements on USS Ex-MENHADEN for developing models and simulations
- (2) Conduct joint U.S./U.K. acoustic measurements
- (3) Conduct acoustic measurements to obtain data base
- (4) Initiate design of fixed weapon target to provide stationary target for the Advanced Lightweight Torpedo (ALMT) and the Advanced Capability (ADCAP) torpedo proofing
- (5) Initiate verification of towed array computer model

c. (U) FY 1984 Planned Program:

- (1) Complete joint U.S./U.K. acoustic measurement program
- (2) Perform joint U.S./U.K. acoustic measurements
- (3) Continue participation in the and analysis of resulting data

Program Element: 52633N

Title: Undersea Warfare Weaponry Technology

- (4) Verify a developed computer model of a generic mobile target towed array
- (5) Complete exploratory development on the fixed weapon target technical phase
- (6) Develop new signal processing technology so mobile targets can operate suitably
- (7) Design an experimental directive \_\_\_\_\_ utilizing multiple directive transducer modules
- (8) Build an experimental signal processor to demonstrate and evaluate new algorithms

d. (U) Program to Completion: This is a continuing program.

6. (U) Project F33-327, Warheads and Fuzes:

- \* The objective of this work is to develop warhead damage mechanisms and designs to provide lightweight and heavyweight torpedoes with high kill probabilities against \_\_\_\_\_ submarines and surface vessels — This work consists of:

- Development of \_\_\_\_\_
- Development of \_\_\_\_\_
- Development of \_\_\_\_\_
- Development of \_\_\_\_\_
- Assessment of \_\_\_\_\_
- Conduct \_\_\_\_\_ to threat submarines
- Development of multi-purpose \_\_\_\_\_

a. (U) FY 1982 Program:

- (1) \_\_\_\_\_ developed for the basic ship attack mode of the MK-48 Torpedo
- (2) The survivability and performance of a full-scale \_\_\_\_\_
- (3) Analyses showed \_\_\_\_\_
- (4) Studies of \_\_\_\_\_

b. (U) FY 1983 Program:

- (1) Complete full scale flat plate tests
- (2) Establish damage performance of \_\_\_\_\_
- (3) Conduct test for \_\_\_\_\_ on 1/27th scale Model
- (4) Design, fabricate, and test \_\_\_\_\_
- (5) Continue analysis and small scale testing on multi-purpose warhead concepts
- (6) Establish configuration for \_\_\_\_\_
- (7) Initiate target definition relative to \_\_\_\_\_

c. (U) FY 1984 Planned Program:

- (1) Procure 1/5 full scale submarine target model and test
- (2) Initiate efforts on \_\_\_\_\_
- (3) Optimize \_\_\_\_\_ warheads for generic or MK-48 Advanced Capability (AECAP) torpedo
- (4) Conduct small scale \_\_\_\_\_ tests against simple targets
- (5) Complete design and initiate construction of \_\_\_\_\_

d. (U) Program to Completion: This is a continuing program.

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

7. (U) Project F33-337, Explosives Development, Effects and Safety:

Very high performance explosives are required to conform to service restrictions in weight and space — This work will provide explosive material, comparative effects data, and the technology base to assure that all Navy weapon system warheads, fuzes, and other explosive loaded devices can meet specified requirements of safety, reliability, and effectiveness — This effort includes:

- Development of more effective and safer explosive compounds
- Development of explosive ingredients which will have favorable processing properties, high energy output, maximum insensitivity, and minimum cost
- Characterization and modeling of the free field shock wave and bubble generated by underwater explosives
- Measurement and prediction of the interaction between an underwater explosion and simple and complex targets
- Development of predictive methods for use with new underwater explosives
- Development of initiation theory
- An attempt to understand, model, and control the detonation process from inception of reaction to stable detonation and to apply such understanding of all reaction stages towards the solution of fleet ordnance survivability and performance problems
- Design and sensitivity evaluation of percussion, stab and electrically initiated primers and detonators; advantageous fabrication and loading methods; and interface reliability and safety evaluation methods

- This program initiates development of all in-service warhead explosives for air launched, surface launched, and submarine launched weaponry

a. (U) FY 1982 Program:

- (1) Completed development and interim qualification testing of cast-cured plastic-bonded explosives (PBX) compositions including two mechanically strong booster explosives, an underwater explosive with improved safety, and two deformable explosives which resist setting and hardening in long term storage
- (2) Synthetic efforts produced new high density explosives including the compound DTN, which is now the most dense carbon-hydrogen-fluorine-nitrogen-oxygen (CHFPNO) explosive known in the free world and a DTN analog which could be used as a casting medium
- (3) Demonstrated conditions to achieve high yield reaction of magnesium in explosive/magnesium/water arrangements
- (4) Developed ultrasonically assisted extrusion methods for loading extrudable explosives into thin channels

b. (U) FY 1983 Program:

- (1) Continue development of insensitive high performance explosives based on energetic binder ingredients and new explosive compounds
- (2) Complete assessments of ingredients and laboratory scale bubble tests for high bubble energy explosive
- (3) Assess cast cure designs for high temperature resistant explosive
- (4) Complete statistical analysis technique to guide design and establish confidence levels for underwater explosion tests and data

c. (U) FY 1984 Planned Program:

- (1) Continue development of insensitive high performance explosives based on energetic binders and new compounds
- (2) Continue development of prediction techniques and data base for underwater explosive performance
- (3) Develop shock, impact, and thermal initiation data for incorporation into mass detonability model
- (4) Continue evaluation of effects of controlled damage on sensitivity of explosives
- (5) Evaluate candidate high bubble energy explosion designs

Program Element: 62633M

Title: Undersea Warfare Weaponry Technology

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(A) (U) Project F33-321, Torpedo Components and Subsystems:

1. (U) DESCRIPTION (Requirement and Project):

- This program provides the technology for greatly improved torpedo performance to counter high performance ASW threats now operational — Objectives are improved target acquisition and homing; increased speed, depth and endurance; lower radiated and self noise; and appreciably reduced hull drag — Recent homing system, propulsion, weapon silencing, hydrodynamic and drag reduction accomplishments have transitioned into the Advanced Lightweight Torpedo (ALWT), the torpedo MK-48 Advanced Capability (ADCAP) and the Advanced Expendable Training Target advanced development programs — This program provided the closed cycle steam turbine engine and MUSCAL electric battery propulsion options for the Advanced Lightweight Torpedo (ALWT) advanced development model — It also established the technology base for the guidance and control systems under development for ALWT and ADCAP — Specifically, this work includes:

- Weapon Guidance and Control:

- Develop technology to maintain adequate detection, acquisition, and homing capability against the evolving high speed, deep-diving submarine threat — This includes the technology to and against countermeasures

- Propulsion:

- Increase weapon propulsion energy and power density in the following approaches:
  - Closed cycle steam turbine Stored Chemical Energy Propulsion System (SCEPS), now in Advanced Lightweight Torpedo (ALWT) advanced development, in an Advanced Stored Chemical Energy Propulsion System (ADSCEPS) configuration.
  - Two high rate lithium battery electric propulsion systems are being developed
  - A high power to weight ratio electric inverter-motor is being investigated

- Hydrodynamics/Weapon Silencing:

- Develop low noise component technology
- Reduce self-noise at high torpedo speeds to permit high speed homing against quiet targets
- Reduce torpedo radiated noise to minimize own ship sonar masking and target alertment

- Drag Reduction for Weapons:

- Demonstrated a reduction in drag with in-water tests of the
- Pursue three approaches to drag reduction technology to achieve higher weapon speeds and greater endurance:

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

- Drag reduction technology supports the design/development [ ] concept for an Advanced Submarine Launched Torpedo (ASLT)

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

Weapon Guidance and Control:

- (1) Obtained at-sea data and evaluated an [ ] homing technique
- (2) Awarded contracts for developing and evaluating a [ ] capability and obtained at-sea self-noise measurements [ ]
- (3) Advanced [ ] concept evaluated and transitioned to the Advanced Lightweight Torpedo (ALMT) to assist in their current [ ] efforts.
- (4) Transitioned to Advanced Lightweight Torpedo (ALMT) [ ] concepts for improving torpedo capabilities [ ]
- (5) Completed fabrication of a [ ]
- (6) Completed plan and initial feasibility studies for joint effort with Defense Advanced Research Project Agency (DARPA) [ ] Completed preliminary ranging and homing algorithms for the concept.
- (7) Conducted at-sea test with [ ]
- (8) Demonstrated capability to [ ]
- (9) Developed and demonstrated [ ]
- (10) Completed theoretical development and tested in-water an advanced passive concept [ ]

Propulsion:

- (11) Completed breadboard design of [ ] high performance propulsion system [ ]
- (12) Completed high temperature Stored Chemical Energy Propulsion System (SCEPS) closed cycle steam turbine boiler design and tests [ ]
- (13) Successfully tested scaled-up [ ]
- (14) Demonstrated electric motor technology at a power ratio above [ ]

Hydrodynamics/Weapons Silencing:

- (15) Conducted in-water tests proving [ ]
- (16) Demonstrated [ ]
- (17) Achieved, by [ ]
- (18) Designed and tested [ ]
- (19) Fabricated composite material transducers [ ]
- (20) Demonstrated in laboratory [ ]

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

Drag Reduction for Weapons:

- (21) Completed construction of the free-running vehicle, designated Low Drag Vehicle-2, and commenced range testing
- (22) Identified as significant performance factors
- (23) Demonstrated that performance of underwater vehicles

b. (U) FY 1983 Program:

Weapon Guidance and Control:

- (1) Develop and evaluate
- (2) Complete algorithm development for improved
- (3) Demonstrate system feasibility and performance capabilities
- (4) Conduct moving platform at-sea tests to validate simulation results
- (5) Conduct at-sea tests to validate simulation results
- (6) Complete feasibility studies of an improved concept
- (7) Continue efforts for developing precise, reliable, capability for includes in-water testing
- (8) Conduct flow noise evaluation test module
- (9) Complete analysis of at-sea data and update signal processing
- (10) Document a first iteration of torpedo tactics for improving torpedo performance

Propulsion:

- (11) Complete component tests for Advanced Stored Chemical Energy Propulsion System (ADSCEPS) including turbine wheels and initiate Stand-off Weapon (SOW) brassboard ADSCEPS fabrication
- (12) Complete 50-cell tests on a 12 3/4-inch diameter battery
- (13) Test power Darlington inverter for a high power-to-weight ratio electric propulsion motor
- (14) Begin multi-stack development of a high rate battery
- (15) Complete design of brassboard of electric propulsion system and initiate material procurement

Hydrodynamics/Weapons Silencing:

- (16) Conduct in-water demonstration of quiet propulsors
- (17) Conduct tests using a MK-48 torpedo
- (18) Start design of a deep depth

Drag reduction for Weapons:

- (19) Test performance of Improved Performance Undersea Vehicle (IPUV) in salt water tank at NASA, Langley
- (20) Develop Improved Performance Undersea Vehicle (IPUV) and test in tank at NASA, Langley Facility
- (21) Redesign Improved Performance Undersea Vehicle (IPUV) and prepare for free running field tests in Dabob Bay in FY84

Program Element: 62633N

Title: Undersea Warfare Weaponry Technology

c. (U) FY 1984 Planned Program:

Weapon Guidance and Control:

- (1) Conduct
- (2) Complete algorithm applicable to
- (3) Complete selection of development Guidance and Control (G&C) technologies for Advanced Submarine-Launched Torpedo (ASLT)
- (4) Complete preliminary evaluation

Propulsion:

- (5) Conduct Improved Stored Chemical Energy Propulsion System (SCEPS) subsystem tests
- (6) Conduct Advanced SCEPS (ADSCEPS) test cell performance tests
- (7) Complete electric motor inverter development
- (8) Complete physical chemical properties study for battery
- (9) Complete 50 cell tests on a 21" diameter battery
- (10) Begin development of rechargeable lithium battery for undersea target vehicle propulsion

Hydrodynamics/Weapon Silencing:

- (11) Design, fabricate, and initiate tests of Quiet Transducer 4
- (12) Complete range tests with Weapon Silencing Research Vehicle
- (13) Evaluate composite transducer on MK-48 torpedo

Drag Reduction for Weapons:

- (14) Complete construction of test vehicle
- (15) Initiate drag reduction

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62711N

Title: Undersea Target Surveillance

DoD Mission Area: 521 - Electronic and Physical Sciences

Budget Activity: 1 - Technology Base

(U) RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                        | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>             | <b>35,714</b>  | <b>37,628</b>    | <b>40,930</b>    | <b>44,421</b>    |                          |                      |
| F11-111     | Concept Assessment for Undersea Surveillance | 6,227          | 592              | 579              | 656              | Continuing               | Continuing           |
| F11-121     | Acoustic Arrays for Undersea Surveillance    | 9,403          | 17,057           | 18,993           | 20,043           | Continuing               | Continuing           |
| F11-122     | Acoustic Transduction Technology             | 2,735          | 2,185            | 1,765            | 2,213            | Continuing               | Continuing           |
| F11-123     | Acoustic Processing Technology               | 11,238         | 12,526           | 13,716           | 15,032           | Continuing               | Continuing           |
| F11-124     | Nonacoustic Antisubmarine Warfare (ASW)      | 3,938          | 3,633            | 4,745            | 4,068            | Continuing               | Continuing           |
| F11-125     | Target Signal Characteristics                | 838            | 645              | 638              | 710              | Continuing               | Continuing           |
| F11-132     | Optical/Infrared/Ultraviolet Surveillance    | 966            | 590              | 491              | 549              | Continuing               | Continuing           |
| F11-133     | Sensor Integration                           | 369            | -----            | -----            | 1,150            | Continuing               | Continuing           |
| F11-555     | Arctic Surveillance                          | -----          | 400              | *                | *                | Continuing               | Continuing           |

\* Program being formulated in conjunction with select OPNAV panel. FY 1984/1985 funding levels will be adjusted during development of FY 1984 Apportionment and FY 1985 Budget.

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION WORK:

- Investigates the relevance and technical feasibility of potential solutions to Navy operational needs in Undersea Target Surveillance
- The work in this program element supports the full spectrum of undersea target surveillance from close-in tactical operation to long-range undersea surveillance.
- Because acoustic techniques are the most effective means of locating and tracking undersea targets, the effort is heavily oriented toward acoustics programs.
- Increased emphasis is being placed on new and improved acoustic [ ]
- The most critical problem being addressed is the detection, classification, and localization of the [ ]
- The effort is grouped into the following seven areas:
  - Fixed Sensor Systems -- medium to long range surveillance, Arctic surveillance, and Bottom Distributed Systems;
  - Mobile Shipborne and Airborne Sensor Systems -- passive and active acoustics for short to medium range tactical surveillance;
  - Towed Array Sensor Systems -- for both tactical and long-range surveillance;
  - Off-Board (deployed/free floating) Sensor Systems -- primarily air-launched sensors for tactical and/or barrier surveillance;
  - Nonacoustic -- bioluminescence, magnetic, and wake detection surveillance;
  - Active Adjunct to Undersea Surveillance -- long-range, low frequency, active acoustic surveillance from a mobile platform;
  - Generic Surveillance Technology -- technology applicable to many undersea target surveillance systems irrespective of platform (e.g., standards and calibration, target characteristics, etc).



Program Element: 62711N

Title: Undersea Target Surveillance

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: total program changes of -96 in FY 1982, -338 in FY 1983, and -1630 in FY 1984 are the result of overall budget adjustments to the technology base and revision of cost estimates.
- Technology feasibility demonstrations are transferred from F11-111 in FY 1982 (Active Adjunct to Undersea Surveillance, Advanced Autonomous Array, and Fiber Optic Distributed System) to F11-121. Arctic Surveillance is transferred to F11-555.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                        | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>             | <b>36,806</b>  | <b>35,810</b>    | <b>37,966</b>    | <b>42,560</b>    | Continuing               | Continuing           |
| F11-111     | Concept Assessment for Undersea Surveillance | 4,625          | 6,105            | 5,671            | 6,070            | Continuing               | Continuing           |
| F11-119     | Navy Science Assistance Program (NSAP)       | 3,000          | *                | *                | *                | Continuing               | Continuing           |
| F11-121     | Acoustic Arrays for Undersea Surveillance    | 8,113          | 9,088            | 10,399           | 11,464           | Continuing               | Continuing           |
| F11-122     | Acoustic Transduction Technology             | 3,350          | 2,827            | 2,230            | 2,367            | Continuing               | Continuing           |
| F11-123     | Acoustic Processing Technology               | 10,306         | 11,644           | 13,466           | 16,285           | Continuing               | Continuing           |
| F11-124     | Nonacoustic Antisubmarine Warfare (ASW)      | 4,406          | 3,931            | 4,230            | 4,429            | Continuing               | Continuing           |
| F11-125     | Target Signal Characteristics                | 1,300          | 860              | 815              | 887              | Continuing               | Continuing           |
| F11-131     | Radio Frequency Surveillance                 | 350            | -----            | -----            | -----            | -----                    | -----                |
| F11-132     | Optical/Infrared/Ultraviolet Surveillance    | 975            | 985              | 1,155            | 1,058            | Continuing               | Continuing           |
| F11-133     | Sensor Integration                           | 400            | 370              | -0-              | -0-              | Continuing               | Continuing           |

\* Transferred to P.R.'s 62766N and 25658N

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES:

- Close liaison is maintained with the Ocean Monitoring and Control Division of the Defense Advanced Research Projects Agency in areas such as surveillance arrays and sophisticated signal-processing techniques through joint program reviews, workshops, symposia, and informal discussions.
- Related program elements are:

62543N, Ships, Submarines, and Boats Technology  
 62633N, Undersea Warfare Weaponry Technology  
 62721N, Command and Control Technology  
 62762N, Electronic Device Technology

62734N, Countermeasures Technology  
 62759N, Ocean and Atmospheric Support Technology  
 62761N, Materials Technology

G. (U) WORK PERFORMED BY:

- INDUSTRIAL** - Applied Research Laboratory, University of Texas, Austin, TX; Bell Telephone Laboratory, Whippany, NJ; Bolt, Beranek and Newman, Cambridge, MA; RCA, Burlington, MA; Systems Development Corp., San Diego, CA; Gould, Inc., Glen Burnie, MD; Sanders Associates, Nashua, NH; Hydroacoustics, Inc., Rochester, NY; Polar Research Lab, Santa Barbara, CA; Sperry Univac, St. Paul, MN; plus 20 additional companies.
- IN-HOUSE** - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Air Development Center, Warminster, PA; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC, and Orlando, FL; Naval Surface Weapons Center, White Oak, MD; Naval Underwater Systems Center, New London, CT, and Newport, RI; Naval Civil Engineering Laboratory, Port Hueneme, CA.

Program Element: 62711N

Title: Undersea Target Surveillance

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F11-111, Concept Assessment for Undersea Surveillance:

- This project comprises quantitative analyses to determine the value of new concepts to the Navy, relative to operational requirements and to costs and capabilities of existing or alternative concepts.
- The objectives are to exploit technology innovation by earlier identification of prospective applications and to identify technology gaps which are crucial to the success of a new concept.
- Concept Assessments include preliminary formulation of systems concepts, system feasibility, effectiveness, and experimental investigations of system feasibility to the degree required to determine whether further development should proceed under another project.

a. (U) FY 1982 Program:

Fixed Sensor System:

- (1) Fiber Optic Distributed System is transferred to F11-121 in FY 1983
- (2) Arctic Surveillance is transferred to F11-155 in FY 1983
- (3) Initiated a Fiber Optic Bottom Distributed Systems Program and conducted an at-sea data collection experiment
- (4) Defined candidate signal processing algorithms for the Fiber Optic Distributed System
- (5) Investigated
- (6) Measured relative current differential
- (7) Analyzed existing Arctic ice cover data to determine the statistics of open or thin ice leads in marginal ice zones
- (8) station
- (9) Program plan defined for the development of a

Mobile (Airborne and Shipborne) Sensor Systems

- (10) Completed assessment of performance problems/operational requirements of current generation sonar systems
- (11) Initiated analysis for SSN operational needs keyed to mid-1990's threats (includes ALFA and OSCAR)

Off-Board Sensor Systems

- (12) Advanced Autonomous Array Program transferred to F11-121 in FY 1983
- (13) Advanced Autonomous Array improved suspension and tensioning systems were developed and tested
- (14) Conducted first sea test of window shade drogue and wave actuated tensioning device for deployed systems
- (15) Alternative communication systems for Advanced Autonomous Array investigated and two candidate low-power transmission techniques identified
- (16) Initial analysis for the Advanced Autonomous Array completed
- (17) Advanced Autonomous Array hydrophone string redesigned and one array fabricated
- (18) Improved shore processing algorithms and display system defined for the Advanced Autonomous Array
- (19) Developed performance model for deployable array
- (20) Defined scenario
- (21) Developed simulations for sonobuoys in the direct support role
- (22) Air ASW shallow water capability assessment

Program Element: 62711N

Title: Undersea Target Surveillance

Active Adjunct to Undersea Surveillance

- (23) Active Adjunct to Undersea Surveillance transferred to Fil-121 in FY 1983
- (24) acoustic sources (including a spare source) constructed and testing initiated
- (25) All major sea test hardware procured, handling system fabrication initiated, and deployment tests conducted at sea
- (26) Shipboard installation plans completed and lease of ship for sea test initiated
- (27) At-sea test plan completed

b. (U) FY 1983 Program

Mobile (Airborne and Shipborne) Sensor Systems

- (1) Continue to develop and analyze basic search and prosecution tactics for various missions
- (2) Complete a summary of propagation and noise models and the required data bases for evaluating sonar performance
- (3) Conduct assessment of technology impact associated with projected threats under different environmental/operational requirements
- (4) Test and evaluate preliminary design for high-altitude, rapid-deployment sonobuoy

Off-Board Sensor Systems

- (5) Initiate low cost sonobuoy development concept
- (6) sensor performance assessment initiated
- (7) Develop model for direct support role of sonobuoys

c. (U) FY 1984 Planned Program

Mobile (Airborne and Shipborne) Sensor Systems

- (1) Complete the study to develop and analyze basic search and prosecution tactics
- (2) Complete the identification of missions and scenarios and determine implications for sonar technology
- (3) Complete the tactical sonar performance assessment against mid 1990's threats with different environmental and operational requirements

Off-Board Sensor Systems

- (4) Evaluate model for direct support role of sonobuoys
- (5) Evaluate low cost sonobuoy performance in barrier, choke points, and other Air ASW scenarios
- (6) Investigate sensor capabilities
- (7) Evaluate sensor capabilities

d. (U) Program to Completion: This is a continuing program.

**Title: Undersea Target Surveillance**

This project comprises the technology of converting acoustic energy to electrical, mechanical, or other desired energy forms; and also the inverse technology of converting other energy forms into acoustic energy. Acoustic transduction technology includes the development of new sonar source transducers and hydrophones and the development of sonar calibration methods.

### Mobile (Airborne and Shipborne) Sensor Systems

- ### Towed Array Sensor Systems

- (2) <sup>-</sup>

(3) Designed and partially completed construction of a shallow water, parametric active sonar  
(4) Transitioned low frequency flextensional projector design to Active Adjunct to Undersea Surveillance Program  
(5) Completed construction  
(6) Produced 4 new test hydrophones, for increased sensitivity  
(7)

- (8) Fabricated new.

### Mobile (Airborne and Shipborne) Sensor Systems

- ### Towed Array Sensor Systems

- (2) Conduct an at-sea test of a flexible composite hydrophone module

- (3) Continue calibration standards and measurements work of active and passive elements for acoustic arrays
- (4) Construct and evaluate performance and reliability of flexensional projector for Active Adjunct to Undersea Surveillance Program
- (5) Construct one-third scale model of planar, focused nearfield calibration array for high resolution sonar
- (6) Complete the

- (7) Scale-up manufacturing process  
(8) Scale-up manufacturing process

(135)

Program Element: 62711N

Title: Undersea Target Surveillance

c. (U) FY 1984 Planned Program

Generic Efforts

- (9) Demonstrate at sea
- (10) Develop and evaluate
- (11) Composite
- (12) Complete development

against a submarine target  
for towed arrays  
transitions to advanced development at Naval Underwater Systems

d. (U) Program to Completion: This is a continuing program

3. (U) Project F11-124, Nonacoustic Antisubmarine Warfare

- This project comprises undersea target surveillance technology in which the primary sensor does not rely upon the detection of acoustic energy
- Nonacoustic antisubmarine warfare includes magnetic, hydrodynamic, contaminant and gravitational phenomena. (Techniques employing electromagnetic phenomena are reported in F11-132.)

a. (U) FY 1982 Program

Nonacoustic

- (1) Completed analysis
- (2) Modified existing
- (3) Completed performance prediction analysis
- (4) Completed evaluation of several classes of nonacoustic localization algorithms using simulated data
- (5) Completed preliminary investigation
- (6) Completed performance prediction analysis of
- (7) Performed initial investigation of environmental/signature interaction for one geographic area
- (8) Completed single and multiple
- (9) Completed fabrication of the multi-axis magnetic gradiometer
- (10) Conducted and analyzed stationary
- (11) Conducted key experiments leading to
- (12) Conducted airborne measurements and data collection of geologic magnetic noise

feasibility tests

b. (U) FY 1983 Program

Nonacoustic

- (1) Complete signature/environmental interaction assessment of sensor performance for one geographic area
- (2) Complete preliminary
- (3) Define criteria and methodology for
- (4) Initiate utility analysis
- (5) Complete investigation
- (6) Define
- (7) Initiate fabrication of

algorithm evaluation

detection algorithms

demonstration unit for detection

Program Element: 62711N

Title: Undersea Target Surveillance

- (8) Measure in-situ the
- (9) Perform the system integration of second-generation,
- (10) Complete laboratory testing
- (11) Initiate airborne background magnetic gradiometer open ocean measurements

c. (U) FY 1984 Planned program

Nonacoustic

- (1) Evaluate algorithms
  - (2) Complete performance prediction investigations
  - (3) Develop concepts for nonacoustic sensing
  - (4) Initiate preliminary design
  - (5) Initiate
  - (6) Evaluate airborne environmental data from magnetic gradiometer
  - (7) Conduct and analyze
- Perform site selection and background survey.

d. (U) Program to Completion: This is a continuing program

4. (U) Project F11-125, Target Signal Characteristics

- This project comprises the technology of target radiation, absorption, reflection, scattering, and re-radiation of energy insofar as these phenomena apply to foreign target detectability and identification.
- Target signal characteristics includes investigations of acoustic passive signature characteristics and active echo structures.

a. (U) FY 1982 Program

Generic

- (1) Provided predictions in the Active Adjunct Undersea Surveillance frequency regime
- (2) Validated the use of 1/100 scale

b. (U) FY 1983 Program

Generic

- (1) Complete weapon's frequency measurements

c. (U) FY 1984 Planned Program

Generic

- (1) Complete target strength measurements of threat submarine models and appraise analytical methods

d. (U) Program to Completion: This is a continuing program

Program Element: 62711N

Title: Undersea Target Surveillance

5. (U) Project F11-132, Optical/Infrared/Ultraviolet Surveillance

This project comprises target surveillance technology in which the primary sensor relies on detection of electromagnetic energy in the visible, infrared, and ultraviolet spectra.  
Optical/Infrared/Ultraviolet surveillance includes photographic, television, laser, and other passive or active techniques.

a. (U) FY 1982 Program

Nonacoustic

- (1) New advanced low light level image intensifier sensor fabricated
- (2) Tested at sea the ability to use
- (3) Conducted a high altitude
- (4) Conducted concept feasibility survey

b. (U) FY 1983 Program

Nonacoustic

- (1) Calibrate and flight test the new Advanced Solid-State Array sensor to evaluate the potential performance of ocean
- (2) Conduct Concepts of daylight operation and advanced detection and image enhancement to be developed

c. (U) FY 1984 Planned Program

Nonacoustic

- (1) Perform operational analysis including investigation of ultraviolet phenomena daytime evaluation and complete signal power spectral density characterization
- (2) Conduct a study on

d. (U) Program to Completion: This is a continuing program

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

A. (U) Project F11-121, Acoustic Arrays for Undersea Surveillance

1. (U) DESCRIPTION (Requirement and Project)

- This project comprises undersea target surveillance technology which relies upon the detection of acoustic energy by various configurations of receiving sensors.
- Acoustic arrays for Undersea Surveillance include sensor configurations for fixed, mobile, deployable, and airborne applications and addresses both active and passive acoustic sensor systems.
- The project also includes transmission methods for relaying sensor outputs to a desired location for processing and analysis. (Processing and analysis is in Project F11-123).
- The following major technology feasibility demonstrations are included in F11-121:

Program Element: 62711N

Title: Undersea Target Surveillance

- Advanced Conformal Submarine Acoustic Sensor
- Fiber Optic Distributed System
- Arctic Surveillance
- Advanced Autonomous Array
- Active Adjunct to Undersea Surveillance

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program

Fixed Sensor Systems

- (1) Fiber Optic Distributed System (FODS) transferred from F11-111 in FY 1982
- (2) Arctic Surveillance transferred from F11-111 in FY 1982
- (3) New fiber optic trunk cable designed including continuously welded conductor tube
- (4) 1 km fiber optic trunk cable section procured and electrical and mechanical tests conducted

Mobile (Airborne and Shipborne) Sensor Systems

- (5) Organized the Advanced Conformal Submarine Acoustic Sensor project. The objective is to yield a tenfold increase in the area search rate of submarine sonar
- (6) Industry-wide briefings and workshop held to press investigations into sonar array design problems
- (7) Previous component developments to improve submarine sensor arrays were integrated into a system design
- (8) Completed [measurements] to identify [noise contributions] to sonar self noise
- (9) Developed [acoustic] arrays
- (10) Conducted prototype Helicopter Long-Range Active Sonar demonstration in the Mediterranean Sea
- (11) [profile unit] demonstrated wide-angle coverage with a single low-

Towed Array Sensor Systems

- (12) Completed development and laboratory test of a new highly reliable towed array telemetry system
- (13) Initiated testing of Kevlar strength members for surveillance towed array applications
- (14) Demonstrated performance of [hydrophone] over an operational range of temperatures and pressures
- (15) Completed analysis of response characteristics of directive sensor elements
- (16) Fabricated and tested [hydrophones]
- (17) Demonstrated feasibility of [operating as a continuous underwater acoustic sensor]
- (18) Developed a new concept for a signal-free-reference sensor
- (19) Completed the feasibility study of multidimensional towed arrays and identified the technology issues
- (20) Completed analysis and inland testing of a low wave number experimental module
- (21) Pull-tests verified full-strength cable termination for new multi-platform (ship, sub, helo) tow cable design
- (22) Initial survey revealed at least 33 submarine towed arrays damaged by shark bite since 1974; held 2nd Shark-Bite Workshop for development of effective repellents



Program Element: 62711K

Title: Undersea Target Surveillance

Off Board Sensor Systems

- (23) Advanced Autonomous Array transferred from F11-111 in FY 1982
- (24) Initial design study for an \_\_\_\_\_ used with off-board sensor arrays completed
- (25) Quantified performance characteristics of supercorrosive metals, under various conditions, for deployed systems applications
- (26) Evaluate \_\_\_\_\_ Directional Frequency Analysis Recording sonobuoys \_\_\_\_\_
- (27) Completed Directional Command Activated Sonobuoy system reverberation reduction development
- (28) Developed low cost sonobuoy concept
- (29) Initiated development of \_\_\_\_\_ Sonobuoy
- (30) Initiated evaluation of existing/evolving Air ASW sensors \_\_\_\_\_
- (31) Design parameters for \_\_\_\_\_
- (32) Sea tests conducted in areas of tactical importance to Air ASW using existing sensors
- (33) Initiated Low Cost Sonobuoy development in accordance with recommendations of the 1981 Off-Board Sensor Workshop
- (34) Compared performance of new and evolving air-deployed sensors \_\_\_\_\_
- (35) Completed fabrication of Submarine Expendable Vertical Array test units (surface launched)
- (36) Successful bench test \_\_\_\_\_ for Acoustic Range Performance Enhancement
- (37) Defined concept for \_\_\_\_\_ array to gain \_\_\_\_\_ against quiet diesel-electric submarine targets

Active Adjunct to Undersea Surveillance

- (38) Transferred from F11-111 in FY 1983.

b. (U) FY 1983 Program

Fixed Sensor Systems

- (1) Develop processing algorithms to perform detection and classification for the Fiber Optic Distributed System (FODS) to include:
- (2) Test candidate Fiber Optic Distributed System algorithms using bottom sensor data collected during the \_\_\_\_\_
- (3) Install acoustic sensor systems \_\_\_\_\_
- (4) Evaluate inter-sensor correlation \_\_\_\_\_
- (5) Design, build, and install a shore controllable \_\_\_\_\_

Mobile (Airborne and Shipborne) Sensor Systems

- (6) Execute experiments on 1/4 scale model submarine to demonstrate revolutionary improvements in components of a sonar array design:
  - Design, specify, build and test \_\_\_\_\_
  - Design, specify, build and test \_\_\_\_\_
  - Define and evaluate changes to \_\_\_\_\_

Program Element: 62711N

Title: Undersea Target Surveillance

- (7) Develop and purchase a
- (8) Evaluate fiber cables and hull penetrators for submarine use at operational depth
- (9) Using 1/15 scale models, evaluate potential
- (10) Initiate analysis of Helicopter Long Range Active Sonar performance
- (11) Conduct acoustic calibration, pressure, and vibration tests on FLYTE units; transition to sea tests

Towed Array Sensor Systems

- (12) Complete procurement of reduced diameter surveillance towed array components and integrate all components prior to FY 1984 system reliability tests
- (13) Fabricate these elements and construct a module using
- (14) Conduct an at-sea test of the
- (15) Complete evaluation of Kevlar strength members for towed array applications
- (16) Complete evaluation, through at-sea testing of the self-noise improvement potential of for both surveillance and tactical towed arrays
- (17) Sea test low wave number tactical towed array module
- (18) Initiate development of prototype directional elements for towed array
- (19) Demonstrate hydrophones
- (20) Complete section design for integrated multi-platform tow cable; continue work on data/power transmission and cable handling/storage techniques
- (21) Develop behavioral assays for new detergent-based shark repellents; conduct lab tests to establish required concentration

Off-Board Sensor Systems

- (22) Complete fabrication of new hydrophone arrays for the Advanced Autonomous Array system
- (23) Conduct short sea tests of Advanced Autonomous Array hydrophone strings in both horizontal and vertical configurations to refine handling, deployment, and tensioning issues
- (24) Implement and test searchlight processing algorithms, displays, and man-machine interface techniques to be used during the FY 1984 Advanced Autonomous Array sea test
- (25) Investigate repeater design and deployment for an
- (26) Initiate testing of general surveillance algorithm implementation using an advanced low power processor for use in a deployed buoy system
- (27) Continue
- (28) Initiate development of the low cost sonobuoy design/configuration
- (29) Design and develop prototype array structures, packaging, and deployment procedures for a
- (30) Investigate improved detection performance for horizontal line array sonobuoy
- (31) Field test prototype fiber optic cable for Acoustic Range Performance Enhancement Program

Active Adjunct to Undersea Surveillance

- (32) Conduct first at-sea demonstration of active adjunct to undersea surveillance system to include:
  - Deployment and retrieval of
  - Measurement of signal propagation characteristics

Program Element: 62711N

Title: Undersea Target Surveillance

- Test of system performance using various transmit signal waveforms and processing techniques
- Measurement of ocean reverberation characteristics and quantification of their effects on system performance

c. (U) FY 1984 Planned Program

Fixed Sensor Systems

- (1) Integrate successful Fiber Optic Distributed System algorithms at the Acoustic Research Center, conduct tests with bottom sensor data, and develop field management and control techniques.

Mobile (Airborne and Shipborne) Sensor Systems

- (2) Complete evaluation of Helicopter Long-Range Sonar performance
- (3) Furnish design recommendations and specification to advanced development sonar projects
- (4) Execute experiments on 1/4 scale model submarine to demonstrate complete new sonar array design concepts.
  - Integrate into a sonar array system.
  - Evaluate to determine effect on noise transmission
  - Finalize and evaluate improvements in and hull penetrator system.
  - Demonstrate the performance of a
- (5) Furnish preliminary sonar array design recommendations to advanced development sonar projects.
- (6) Evaluate the effects of a

Towed Array Sensor Systems

- (7) Conduct self noise measurements and reliability testing of a
- (8) Investigate improved surveillance towed array materials.
- (9) Complete sea test of tactical towed test bed array with
- (10) Complete development for reference sensor for for tactical towed arrays.
- (11) Define the performance characteristics of the towed array designs.
- (12) Determine and quantify
- (13) Perform a acoustic sensor.
- (14) Fabricate prototype multi-platform tow cable and conduct initial lab tests prior to sea tests.
- (15) Conduct field tests of acoustic arrays with and without shark repellents to establish operational effectiveness of new detergent-based shark repellents.

Off Board Sensor Systems

- (16) Conduct an at-sea demonstration of the Advanced Autonomous Array system to include evaluation of improved array tensioning searchlight processing and display
- (17) Demonstrate low power processor capability for general surveillance processing of Advanced Autonomous Array data.
- (18) Develop and fabricate improved vertical array designs for deployed system sea tests.
- (19) Test deployment from an aircraft platform.
- (20) Update the identification of missions and scenarios for evolving off-board sensors and determine the implications for their further development.
- (21) Develop/fabricate
- (22) Develop/fabricate/demonstrate Low Cost Sonobuoy candidates.

Program Element: 62711M

Title: Undersea Target Surveillance

- (23) Develop sensor concepts for
- (24) Develop/fabricate Advanced Sonobuoy System.
- (25) Increase the number of hydrophones and introduce a vertical steering capability in the vertical fiber-optic array.
- (26) Construct full scale submarine detection and conduct proof-of-concept demo in FY 1985.
- (27) Test improved detection performance for horizontal line array sonobuoy

Active Adjunct to Undersea Surveillance (AAUS)

- (28) Conduct an at-sea test in a
- (29) Complete processing and analysis of all sea test data and provide recommendations for potential Active Adjunct System performance.

d. (U) Program to Completion: This is a continuing program

e. (U) Milestones: Not applicable

B. (U) Project F11-123, Acoustic Processing Technology

1. (U) DESCRIPTION (Requirement and Project)

- This project comprises the technology of detecting, localizing, tracking and classifying targets by signal processing and other techniques of evaluating the outputs of acoustic sensor systems.
- Acoustic processing technology includes electronic, optical, computer-aided, visual, and aural methods.
- Also included is information processing, storage, retrieval, and display technologies.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS

a. (U) FY 1982 Program

Fixed Sensor Systems

- (1) Three optical ambig surface processors of different designs installed and tested at the Acoustic Research Center
- (2) Wavefront beamforming task completed. Capability to discriminate target of interest
- (3) quantified. Ocean effects on the algorithm
- (4) Investigation of and tracker correction quantified. completed. Important parameters for
- (5) Improved man-machine interface (MMI) algorithms and displays installed on a high resolution display system at the Acoustic Research Center.
- (6) Improved target association techniques identified.
- (7) A new technique developed to utilize beam merging displays
- (8) techniques tested at the Acoustic Research Center.
- (9) Acoustic Research Center transferred to Navy management and steps initiated to move this facility to the Naval Ocean Systems Center, San Diego.
- (10) The following were tested at the Acoustic Research Center:

Program Element: 62711N

Title: Undersea Target Surveillance

- Multiaarray technology demonstration showed successful classification of a threat target using the

- (11) Improved man-machine interface (MMI) for interarray processing implemented on a high resolution display system.
- (12) Improved data base management techniques developed and tested for surveillance signal processing applications.
- (13) Demonstrated that ocean multipath structure can be resolved in two-array

#### Mobile (Airborne and Shipborne) Sensor Systems

- (14) Fabricated a real-time processor for [ ] algorithm and evaluated its performance with simulated and sea data.
- (15) Initiated development of a [ ]
- (16) Developed maximum likelihood detection techniques for processing [ ]
- (17) Developed software test bed for evaluation of alternative detection and classification techniques for active ASW Sonar using recorded sea data.
- (18) Developed and demonstrated at sea on three occasions an active sonar single target classification prototype.
- (19) Developed, extensively tested in the laboratory and at sea, and transitioned [ ]
- (20) Assembled [ ] data collection equipment and conducted an in-water experimental program providing data for development of the [ ]
- (21) Conducted at-sea experiments for determining the feasibility of using [ ] of mines for detection and classification.
- (22) Initiated an effort to determine the utility of [ ]
- (23) Evaluated the [ ] using an extensive base of sea data recordings.
- (24) Initiated a major program for developing, demonstrating and evaluating [ ]
- (25) Evaluated/tested [ ]
- (26) Initiated [ ] to array data.
- (27) Developed Airborne sensor processing and correlation for [ ]

#### Towed Array Sensor Systems

- (28) Completed analytical investigation of [ ]
- (29) Completed analysis of [ ]
- (30) Developed and sea tested adaptive signal processing techniques for [ ] towed arrays.
- (31) Completed analytical investigation of using [ ]

#### Off-Board Sensor Systems

- (32) Completed fabrication of Submarine Expendable Vertical Array test units (surface launched).
- (33) Initiated efforts to validate [ ] test resources.

Program Element: 62711N

Title: Undersea Target Surveillance

- (34) ☒ resulting data. ☒ Submarine Expendable Vertical Array and completed analysis of the
- (35) Completed development of evaluation methodology for comparing candidate offboard surface ship sensor systems ☒
- (36) Implemented ☒ for Directional Frequency Analysis Recording (DIFAR) sonobuoys.
- (37) Completed a ☒
- (38) Completed an efficient ☒
- (39) Completed evaluation of ☒ Directional Frequency Analysis Recording with real data.
- (40) Demonstrated ☒ for Air ASW sensors using ☒
- (41) Completed performance testing of ☒
- (42) Implementation of ☒ mode for ASW Aircraft Advanced Signal Processor initiated.
- (43) ☒ implemented for low frequency acoustic range/gram (LOFARgram) analysis enhancement.

b. (U) FY 1983 Program

Fixed Sensor Systems

- (1) Design and implement data base management systems to support the development of advanced information processing concepts and signal processing applications at the Acoustic Research Center.
- (2) Reinstall the Acoustic Research Center facility formerly located at Moffett Field, CA at the Naval Ocean Systems Center, San Diego, CA and perform the following experiments:
  - Second multi-array demonstration experiment
- (3) Evaluate bearing sector display techniques for use in ☒
- (4) Conduct an intensive test of ☒ to evaluate potential performance in comparison with
- (5) Develop and test information processing techniques for surveillance data association, including advanced displays and man-machine interface.
- (6) Develop and test a ☒ for Surveillance Towed Array Sensor System (SURTASS) application.
- (7) Develop techniques to provide improved computational efficiency ☒
- (8) Fabricate and test a new high speed ☒
- (9) Investigate new computationally intensive signal processing algorithms with surveillance potential, for application to systolic array processors.
- (10) Transfer the Honeywell-built acousto-optic passive ambiguity surface (PAS) processor to Naval Research Laboratory for optical implementation of image/pattern recognition algorithms.
- (11) Extend ☒ integration time to ☒
- (12) Initiate project for detecting, analysis and display ☒

Mobile (Airborne and Shipborne) Sensor Systems

- (13) Validate analytical results ☒
- (14) ☒
- (15) Implement ☒ to reduce loading.
- (16) Evaluate ☒
- (17) Complete quantification of the performance of computer aided classification technology ☒
- (18) Complete evaluation of utility of ☒

Program Element: 62711N

Title: Undersea Target Surveillance

- (19) Exercise offboard surface ship sensor system evaluation techniques and select a candidate approach
- (20) Investigate the effectiveness of
- (21) Determine the
- (22) Complete functional description of an Advanced Sonar Information Processor for automating the processing of tactical acoustic data.
- (23) Develop algorithms to realize
- (24) Evaluate at-sea data
- (25) Complete development of
- (26) Evaluate concepts for detection and localization of mines.
- (27) Begin implementation of a target management system approach.
- (28) Complete analysis of tests.
- (29) Complete assessment of feasibility of
- (30) Develop acoustic environment/localization sensor fusion techniques for
- (31) Evaluate for Air ASW application.
- (32) Evaluate/Test interactive operator aids for Advanced Signal Processor.

Towed Array Sensor Systems

- (33) Determine detection improvements for tactical towed arrays
- (34) Determine towed array
- (35) Conduct tests of
- (36) Demonstrate
- (37) Evaluate the performance of
- (38) Reprocess the results.
- (39) Formulate the design and begin fabrication of the
- (40) Determine the effectiveness of in liquid filled towed arrays.
- (41) Evaluate robustness and in-the-array implementation requirements for

Off-Board Sensor Systems

- (42) Develop new displays and processing algorithms for general surveillance operation with Advanced Autonomous Array data.
- (43) Initiate testing of general surveillance algorithm implementation using an advanced low power processor.
- (44) Compare SEVA (Submarine Expendable Vertical Array) targeting range and depth performance with that expected from other Submarine sensors such as the spherical and towed array of the BQQ-5 and generate a revised SEVA baseline design.
- (45) Conduct an at-sea Submarine Expendable Vertical Array (SEVA) data collection exercise
- (46) Evaluate an

Program Element: 62711N

Title: Undersea Target Surveillance

- (47) Extend development processor.

to the AQA-7

c. (U) FY 1984 Planned Programs

Fixed Sensor Systems

- (1) Evaluate the performance of a processor during real time experiments at the Acoustic Research Center.
- (2) Demonstrate and refine processor.
- (3) Develop and test algorithms that exploit systolic array technology to improve surveillance system performance.
- (4) Implement and evaluate advanced operator displays and man-machine interface designs for information processing at the Acoustic Research Center.
- (5) Continue the demonstration of technology developments to improve single and multiple array signal processing with emphasis on increased automation and improved displays and man-machine interface.
- (6) Optimal implementation of computationally intensive Fourier and matrix algebra operations for large-array, dynamic-array, and emitter-location processing.
- (7) Develop automatic/semi-automatic processing for measurement and classification of submarine transient signals.

Mobile (Airborne and Shipborne) Sensor Systems

- (8) Initiate development of a detection/classification/localization processor.
- (9) Complete evaluation of processor.
- (10) Generate a specification for an processor.
- (11) Demonstrate in the laboratory an processor.
- (12) Plan and conduct system. Perform analysis of sea test data.
- (13) Transition to Advanced Development.
- (14) Initiate development of a breadboard.
- (15) Initiate experimental program for demonstration of using offboard sensor technology.
- (16) Initiate the development of an algorithm.
- (17) Conduct at-sea experimentation required to support development and evaluation of techniques.
- (18) Develop classification.
- (19) Determine the feasibility of using.
- (20) Initiate the design of a testbed for evaluating candidate data and information processing algorithms and identify the critical experiments and measures of effectiveness needed to demonstrate sonar information processing.

Towed Array Sensor Systems

- (22) Develop optimized array/processor configuration.
- (23) Develop prototype hardware for the processor.
- (24) Conduct at-sea experimentation necessary to demonstrate concepts.
- (25) Complete fabrication of a concepts.

Off-Board Sensor Systems

- (26) Evaluate/implement

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Program Element: 62711N

Title: Undersea Target Surveillance

- (27) Implement [ ] for advanced reconnaissance sonobuoy.
- (28) Develop [ ] processor.
- (29) Complete operation interactive performance evaluation for Advanced Signal Processor.
- (30) Investigate advanced [ ] for detection and classification of targets.
- (31) Evaluate sensor processing and correlation for [ ]

d. (U) Program to Completion: This is a continuing program

e. (U) Milestones: Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

DoD Mission Area: 521 - Electronic and Physical Sciences

Budget Activity: 1 - Technology Base

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                       | <b>32,946</b>  | <b>34,986</b>    | <b>36,635</b>    | <b>38,141</b>    | Continuing               | Continuing           |
| F12-111     | Concept Assessment for Surveillance                    | 4,058          | 5,304            | 3,496            | 2,893            | Continuing               | Continuing           |
| F12-150     | Non-Cooperative Target Recognition Technology          | 460            | 1,100            | 964              | 1,076            | Continuing               | Continuing           |
| F12-131     | Radio Frequency Surveillance                           | 8,104          | 8,038            | 9,864            | 10,827           | Continuing               | Continuing           |
| F12-132     | Optical/Infrared/Ultraviolet Surveillance              | 2,624          | 2,293            | 2,264            | 1,956            | Continuing               | Continuing           |
| F12-133     | Sensor Integration                                     | 1,139          | 4,115            | 4,120            | 5,105            | Continuing               | Continuing           |
| F12-134     | USMC Tactical Surveillance Technology                  | 2,036          | 1,755            | 1,939            | 1,899            | Continuing               | Continuing           |
| F12-141     | Satellite/Remote Platform Surveillance                 | 8,290          | 3,586            | 4,420            | 4,824            | Continuing               | Continuing           |
| F12-142     | Satellite Infrared Sensors/Spacecraft Technology       | -0-            | 2,737            | 2,475            | 2,406            | Continuing               | Continuing           |
| F12-151     | Multipurpose Radio Frequency Surveillance              | 5,548          | 4,626            | 4,704            | 5,144            | Continuing               | Continuing           |
| F12-152     | Multipurpose Optical/Infrared/Ultraviolet Surveillance | 473            | 1,020            | 1,466            | 1,292            | Continuing               | Continuing           |
| F12-242     | Tactical Information Correlation and Presentation      | -0-            | -0-              | 696              | 489              | Continuing               | Continuing           |
| F12-701     | Small Business                                         | 194            | 410              | 217              | 230              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- This is a technology base program element intended to support Naval surveillance from ships, aircraft, and satellite platforms. Specific goals are:
  - Increase the range of sensor systems to accommodate increased range capability of both offensive and defensive weapons
  - Extract information from sensors that will lead to the identification or classification of targets
  - Improve the critical surveillance systems used by the fleet for air electronic warfare and shipboard air defense
  - Reduce the size and weight of sensors without reducing performance
  - Make use of combined information from multiple sensors
  - Maintain required performance in spite of hostile actions such as electronic countermeasures, anti-radiation missiles, electronic support measures, as well as direct attack
- Surveillance includes both active and passive sensors that use electromagnetic (radio frequency, microwave, millimeter wave, infrared, visual, ultraviolet), acoustic, and seismic radiation
- Supports electronic warfare, anti-space warfare, air warfare, anti-surface warfare, amphibious warfare, and tactical warfare ashore
- Supports reconnaissance and intelligence gathering and provides the surveillance system technology base to support weapon systems and the platforms or vehicles they serve including shorebased facilities, surface ships, aircraft and spacecraft

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Total funding for the element changed as follows: -688 in FY 1982, -30 in FY 1983 and +42 in FY 1984. These numbers reflect a revision of cost estimates, pay adjustments, and one new project start in FY 1984 (F12-242)
- Several continuing subproject tasks were realigned under different project headings in the FY 1984 Descriptive Summary. This was done to bring work of a similar technical nature under the proper project headings. This realignment changed the project funding profiles for F12-111, F12-135, F12-141, F12-151, F12-152. Details are given below.
- F12-111 - Concept Assessment for Surveillance: an increase of 1,954 in FY 1983 and an increase of 1,016 in FY 1984 is due primarily to the shift of analysts efforts previously listed under F12-151. The work was judged to be more of a concept assessment rather than a development effort
- F12-130 - Non-Cooperative Target Recognition: FY 1984 estimate decreases 436 due to the cancellation of one of the high risk project tasks. Technical feasibility was reassessed as questionable
- F12-131 - Radio Frequency Surveillance: FY 1984 increase of 1,213 is due to a new start. NAVAR program to investigate using enemy radar jamming radiation to do raid count was initiated
- F12-132 - Optical/Infrared/Ultraviolet Surveillance: decrease 355 in FY 1983 and decrease 546 in FY 1984 reflects elimination of a low priority task
- F12-134 - USMC Tactical Surveillance: decreases 300 in FY 1983 and 600 in FY 1984 reflect elimination of a low priority task
- F12-133 - Sensor Integration: increase 2,693 in FY 1983 and 2,170 in FY 1984 is due to a shift of a program from XF12-141. F12-133 previously contained only sensor integration related to individual ship and aircraft platforms. Work on the integration of Navy global sensors, previously listed under XF12-141 is now incorporated in XF12-133. This transfer significantly changes the funding profiles for both F12-133 and F12-141
- F12-141 - Satellite/Remote Platform Surveillance: project shows a decrease 5,646 in FY 1983 and a decrease 4,873 in FY 1984. Changes are due to the realignment of two major subprojects. First, as mentioned above, global sensor integration work for improved ocean surveillance was transferred to F12-133. Second, space infrared sensor work and spacecraft related technology (electronic survivability/vulnerability) were split out into a new project, F12-142. F12-141 now contains only work on space-based radar and remotely-piloted-vehicle sensor systems
- F12-142 - Satellite Infrared Sensors/Spacecraft Technology: this is a new project heading in FY 1983, but not a new project. It is a breakout of work previously listed under F12-141
- F12-151 - Multi-purpose Radio Frequency Surveillance: project shows decreases of 1,386 in FY 1983 and 1,675 in FY 1984. In the past this project covered all passive sensor work, i.e., infrared as well as radio frequency/electronic support measure devices. Under the new realignment, infrared sensor work was transferred to F12-141 if it related to space systems and to F12-152 if it related to shipboard applications
- F12-152 - Multi-purpose Optical/Infrared/Ultraviolet Surveillance: increase of 467 in FY 1983 and 816 in FY 1984 reflects transfer of infrared tasks from F12-151
- F12-242 - Tactical Information Correlation and Presentation: this is a new start in FY 1984

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                                             | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Estimated Cost |
|-------------|-------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                                  | <b>29,575</b>  | <b>33,634</b>    | <b>35,016</b>    | <b>36,593</b>    | Continuing               | Continuing     |
| F12-100     | Airborne Surface/Aerospace Target Surveillance                    | 5,671          | -0-              | -0-              | -0-              | Completed                | Completed      |
| F12-111     | Concept Assessment for Surveillance                               | -0-            | 4,404            | 3,350            | 2,480            | Continuing               | Continuing     |
| F12-113     | Systems Investigations                                            | 2,267          | -0-              | -0-              | -0-              | Completed                | Completed      |
| F12-130     | Resonant Structures Non-Cooperative Target Recognition Technology | -0-            | 400              | 1,100            | 1,400            | Continuing               | Continuing     |
| F12-131     | Radio Frequency Surveillance                                      | -0-            | 8,495            | 8,432            | 8,651            | Continuing               | Continuing     |
| F12-132     | Optical/Infrared/Ultraviolet Surveillance                         | -0-            | 2,440            | 2,650            | 2,810            | Continuing               | Continuing     |
| F12-133     | Sensor Integration                                                | 673            | 1,172            | 1,422            | 1,950            | Continuing               | Continuing     |
| F12-134     | USMC Tactical Surveillance Technology                             | -0-            | 2,205            | 2,055            | 2,559            | Continuing               | Continuing     |
| F12-141     | Satellite/Remote Platform Surveillance                            | 6,712          | 8,500            | 9,232            | 9,293            | Continuing               | Continuing     |
| F12-143     | Special/Unconventional Aerospace Surveillance Technology          | 7,810          | -0-              | -0-              | -0-              | Completed                | Completed      |
| F12-151     | Multipurpose Radio Frequency Surveillance                         | 5,920          | 5,340            | 6,012            | 6,579            | Continuing               | Continuing     |
| F12-152     | Multipurpose Optical/Infrared/Ultraviolet Surveillance            | 522            | 478              | 553              | 650              | Continuing               | Continuing     |
| F12-701     | Small Business                                                    | -0-            | 200              | 210              | 221              | Continuing               | Continuing     |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Related Navy Exploratory Development program elements are: 62721N - Command and Control Technology, 62734N - Countermeasures Technology, and 62332N - Strike Warfare Weaponry Technology
- The U.S. Air Force, U.S. Army, Defense Advanced Research Projects Agency, and others have an interest in this work
- Coordination of efforts to assure a timely exchange of ideas and techniques and to avoid unwarranted duplication is maintained by standardized documentation of planning and procedures, budget and program reviews at various levels, inter-service committees, formal and informal committees and working groups such as the Navy Electronic Warfare Advisory Group, the Surface/Aerospace Technical Strategy Team, and personal contacts between parties involved at project and subproject levels
- Coordination at the management level and the laboratory level is effected through periodic visits and conferences, review of publications distributed through the Defense Technical Information Center, and symposia such as the Tri-Service Radar Symposium, Tri-Service Electronic Warfare Symposium, Tri-Service Combat Identification Conference

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Air Development Center, Warminster, PA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA;
- CONTRACTORS - General Dynamics, San Diego, CA; General Electric Company, Utica, NY; Grumman Aircraft Corporation, Bethpage, Long Island, NY; Hughes Aircraft, El Segundo, CA; Hughes Aircraft, Fullerton, CA; ITK Corporation, Lexington, MA; RCA Laboratories, Princeton, NJ; Westinghouse Defense Systems, Baltimore, MD; Texas Instruments, Dallas, TX; ALL, Deer Park, NY; Honeywell, Minneapolis, MN; GTE, Waltham, MA; Motorola, Scottsdale, AZ; Sanders Corp, Nashua, NH; Ball Aerospace, Boulder, CO; Aerojet Electric, Azusa, CA; Science Applications, Inc., McLean, VA; Boos-Allen, Bethesda, MD; Litton, Pasadena, CA; Rockwell Int., Anaheim, CA; TRW, Redondo Beach, CA; Hazeltine, Greenlawn, NY; Mordas Systems, Norwalk, CT; Raytheon, Lexington, MA; Flan and Russell, Horsham, PA; ITT, Nutley, NJ; Syracuse Research Center, Syracuse, NY; Lockheed, Sunnyvale, CA

Program Element: 62712H

Title: Surface/Aerospace Target Surveillance

- ACADEMIC - Ohio State University, Columbus, OH; MIT Lincoln Lab, Lexington, MA; Georgia Institute of Technology, Atlanta, GA

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F12-111, Concept Assessment for Surveillance

- The work under this project heading includes:

- assessments of unusual surveillance concepts for use by Naval surveillance aircraft, e.g., the use of acoustic devices for over-the-horizon targeting of surface ships
- studies and evaluations of shipboard systems for cruise missile detection and tracking

a. (U) FY 1982 Program:

- (1) Validated acoustic range predictions against surface ship targets in an at-sea experiment
- (2) Investigated the sensitivity and response of shipboard defense systems (e.g. Phalanx, Aegis) to low-radar cross-section sea skimmer missiles, including sizing of a detection subsystem and an interceptor terminal homing and fusing sensor

b. (U) FY 1983 Program:

- (1) Complete open ocean and test range experiments with acoustic sensor to verify localization predictions
- (2) Design and analytically assess subsystems for sea skimmer missile defense

c. (U) FY 1984 Planned Program:

- (1) Analyze ability to classify ships from at-sea acoustic data mentioned above
- (2) Continue assessment of concepts and subsystems for sea skimmer missile defense

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F12-130, Non-Cooperative Target Recognition Technology

- Objective is (1) to develop and demonstrate the feasibility of long range recognition of aircraft and missiles based on excitation of target resonance scatterers; (2) to develop target classification techniques (radar and infrared imagery) so that anti-ship missile seekers can automatically select high priority ship targets from among surrounding vessels

a. (U) FY 1982 Program:

- (1) Upgrades of a unique radar cross section measurement facility at Ohio State Univ. continued on schedule.

b. (U) FY 1983 Program:

- (1) Facility at Ohio State will be complete. Measurements on small models will commence
- (2) The radar/infrared seeker work is a new start in FY 1983

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

- c. (U) FY 1984 Planned Program:
  - (1) Measurements and analysis of data on scaled models will continue
  - (2) Radar data will be analyzed to determine feasibility of applying classification techniques to seeker missiles
- d. (U) Program to Completion: This is a continuing program.
- 3. (U) Project F12-131, Radio Frequency Surveillance:
  - Addresses automatic classification of enemy surface ships at stand-off ranges using radar imaging techniques
  - Develops techniques for large volume surveillance of airborne threat targets
  - Supports radar antenna development and signal processing improvements for airborne early warning
  - Supports development of miniature lightweight radio frequency sensors for use aboard aircraft
  - Provides a broad technology base to improve the performance of shipboard radars in areas of target handling, clutter rejection and target identification, and for retained performance under increasingly stringent conditions of electronic interference, reduced target cross sections and reduced maintenance support
  - Supports the definition and demonstration of new concepts for shipboard radars
- a. (U) FY 1982 Program:
  - (1) Demonstrated imaging capability of a narrow band frequency agile radar
  - (2) The Naval Research Laboratory SENRAD radar, which transmits two frequency bands simultaneously, is currently operating. Electronic counter-countermeasure testing was recently completed
  - (3) Major subsystems for a Directed Mirror Antenna Radar (DMAR) were completed and successfully tested
  - (4) A new Moving Target Indicator (MTI) technique using polyphase codes and having no blind speeds was developed
  - (5) Fabrication of the antenna for the Fixed Array Surveillance Radar (FASR) proceeded on schedule. The transmitter has been installed and the receiver performance checked out.
- b. (U) FY 1983 Program:
  - (1) Specify and develop a high-resolution processor for a radar-imaging/classification radar
  - (2) Complete analysis of RAPID/PROFILE flight test data
  - (3) Begin roof top testing of a passive wing array for an airborne early warning system
  - (4) Complete evaluation of reliability of surface evaporation duct for over-the-horizon targeting
  - (5) Complete evaluation of the directed mirror antenna
  - (6) Continue development of new methods for adaptive control, side lobe cancellation, and Moving Target Indicator (MTI) techniques applicable to shipboard radars
- c. (U) FY 1984 Planned Program:
  - (1) Initiate flight tests of a real-time, high-resolution radar-imaging system
  - (2) Complete roof top demonstration tests of Airborne Early Warning (AEW) conformal array
  - (3) Complete evaluation of Fixed Array Surveillance Radar (FASR) concept
  - (4) Continue development of radar advanced signal processing techniques
  - (5) Complete specifications for a wide-band Electronic counter-countermeasure capable long range air surveillance radar
- d. (U) Program to Completion: This is a continuing program.

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

4. (U) Project F12-132, Optical/Infrared/Ultraviolet Surveillance

- This project is developing and demonstrating critical electro-optical technologies required for advanced airborne reconnaissance and surveillance systems. Included are the following: Infrared detector arrays for next generation Forward Looking Infrared (FLIR) systems; signal/image processing techniques for enhancing infrared imagery; technology for employing infrared search and track (IRST) system on surveillance aircraft and remotely piloted vehicle platforms; approaches for stable high-performance optics suitable for day/night standoff reconnaissance; development of variable focal-length optics for large format cameras; and hybrid photographic/electro-optics camera employing charge-coupled devices.

a. (U) FY 1982 Program:

- (1) A lab demonstration of an advanced signal processor algorithm was completed, demonstrating the ability to process imagery with signal-to-noise ratio less than one

b. (U) FY 1983 Program

- (1) Existing data on infrared radiation from clouds will be used to develop a simulation model

c. (U) FY 1984 Planned Program

- (1) Plans call for the completion of background clutter rejection technique for an airborne infrared search and track (IRST) system.

d. (U) Program to Completion: This is a continuing program.

5. (U) Project F12-133, Sensor Integration

- Efforts are directed towards improving overall surveillance capability by combining information from several sensors and remote data sources. Integration should increase the detection probability of individual sensors, compensate for individual sensor deficiencies, provide a sensor cueing function, and reduce operator overload. Three distinct programs are underway. (1) Integration onboard airborne platforms such as F-3 and S-3 aircraft to combine acoustic, electronic support measures (ESM), forward looking infrared (FLIR), and radar sensor data. (2) Integration of sensor data aboard a ship platform to include information from own ship's sensors as well as other ships in the Fleet. (3) Finally, integration and data correlation techniques to improve remote area national-level surveillance sensors, e.g., SOSUS arrays, and passive Electronic Support Measures (ESM) Systems.

a. (U) FY 1982 Program:

- (1) Completed flight tests of airborne radar/electronic support measures systems (ESM) for automatically classifying ships
- (2) Completed a basic shipboard multi-sensor target tracking model
- (3) Software for Merchant Ship Tracker Module was transitioned to PL 63530N

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

b. (U) FY 1983 Program:

- (1) Initiate development of a laboratory simulation device to quantitatively evaluate airborne sensor integration data
- (2) Fold advanced sensor and external source data into basic multi-source track management model
- (3) Continue evolutionary development of models and software for combining broad area sensor data into a complete Ocean Surveillance Information System

c. (U) FY 1984 Planned Program:

- (1) Continue design of basic airborne system
- (2) Continue design of advanced shipboard sensor integration system

d. (U) Program to Completion: This is a continuing program.

6. (U) Project F12-134, USMC Tactical Surveillance Technology:

- To develop methods of gathering, processing, and distributing tactical intelligence and targeting information for the Marine Corps tactical field commander. Emphasis is placed on demonstrating the feasibility of employing mobile independent robotic devices for intelligence gathering

a. (U) FY 1982 Program:

- (1) A sensor design was completed for a ground robot vehicle

b. (U) FY 1983 Program:

- (1) Continuation of evaluation of a variety of battlefield robotic devices. Selection of most promising for further development

c. (U) FY 1984 Planned Program:

- (1) Continue robotic designs
- (2) Conduct preliminary demonstration of those furthest along such as a remote control manikin-like teleoperator and a ground robot surveillance vehicle

d. (U) Program to Completion: This is a continuing program.

7. (U) Project F12-141, Satellite/Remote Platform Surveillance:

- Two major thrusts comprise this project. Both address the Navy need for long range wide area detection of threat platform for Fleet defense. (1) The Space Based Radar project addresses critical technology related to development of a radar sensor for a Navy tactical surveillance satellite. Current emphasis is on the detection and classification of air/surface targets against a sea clutter background. (2) The High Altitude Remote Platform Surveillance System (HARPPS) project is expected to demonstrate a suite of specially configured, long range, small, lightweight miniaturized sensors

actual platform is not specifically addressed in this Element



Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

a. (U) FY 1982 Program:

- (1) A trade-off analysis and a baseline design were completed for a potential Navy space based radar sensor
- (2) Operational scenarios were analyzed and payload characteristics defined for the High Altitude Remote Platform Surveillance System (HARPPS) program

b. (U) FY 1983 Program:

- (1) Ground tests of a radar classification technique (applicable to a space platform) will be conducted at Point Loma, CA
- (2) Specifications for potential remotely piloted vehicle (RPV) sensors (Electronic Support Measures, Radar, Infrared) should be complete

c. (U) FY 1984 Planned Program:

- (1) Aircraft flight tests of the radar target classifier system are scheduled. The results will be scaled to a satellite platform
- (2) The design of a prototype lightweight high sensitivity electronic support measure (ESM) sensor for remotely piloted vehicle (RPV) is scheduled for completion

d. (U) Program to Completion: This is a continuing program.

6. (U) Project F12-142, Satellite Sensors/Spacecraft Technology

- In addition, a survivability/vulnerability task will identify failure modes induced by natural or weapon injected radiation and develop components or techniques to overcome these threats to satellite survivability and utility

a. (U) FY 1982 Program:

- (1) The Naval Research Laboratory completed an analysis of infrared cloud background data obtained under a DARPA supported flight test program

b. (U) FY 1983 Program:

- (1) The Navy is currently completing plans to participate in the joint DARPA/Air Force TEAL RUBY experiment.
- (2) Complete breadboard design of radiation-hardened charge coupled device star-tracker

c. (U) FY 1984 Planned Program:

- (1) The Navy will continue to analyze infrared data as it becomes available and determine the specific utility of satellite infrared sensors for tactical ocean surveillance
- (2) Complete development of a solid state dosimeter for monitoring the status of spacecraft in a radiation environment

d. (U) Program to Completion: This is a continuing program.

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

9. (U) Project F12-151, Multipurpose Radio Frequency Surveillance:

- The tactical commander needs jam resistant/electronic countermeasure systems to be able to detect, identify, and track threat targets at standoff ranges in a dense electromagnetic environment. Towards this end, both passive electronic support measure and bistatic/multistatic radar technologies are being developed. Specific examples are: enhance performance of conventional electronic support measures systems by providing real-time specific emitter identification;

and development of acousto-optic devices for wideband signal sorting, director finding, and parameter characterization. A broad base of electronic support measures technology (techniques, devices, subsystems) for both air and ship platforms is under investigation.

a. (U) FY 1982 Program:

(1) -

(2) A new multi-element detector chip was successfully developed which combines detection and signal processing on a single circuit

b. (U) FY 1983 Program:

(1) -

(2) Continue generic work on bulk acousto-optical devices for wideband signal processing

c. (U) FY 1984 Planned Program:

- (1) Complete development of a new high speed signal processor for an airborne electronic support measure system
- (2) Demonstrate a new shipboard acousto-optic electronic support measures receiver

d. (U) Program to Completion: This is a continuing program.

10. (U) Project F12-152, Multipurpose Optical/Infrared/Ultraviolet Surveillance

- Primary emphasis is on the development of a technology base for shipboard infrared devices and in particular for shipboard infrared search and track (IRST) systems. Specific efforts include (1) a program to measure infrared background clutter at high resolution. Such measurements are needed to determine the performance of future focal plane array detectors. (2) Development of new signal processing techniques to improve the signal to clutter ratio and thus the operational range of infrared search and track (IRST) systems

a. (U) FY 1982 Program:

(1) Field data was obtained using an infrared search and track (IRST) sensor employing a 3 color (3 wavelength band) signal processing algorithm

b. (U) FY 1983 Program:

(1) Calibrated measurements of cloud backgrounds will be made using an existing specialized infrared sensor. Development of unique signal processing algorithms will continue

Program Element: 62712N

Title: Surface/Aerospace Target Surveillance

- c. (U) FY 1984 Planned Program:
  - (1) Development of an advanced sensor to be used in the field for high sensitivity, high resolution, calibrated, background clutter measurements. Future field programs employing this sensor will allow us to verify the predicted performance of focal plane arrays currently under development
- d. (U) Program to Completion: This is a continuing program.
- 11. (U) Project F12-242, Tactical Information Correlation and Presentation (New Start)
  - The objective of this project is to develop automated or semiautomated aids in plotting, correlating and analyzing ocean surveillance data for tactical commanders. Following a survey of existing and planned capabilities, this effort will include building and testing of storage, retrieval and presentation algorithms on a breadboard system which will interface with shore produced ocean surveillance products and organic sensor systems, and direct link of raw data from some systems.
  - This project is supported in part by two other Program Elements (PE 62721N and 62757N)
  - a. FY 1982 Program: Not applicable
  - b. FY 1983 Program: Not applicable
  - c. (U) FY 1984 Planned Program:
    - (1) Study specific needs of tactical commanders for improved ocean surveillance. Evaluate current system architecture and processing capability. Initiate the development of new algorithms and techniques to improve information analysis and display.
- 12. (U) Project F12-701, Small Business
  - This project is part of the Department of Defense's Small Business Advanced Technology Program (DESAT). The DESAT Program seeks to promote innovative solutions to important scientific and technical problems facing the defense community by utilizing the innovativeness and resources of small science and technology based firms in DOD research and development
  - a. (U) FY 1982 Program:
    - (1) Four study contracts were awarded
    - (2) Completed feasibility study for Variable Signal Processing of Synthetic Aperture Radar Data for Target Detection and Classification
    - (3) Completed feasibility study for Ultra-Low Side Lobe Planar Near Field (ULS-PNF) measurement study
    - (4) Completed feasibility study for Broadband Null-Forming Antennas for HF Communications
    - (5) Completed feasibility study for Below Backs Electromagnetic Survey
  - b. (U) FY 1983 Program:
    - (1) One or more of the preceding study efforts will be selected for further development

Program Element: 62712M

Title: Surface/Aerospace Target Surveillance

c. (U) FY 1984 Planned Program:

(1) To be restructured to comply with Small Business Innovation Development Act (SBIDA), Public Law 97-219

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62721M

Title: Command and Control Technology

DoD Mission Area: 521 - Electronic and Physical Sciences

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                        | FY 1982<br>Actual | FY 1983<br>Estimate | FY 1984<br>Estimate | FY 1985<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|-------------|----------------------------------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>             | <b>29,041</b>     | <b>30,187</b>       | <b>36,112</b>       | <b>37,869</b>       | Continuing                  | Continuing                 |
| F21-133     | Superresolution Targeting                    | -0-               | -0-                 | 294                 | 293                 | Continuing                  | Continuing                 |
| F21-211     | Command and Control Concept Assessment       | 3,740             | 2,940               | 2,447               | 1,690               | Continuing                  | Continuing                 |
| F21-221     | Acoustic Communications                      | 770               | 700                 | 588                 | 1,124               | Continuing                  | Continuing                 |
| F21-222     | Radio Frequency Communications               | 8,838             | 9,098               | 11,934              | 10,818              | Continuing                  | Continuing                 |
| F21-223     | Optical/Infrared/Ultraviolet Communications  | 498               | 492                 | 980                 | 1,222               | Continuing                  | Continuing                 |
| F21-224     | Ship Internal Communications                 | 341               | 300                 | 339                 | 416                 | Continuing                  | Continuing                 |
| F21-231     | Navigation Sensor Technology                 | 404               | 1,299               | 1,469               | 782                 | Continuing                  | Continuing                 |
| F21-232     | Navigation System Technology                 | 3,926             | 3,853               | 3,134               | 3,456               | Continuing                  | Continuing                 |
| F21-233     | Navigation Technology (SHAD)                 | 1,231             | *                   | *                   | *                   | *                           | *                          |
| F21-241     | Information Processing                       | 2,844             | 5,290               | 4,898               | 5,405               | Continuing                  | Continuing                 |
| F21-242     | Information Management, Assessment & Display | 3,511             | 3,630               | 7,290               | 9,684               | Continuing                  | Continuing                 |
| F21-243     | Software Technology                          | 1,613             | 1,340               | 1,322               | 1,444               | Continuing                  | Continuing                 |
| F21-245     | Battlefield Command & Control                | 1,325             | 1,245               | 1,417               | 1,535               | Continuing                  | Continuing                 |

\* This effort was combined with Project F21-231 in FY 1983 and subsequent years

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Command and Control supports military commanders in the integrated use of available forces in the deterrence of war or, if such deterrence fails, in the conduct of war to achieve national objectives.
- Command and Control provides military commanders with the information needed to make operational decisions, developing and promulgating orders to implement the decisions, and monitoring the resulting course of events.
- The timeliness of information available to the commander is vitally important for effective command and control of operational forces.
- This program element develops and demonstrates new technologies encompassing the transmission, dissemination, processing and correlation of sensor data for more effective and survivable Navy command and control.

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary (-120 in FY 1982, -390 in FY 1983 and +503 in FY 1984) are the result of refined cost estimates including escalation and application of a Navy exploratory development budget adjustment to fund priority programs, initiatives and deficiencies. Internal program changes result from a redefinition of projects, project numbers, and project titles thereby causing redistribution of funding
- In addition, the program structure has been changed to include a new project (F21-133) starting in FY 1984.

Program Element: 62721N

Title: Command and Control Technology

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY**

| Project No. | Title                                        | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Estimated Cost |
|-------------|----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>             | <b>35,381</b>  | <b>29,161</b>    | <b>30,577</b>    | <b>35,609</b>    | Continuing               | Continuing     |
| F21-201     | Information Management                       | 1,394          | -0-              | -0-              | -0-              | Completed                | Completed      |
| F21-211     | Command and Control Concept Assessment       | 4,084          | 3,701            | 3,480            | 3,847            | Continuing               | Continuing     |
| F21-221     | Acoustic Communications                      | 825            | 775              | 700              | 797              | Continuing               | Continuing     |
| F21-222     | Radio Frequency Communications               | 9,379          | 8,690            | 9,835            | 11,497           | Continuing               | Continuing     |
| F21-223     | Optical/IR/UV Communications                 | -0-            | 500              | 500              | 564              | Reinstated               | Continuing     |
| F21-224     | Ship Internal Communications                 | 340            | 340              | 340              | 400              | Continuing               | Continuing     |
| F21-231     | Navigation Sensor Technology                 | -0-            | 345              | 1,194            | 1,408            | Continuing               | Continuing     |
| F21-232     | Navigation System Technology                 | 1,197          | 2,050            | 1,350            | 1,485            | Continuing               | Continuing     |
| F21-233     | Navigation Technology (SHAD)                 | 87             | 1,231            | 855              | 400              | Continuing               | Continuing     |
| F21-234     | Inertial Navigation                          | 765            | 815              | 830              | 835              | Continuing               | Continuing     |
| F21-235     | Aircraft Navigation System Technology        | 1,130          | 1,121            | 1,348            | 1,405            | Continuing               | Continuing     |
| F21-241     | Information Processing                       | 10,104         | 2,973            | 3,050            | 3,311            | Continuing               | Continuing     |
| F21-242     | Information Management, Assessment & Display | 3,380          | 3,560            | 4,285            | 6,093            | Continuing               | Continuing     |
| F21-243     | Software Technology                          | 229            | 1,740            | 1,490            | 1,900            | Continuing               | Continuing     |
| F21-244     | Information Assessment                       | 817            | -0-              | -0-              | -0-              | Completed                | Completed      |
| F21-245     | Battlefield Command & Control                | 1,650          | 1,320            | 1,320            | 1,667            | Continuing               | Continuing     |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** None.

**F. (U) RELATED ACTIVITIES**

- Efforts in this element which are related to those of other Services and agencies are coordinated by the Under Secretary of Defense for Research and Engineering, Assistant Secretary of the Navy (Research, Engineering, and Systems), Joint Service Project Offices, Joint Service/Industry symposia, circulation of reports of Joint Service interest, and informal liaison between program managers of the Naval Material Command, Army Material Command, Defense Advanced Research Projects Agency, and Air Force Systems Command.
- Program Elements 62711N, Undersea Target Surveillance, and 62739N, Ocean and Atmospheric Support Technology, provide the technology base in transducers and propagation in support of communications.
- Program Element 62762N, Electronic Device Technology, provides the device technology base from which the program draws.
- Program Element 62712N, Surface and Aerospace Target Surveillance, provides sensor information needed to update data bases.

**G. (U) WORK PERFORMED BY**

- **IN-HOUSE** - Naval Air Development Center, Warminster, PA; Naval Air Test Center, Patuxent River, MD; Naval Avionics Facility, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; Naval Postgraduate School, Monterey, CA; Naval Research Laboratory, Washington, DC; Naval Underwater Systems Center, Groton, CT and Newport, RI; David Taylor Naval Ship R&D Center, Bethesda, MD; Naval Weapons Center, China Lake, CA; Naval Surface Weapons Center, White Oak, MD.
- **INDUSTRIAL** - Bolt, Beranek & Newman, Cambridge, MA; Computer Corp. of America, Cambridge, MA; GTE Sylvania, Mt. View, CA; Harris Corp., Buffalo, NY and Melbourne, FL; Hughes Research Laboratory, Malibu, CA; ITR, Inc., Baltimore, MD; Raytheon Company, Portsmouth, RI and Bedford, MA; Westinghouse Electric Corporation, Baltimore, MD; International Business Machines, San Jose, CA; Honeywell, Minneapolis, MN; plus 31 others.

Program Element: 62721N

Title: Command and Control Technology

- ACADEMIC - University of Southern California, Information Sciences Institute, Marina Del Rey, CA; Massachusetts Institute of Technology, Cambridge, MA; Stanford Research Institute, Menlo Park, CA; University of California, Lawrence Livermore Laboratory, Livermore, CA; Georgia Institute of Technology, Atlanta, GA; Carnegie Mellon University, Pittsburgh, PA; Stanford University, Stanford, CA; Univ. of California, Irvine, CA; Univ. of Maryland, College Park, MD; Univ. of Wyoming, Laramie, WY

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F21-133, Superresolution Targeting (New Start)

- This project, a new start in FY 1984, is directed towards determining the applicability of high resolution techniques to identify individual targets from among a cluster of targets.
- This project addresses the current problem of inadequate angular resolution in data correlation from multiple sensors for target identification.

a. (U) FY 1982 Program:

(1) Not applicable

b. (U) FY 1983 Program:

(1) Not applicable

c. (U) FY 1984 Planned Program:

(1) Complete development of a test plan for the construction and feasibility demonstration of a breadboard model

d. (U) Program to Completion: This is a continuing program

2. (U) Project F21-211, Command and Control Concept Assessment

- This project is directed towards developing and assessing new and/or alternative concepts for Command, Control and Communications
- The objectives are to assess various alternatives and new concepts, identify technology gaps and areas of high technological payoff from which advanced Command, Control and Communications systems may evolve

a. (U) FY 1982 Program:

- (1) The configuration management plan and the enhancement plan for the Advanced Command & Control Architectural Testbed were completed
- (2) New nodes for the Command Center Networks were demonstrated
- (3) Completed analysis of the effectiveness of individual tactical communication links in Fleet air defense
- (4) Initiated concept definition for a new Command, Control and Communications computer model for evaluation, command and control support for battle group anti-air warfare and anti-surface warfare
- (5) Navy Center for Artificial Intelligence established at Naval Research Laboratory
- (6) Experiments using artificial intelligence for crisis alerting were initiated.
- (7) Design of experiment to evaluate contending concepts and issues for a surface ship combat direction system were completed

Program Element: 62721N

Title: Command and Control Technology

- b. (U) FY 1983 Program:
    - (1) Command and Control technologies will be identified for incorporation into the Advanced Command and Control Architectural Testbed
    - (2) Two local area networks using ringnet technology and ethernet bus technology will be implemented and compared in command center network operations
    - (3) Complete concept definition and initiate design for the Command, Control and Communications support system model for battle group operations
    - (4) Continue exploratory investigations of artificial intelligence to Navy problems such as in expert systems for electronic maintenance, message system automation, multisensor integration and naval warfare planning
    - (5) Evaluate crisis alerting utilizing Advanced Command and Control Architectural Testbed
  - c. (U) FY 1984 Planned Program:
    - (1) Deploy Advanced Command and Control Architectural Testbed for testing of advanced Command and Control technologies
    - (2) Continue design for the Command, Control and Communication computer model for battlegroup operations
    - (3) Apply artificial intelligence technologies to situation assessment, information management and expert systems for electronic maintenance and decision aids
    - (4) Evaluate enhanced baseline model for the ship combat system simulator
  - d. (U) Program to Completion: This is a continuing program
3. (U) Project F21-221, Acoustic Communications

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- a. (U) FY 1982 Program:
  - (1) The waveform definition and threat assessments were completed
  - (2) An assessment of vulnerability to underwater explosion was performed
  - (3) An acoustic relay concept definition was initiated
- b. (U) FY 1983 Program:
  - (1) Conduct a feasibility demonstration of the strategic acoustic communications system
  - (2) Schedule and install test equipment in submarine for sea tests
- c. (U) FY 1984 Planned Program:
  - (1) Start a new task to develop improved communications to tactical submarines
  - (2) Assess the feasibility of employing varying depth sonobuoys and acoustic relay technologies
- d. (U) Program to Completion: This is a continuing program



Program Element: 62721M

Title: Command and Control Technology

4. (U) Project F21-222, Radio Frequency Communications:

- This project is directed towards the application of advanced technology for communications requiring the electromagnetic energy ranging from extremely low frequencies to extremely high frequencies
- This project addresses naval needs for secure, jam resistant communications for both tactical and strategic

a. (U) FY 1982 Program:

- (1) The Mobile Access Terminal was demonstrated on board the USS FANNING
- (2) Low probability of intercept radios operating in the high frequency and ultrahigh frequency bands preparation for evaluation testing
- (3) A Very High Speed Integrated Circuit on board signal processor has been built for extremely high frequency operations
- (4) A high frequency surface wave buoy was built and demonstrated for submarine communication application
- (5)
- (6) First bioluminescence measurements were made from a submarine

b. (U) FY 1983 Program:

- (1) Prepare for and conduct at-sea tests of the Mobile Access Terminal
- (2) Demonstrate and evaluate the system performance of the low probability of intercept radio
- (3) Continue systems integration and tests of subsystem for extremely high frequency satellite communications
- (4) Demonstrate and assess the feasibility of the Deploy Retrieve and Storage System and the Buoyant Cable Antenna technology for submarine communications
- (5)
- (6) Demonstrate aircraft-to-submarine communication using blue-green lasers

c. (U) FY 1984 Planned Program:

- (1) Transition Mobile Access Terminal to advanced development
- (2) Transition the low probability of intercept technology to advanced development
- (3) Conduct technology investigations to enhance extremely high frequency satellite communications capability
- (4) Transition the Deploy Retrieve and Storage System and the Buoyant Cable Antenna technology to advanced development
- (5) Continue development of an airborne, high frequency electronic counter-countermeasures system
- (6) Conduct experiments of the blue-green laser communication system under different propagation conditions

d. (U) Program to Completion: This is a continuing program

5. (U) Project F21-223, Optical/Infrared/Ultraviolet Communications:

- This project is directed towards the application of advanced technology for communications requiring optical, infrared and ultraviolet energy
- This project addresses the need to communicate with submerged submarines

a. (U) FY 1982 Program:

- (1) Developed test plans for investigating the feasibility of copper-vapor lasers for aircraft and communications to submarines
- (2) Developed concept for a blue-green optical receiver to be incorporated in a submarine towed-buoy system

Program Element: 62721M

Title: Command and Control Technology

- (3) Submarine laser communications system engineering concepts were investigated, and the signal waveform was defined
- b. (U) FY 1983 Program:
  - (1) Experimental testbed equipment will be assembled and calibrated in preparation for brassboard testing of copper-vapor lasers
  - (2) Signalling requirements (waveform, beam shape, etc.), packaging and systems integration for the blue-green, towed-buoy receiver system will be determined
  - (3) Investigate submarine laser communication issues such as waveform optimization, mobile platform development, receiver/airframe integration and operational deployment
- c. (U) FY 1984 Planned Program:
  - (1) Brassboard testing of the copper-vapor lasers will be conducted
  - (2) Continue development and feasibility testing of submarine laser communications subsystems
- d. (U) Program to Completion: This is a continuing program
- 6. (U) Project F21-224, Ship Internal Communications:
  - This project is directed towards the application of advanced technology for improved ship and submarine internal communications employing wire or fiber optic cables
  - This project responds to future shipboard data transfer requirements as set forth in the 1979 Science and Technology Objectives promulgated by the Chief of Naval Operations
- a. (U) FY 1982 Program:
  - (1) Performed computer simulation and hardware measurements of data transfer technology
  - (2) Developed Standard Information Transfer Architecture for Combat Systems specification and description
  - (3) Performed system analysis and trade-off study to identify preferred shipboard digital voice multiplex concept
  - (4) Continued monitoring related digital voice multiplex technologies in industry
- b. (U) FY 1983 Program:
  - (1) Complete software, interface and switch matrix design for the Standard Information Transfer Architecture for Combat Systems node
  - (2) Start tests in a 3-node configuration
  - (3) Select digital voice encoding techniques to be used in the digital voice multiplex system
  - (4) Update industry technology survey for latest developments
- c. (U) FY 1984 Planned Program:
  - (1) Complete 3-node configuration tests of the Standard Information Transfer Architecture for Combat Systems
  - (2) Perform trade-off analysis and begin preparation for transitioning to engineering development
  - (3) Complete interface specifications for the digital voice multiplex subsystems
- d. (U) Program to Completion: This is a continuing program

Program Element: 62721N

Title: Command and Control Technology

7. (U) Project V21-231, Navigations Sensor Technology:

- This project is directed towards providing the capability for accurate, continuous navigation and position-fixing
- This project responds to Command-in-Chief, Atlantic Fleet's 1981 "Submission of Research and Development Objectives"

a. (U) FY 1982 Program:

b. (U) FY 1983 Program:

c. (U) FY 1984 Planned Program:

d. (U) Program to Completion: This is a continuing program

8. (U) Project V21-232, Navigation System Technology:

- This project is directed towards applying advanced technology for improved navigation systems for weapon, ship, submarine, and aircraft platform

a. (U) FY 1982 Program:

- (1) Determined the impact of navigation errors on combat system performance
- (2) Began ring laser gyro development for submarine applications
- (3) Conducted at-sea tests of ship strapdown inertial systems and performed data analysis
- (4) Conducted tests on the Litton LW-2728 laser gyro and the Singer MOD IID laser gyro for aircraft application
- (5) Prepared for flight evaluation of an aircraft correlation velocity sensor
- (6) Completed flight test of Litton LN-90A strapdown ring laser gyro
- (7) Completed system concept and integration analysis for a secure, carrier-based air-traffic control system

b. (U) FY 1983 Program:

- (1) Analyze the processing of navigational information in the Naval Tactical Data System

Program Element: 62721M

Title: Command and Control Technology

- (2) Complete ring laser gyro evaluation for submarine application
- (3) Determine feasibility of strapdown inertial systems for ship application
- (4) Assess new laser gyro design approaches for aircraft applications
- (5) Complete flight evaluation of aircraft correlation velocity sensor
- (6)

c. (U) FY 1984 Planned Program:

- (1) Continue analysis of navigation error effects on the Naval Tactical Data System
- (2) Perform flight test of the Global Positioning System Ring Laser Gyro Navigator to demonstrate feasibility
- (3) Transition correlation velocity sensor to advanced/engineering development
- (4)

d. (U) Program to Completion: This is a continuing program

9. (U) Project F21-233, Navigation Technology (SHAD):

- See Project F21-231

10. (U) Project F21-241, Information Processing:

- This project is directed towards exploratory development in both software and hardware specifically related to digital and analog processing of information
- This project addresses the need for faster and more reliable information processing in response to the high speeds of multiple threats facing naval sea and air platforms

a. (U) FY 1982 Program:

- (1) Started construction of the 16x16 S-1 Mark IIA multiprocessor system
- (2) Two generations of the Structured Computer-Aided Logic Design system used in the design and construction of the Mark IIA computer were developed and released to the private sector
- (3) Analyzed candidate operating systems for ship combat distributed processing applications
- (4) Experiments investigating the reconfiguration of distributed processing nodes to support fault tolerance were completed for the combat direction system processing architecture
- (5) Initial operational capability for the Generalized Computer System Simulator II was achieved
- (6) Developed optimal hardware configuration design algorithm for the Generalized Computer System Simulator II
- (7) Demonstrated 10kbit/sec writing speed and  $10^4$  bits/cm<sup>2</sup> storage density for cryogenic optical memories based upon photochemical hole burning

b. (U) FY 1983 Program:

- (1) Continue construction of the 16x16 S-1 Mark IIA multiprocessor system
- (2) Complete development and performance validation of a third generation Structured Computer-Aided Logic Design system
- (3) Determine alternatives and evaluate candidate distributed processing systems for tactical applications
- (4) Incorporate improvements into the input file for the Generalized Computer System Simulator
- (5) Complete hardware specification for a solid state Flight Data Recorder
- (6) Construct a prototype cryogenic optical memory capable of 1 Mbit/sec writing speed and  $10^9$  bits/cm<sup>2</sup> storage density

Program Element: 62721N

Title: Command and Control Technology

c. (U) FY 1984 Planned Program:

- (1) Complete construction of the 16x16 S-1 Mark IIA multiprocessor system
- (2) Initiate evaluations of the S-1 Mark IIA multiprocessor
- (3) Investigate support-environment requirements for tactical distributed processing system
- (4) Continue efforts to adapt commercially available computer memory technology for airborne information processing applications
- (5) Initiate testing and evaluation of the photochemical hole-burning memory prototype

d. (U) Program to Completion: This is a continuing program

11. (u) Project F21-242, Information Management, Assessment & Display:

- This project is directed towards the application of advanced technology for information management relevant to making effective and timely command and control decisions
- Areas of concern include distributed data base query and management, networking, information assessment and correlation, man/machine interface and display technology
- Advances in information management technology are needed to handle adequately high volumes of data from multiple sensors and diverse data sources

a. (U) FY 1982 Program:

- (1) Comprehensive redesign for the Multibase prototype, implemented in the ADA language, was completed
- (2) Completed the design specification for the Distributed Database Manager
- (3) Initiated implementation of a high level graphic interface to Multibase to support multilevel user access
- (4) Initiated construction of PDP-11 general purpose computers for integration into Command and Control work stations
- (5) Initiated investigation into local network and global internetwork architectural issues and concepts
- (6) Initiated system integration and bus testing for the lightweight modular display system
- (7) Complete characterization of silicon liquid crystal light valve device and evaluate with large screen display testbed

b. (U) FY 1983 Program:

- (1) Demonstrate the final version of the File Access Module for Multibase
- (2) Prepare a performance report on the Physical Database Processor module for the Distributed Database Manager
- (3) Complete development of the graphical interface to Multibase and install on a VAX 11/780 computer
- (4) Interface Command and Control work stations to local area networks and test out the multimedia enhancements and the natural language processing capability
- (5) Continue investigation into network and internetwork architectural issues and concepts
- (6) Demonstrate a prototype natural language voice processor with limited vocabulary set
- (7) Complete system integration testing for the lightweight modular display system
- (8) Start manufacturing technology program for silicon liquid crystal device

c. FY 1984 Planned Program:

- (1) Continue data base management investigation involving large data bases and multiuser access
- (2) Assess maturity of on-going efforts and integrate appropriate development into an effective globally distributed command support system
- (3) Complete lightweight modular display system development model specifications and initiate procurement

Program Element: 62721N

Title: Command and Control Technology

- (4) Complete manufacturing technology program for silicon liquid crystal light valve device
- (5) The large increase in funding in FY 1984 is the result of initiating several new efforts in FY 1984

d. (U) Program to Completion: This is a continuing program

12. (U) Project F21-243, Software Technology:

- This project is directed towards the development of a modern, comprehensive software engineering technology base applicable to embedded computer systems demonstrating high reliability and low life cycle costs

a. (U) FY 1982 Program:

- (1) Performed initial demonstration of a prototype Software Engineering Environment facility
- (2) Prepared phase I of the A-6 aircraft Operational Flight Program model
- (3) Evaluated candidate high-order languages for the Operational Flight Program
- (4) Prepared final reports on software engineering automation for tactical embedded computer systems and on a software performance oriented design methodology

b. (U) FY 1983 Program:

- (1) Complete the Software Engineering Environment facility performance specification and initiate detailed design specification
- (2) Continue to integrate software methodologies for use in the production of software for the A-6 Operational Flight Program restructure effort
- (3) Redesign the A-7 Operational Flight Program according to software engineering principles
- (4) Develop the strategy for integrating ADA, the DOD standard high level language, with the Hierarchical Development Methodology

c. (U) FY 1984 Planned Program:

- (1) Complete detailed design specification for the Software Engineering Environment facility
- (2) Initiate coding of the full set A-7 Operational Flight Program
- (3) Develop computerized tools to check the properties of the Hierarchical Development Methodology implemented in ADA
- (4) Initiate effort to develop techniques to simplify and reduce cost of producing software documentation that conforms to Military Standard 1679

d. (U) Program to Completion: This is a continuing program

13. (U) Project F21-245, Battlefield Command and Control

- This project is directed towards application of advanced technologies for Marine Corps command and control requirements in a battlefield environment
- Included is a communications thrust that addresses the need to provide increased quality and quantity of tactical communication in an environment characterized by electronic warfare emissions and radio frequency interference

a. (U) FY 1982 Program:

- (1) Investigated technologies such as ultraviolet wave propagation and low data rate voice links to improve reliability and survivability of the Landing Force Integrated Communication System

Program Element: 62721N

Title: Command and Control Technology

- (2) Evaluated technologies and distributed architecture for a mobile command concept appropriate for Marine air-ground operations
- (3) Completed very high frequency multicoupler development for the purpose of reducing the number of antennas required for the LVTC-7 mobile command post
- (4) The electronics portion of the Unit Level Message Switch was assembled using fault tolerant principles
- (5) Developed a decision support system for artillery fire support application

b. (U) FY 1983 Program:

- (1) Conduct tests of the low data rate voice technology over tactical radio links
- (2) Develop channel characteristics and modulation techniques for the ultraviolet link
- (3) Define the issues for the marine air-ground distributed architecture and complete the design for a representative node
- (4) Initiate development of a high frequency distributed multicoupler system for the LVTC-7 as a mobile command post
- (5) Complete the reliability testing of the fault tolerant model drawn from the Unit Level Message Switch
- (6) Complete in-house testing of the artillery support decision support system
- (7) Analyze the deployment and survivability of optical fibers for tactical communications

c. (U) FY 1984 Planned Program:

- (1) Continue technology investigations related to tactical networking for the Land Force Integrated Communication System
- (2) Investigate the feasibility of packet radio technology for the Marine air-ground distributed architecture
- (3) Complete the testing of the high frequency distributed multicoupler system
- (4) Initiate investigation into the application of artificial intelligence concepts for decision aids
- (5) Pursue proof of concept of long haul fiber optics networks for tactical communications

d. (U) Program to Completion: This is a continuing program

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984

(A) (U) Project F21-222, Radio Frequency Communications

1. (U) DESCRIPTION (Requirement and Project):

- This project is directed towards providing reliable and survivable means for transmitting information employing electromagnetic radiation.
- Develops technological advances which can be applied to improving connectivity and communications capability of the Navy and Marine Corps
- Areas of emphasis include jam resistant, and low probability of intercept techniques; increased survivability, reliability, interoperability, maintainability, and affordability; minimizing the impact of communications requirements on platform speed, depth (submarine only), and maneuverability; and the reduction of volume and weight of communications systems

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS

(a) (U) FY 1982 Program:

- (1) The Narrow Band Signal Conversion Unit for the integrated Communications, Navigation and Identification suite has been demonstrated in the lab and is ready for Fleet applications

Program Element: 62721N

Title: Command and Control Technology

(2)†

- (3) The noise and distortion of receiving subsystems for the Broadband High Frequency Intra-Task Force System were measured in a simulated shipboard environment
- (4) Fabricated a high frequency surface wave expendable buoy, completed at-sea evaluation, and transition effected
- (5) The first bioluminescence measurements were made from a submarine platform. Quiescent bioluminescence noise data were made from a moored detector
- (6) The Mobile Access Terminal Network was installed at testbed facilities in preparation for at-sea demonstration of new transmission protocols
- (7) A wideband high-frequency antenna for submarine buoy application has been completed and transitioned

b. (U) FY 1983 Program:

(1)†

- (2) Complete at sea tests of the Mobile Access Terminal and transition to advanced development
- (3) Incorporate anti-jam features into high frequency intra-Task Force Network model
- (4) Complete submarine and moored detector measurements, of bioluminescence and attendant data reductions
- (5) Complete the integration of the wideband signal processor for the advanced Communications, Navigation and Identification (CNI) suite into the site demonstration brassboard
- (6) Complete flight tests for the L-band adaptive array for Joint Tactical Information Distribution System

c. (U) FY 1984 Planned Program:

- (1) Continue investigation into system and network design for the high frequency Intra-Task Force architecture
- (2) Demonstrate Global Positioning System capability for the wideband signal processor for the Communications, Navigation and Identification suite
- (3)†
- (4) Continue exploratory development work on an anti-jam modem and adaptive antenna for aircraft communications
- (5)†
- (6) Continue Packet Radio Communications (Mobile Access Terminal) for shipboard application
- (7) Continue development of a wideband bus architecture for aircraft

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable.



# FY 1984 RUT&E DESCRIPTIVE SUMMARY

Program Element: 62734N

Title: Countermeasures Technology

DoD Mission Area: 521 - Electronic and Physical Sciences

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | <b>25,514</b>  | <b>32,073</b>    | <b>29,633</b>    | <b>31,246</b>    | Continuing               | Continuing           |
| F34-311     | (Classified Project)                             | 1,797          | 2,450            | 1,909            | 1,662            | Continuing               | Continuing           |
| F34-371     | Acoustic/Torpedo Countermeasures                 | 2,446          | 3,045            | 3,055            | 3,398            | Continuing               | Continuing           |
| F34-372     | Electronic Warfare                               | 8,513          | 9,971            | 9,414            | 9,797            | Continuing               | Continuing           |
| F34-373     | Explosive Ordnance Disposal Equipment/Technology | 1,528          | 2,826            | 3,625            | 3,691            | Continuing               | Continuing           |
| F34-374     | Satellite Countermeasures and Defense            | 1,114          | 1,695            | 1,098            | 1,304            | Continuing               | Continuing           |
| F34-375     | Optical/Infrared/Ultraviolet Countermeasures     | 1,784          | 2,580            | 2,321            | 2,544            | Continuing               | Continuing           |
| F34-376     | Mine Countermeasures                             | 6,663          | 6,998            | 5,866            | 6,231            | Continuing               | Continuing           |
| F34-377     | Special Warfare Technology                       | 395            | 200              | 343              | 391              | Continuing               | Continuing           |
| F34-393     | USMC Land Mine Countermeasures                   | 1,272          | 1,858            | 2,002            | 2,228            | Continuing               | Continuing           |
| F34-573     | Pyrotechnics/Cartridge Actuated Devices          | *              | 450              | **               | **               | **                       | **                   |

\* - Transferred from Program Element 62765N

\*\* - Transferred to Project F34-375 in this program element

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports the development of effective fleet countermeasures for use against hostile systems designed for:
  - Surveillance
  - Command/Control/Communications
  - Target acquisition
  - Weapon guidance
- Objectives comprise operational deception for precombat and combat operations; dilution of force that the hostile command can apply by use of long range decoy, replaced weapon neutralization, advanced covert countermeasures, jamming applied over the entire combat area; and forceful jamming of enemy sensors and control circuits during combat operations
- Investigates the acoustic, electromagnetic, and optical spectra as well as the operational environments of surface, subsurface, and aerospace warfare

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary (-2,417 in FY 1982, +2,929 in FY 1983, and -1,874 in FY 1984) are due primarily to transitions to advanced development and redirected efforts within Countermeasures projects in FY 1983 and out-years, reduction of "classified programs" in FY 1982 and out-years, and escalation reduction
- In order to enhance fiscal and technical management, the following project realignments were instituted
  - F34-573 was established in FY 1983 to transfer management of Pyrotechnic/Cartridge Actuated Devices (CADS) to this P.E. (62734N). Funding and management appears in Project F34-375 in FY 1984 and out-years

(172)

Program Element: 62734N

Title: Countermeasures Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No.                      | Title                                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                                  | <b>25,036</b>  | <b>27,931</b>    | <b>29,144</b>    | <b>31,907</b>    | Continuing               | Continuing           |
| F34-311                          | (Classified Project)                             | 1,782          | 4,280            | 3,435            | 4,695            | Continuing               | Continuing           |
| F34-371                          | Acoustic/Torpedo Countermeasures                 | 2,056          | 2,266            | 2,445            | 2,580            | Continuing               | Continuing           |
| F34-372                          | Electronic Warfare                               | 7,874          | 8,293            | 8,751            | 9,219            | Continuing               | Continuing           |
| F34-373                          | Explosive Ordnance Disposal Equipment/Technology | 1,641          | 1,480            | 1,480            | 1,584            | Continuing               | Continuing           |
| F34-374                          | Satellite Countermeasures and Defense            | 830            | 1,371            | 1,870            | 1,875            | Continuing               | Continuing           |
| F34-375                          | Optical/Infrared/Ultraviolet Countermeasures     | 1,193          | 1,885            | 2,220            | 2,430            | Continuing               | Continuing           |
| F34-376                          | Mine Countermeasures                             | 6,979          | 6,918            | 7,485            | 7,590            | Continuing               | Continuing           |
| F34-377                          | Special Warfare Technology                       | ---            | 200              | 200              | 214              | Continuing               | Continuing           |
| F34-384                          | Nuclear Warfare Vulnerability and Hardening      | 781            | *                | *                | *                | *                        | *                    |
| F34-388                          | High Power Microwave                             | 600            | **               | **               | **               | **                       | **                   |
| F34-393                          | USMC Land Mine Countermeasures                   | 1,300          | 1,238            | 1,258            | 1,320            | Continuing               | Continuing           |

\* Transferred to Program Element 62764N

\*\* Transferred to Program Element 62768N

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Information is disseminated through routine planning documents, professional seminars and publications, exchange of interim and final development reports, and dissemination of scientific and technical intelligence data from Central Intelligence Agency, Defense Intelligence Agency, Naval Intelligence Center, Foreign Scientific and Technical Intelligence Center of the Department of the Army, and Foreign Technology Division of the Air Force Systems Command
- Exploratory Development technologies resulting from work under Program Elements 62633N, Undersea Warfare Weaponry Technology; 62711N, Undersea Target Surveillance Technology; 62762N, Electronic Device Technology are exploited vigorously, not only for the basic technological advances which may be useful in future countermeasures systems, but also to project future hostile radars, communications, and weapon guidance systems which our countermeasure systems will be required to deceive, jam, or neutralize
- Office of Naval Technology management facilitates coordination by conducting their own technical/management reviews, and by participation in monitoring technical advisory groups consisting of tri-service/other government agencies (e.g., DARPA), Tri-service committees, program reviews by the Assistant Secretary of the Navy (Research, Engineering and Systems), and the inclusion of representative(s) of the Under Secretary of Defense for Research and Engineering in all internal planning and strategy development relating to this Program Element

G. (U) WORK PERFORMED BY

- DM-NORSE** - Primary laboratories are: David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Air Development Center, Warminster, PA; Naval Ammunition Depot, Crane, IN; Naval Coastal Systems Center, Panama City, FL; Naval Explosive Ordnance Disposal Center, Indian Head, MD; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA and White Oak, Silver Spring, MD; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA; Naval Underwater Systems Center, Newport, RI and New London, CT
- INDUSTRIAL** - Primary contractors and academic institutions are: Integrated Systems Corporation, Santa Monica, CA; ITR Research, Los Angeles, CA; Hughes Aircraft Corp., Fullerton, CA; ITT, Van Nuys, CA; Lockheed Missiles and Space Corporation, Sunnyvale, CA; NANTech International, Washington, DC; Norden Division of United Aircraft Corporation, East Hartford, CT;

Program Element: 62734N

Title: Countermeasures Technology

Planning Systems, Inc., McLean, VA; RCA, Burlington, MA; Raytheon Corporation, Waltham, MA, and Goleta, CA; TRACOR, Austin, TX; Sanders Associates, Nashua, NH; Singer-Librascope, Glendale, CA; Stanford Research Institute, Menlo Park, CA; Systems Control Technology, Inc., Palo Alto, CA; Texas Instrument Co., Dallas, TX; Watkins Johnson Co., Palo Alto, CA; Westinghouse, Baltimore, MD; Applied Research Laboratory, University of Texas, Austin, TX; Applied Physics Laboratory of Pennsylvania State University, State College, PA

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F34-311, Classified Project:

2. (U) Project F34-371, Acoustic/Torpedo Countermeasures:

- This project is directed toward the application of advanced technology to provide countermeasures against potential enemy sound navigation and ranging (Sonar) equipments, acoustic detection, classification, and targeting devices, and submarines launched underwater weaponry
- Applies to Surface and Submarine platforms

a. (U) FY 1982 Program:

- (1) Completed assessment of the acoustic and torpedo countermeasures capabilities of the Submarine Advanced Combat System and transitioned results to advanced development
- (2) The initial series of threat torpedo hull rupture vulnerability field tests was completed
- (3) Completed and transitioned surface ship concept to advanced development in Project 30225 (P.R. 63506N) — countermeasure technology/systems

b. (U) FY 1983 Program:

- (1) Define requirements for a successful surface ship torpedo defense option, a new start technical option in FY 1984
- (2) Develop the technology to counter — threat torpedoes
- (3) Complete initial internal component torpedo vulnerability tests
- (4) Field test broadband — jammer

c. (U) FY 1984 Planned Program:

- (1) Major new effort directed toward successful surface ship torpedo defense and countermeasure demonstration
- (2) Develop decoys to allow evasion of threat ASW units by U.S. Fleet Units
- (3) Develop the capability to — launch torpedoes and other devices from U.S. submarines
- (4) Pursue technologies to defeat/decoy threat undersea — systems

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F34-372, Electronic Warfare:

- Electronic Countermeasures for multi-mode threats
- Command, Control, and Communications Countermeasures
- Battle Group coordinated Electronic Warfare
- Deception/Decoys to counter threat sensors/missile guidance systems

Program Element: 62734H

Title: Countermeasures Technology

- Jammer technology
- Develop technologies to counter threat Anti Radiation Missiles (Anti-radiation missile countermeasures)

a. (U) FY 1982 Program:

- (1) Completed prototype effort for radar adaptive control hardware/software for anti-radiation missile countermeasures decoy inter-operability. Defined implementation issues for all ship classes
- (2) Built and tested two (2) receivers for aircraft application. Delivered (transitioned) to advanced development
- (3) Detailed Antenna model completed
- (4) Completed system design for aircraft employed jammer
- (5) Began field tests of cooperative Aircraft decoy
- (6) Successfully tested decoy
- (7) Microwave Integrated Solid State repeater - wide band power amplifiers demonstrated in phased array slice
- (8) Demonstrated rapidly inflatable corner reflector for shipboard launch with installed equipment.

b. (U) FY 1983 Program:

- (1) Assemble hardware to conduct effectiveness tests of Anti-Radiation Missile Countermeasures in Naval Research Laboratory Central Target Simulator facility and field test against tri-service generic anti radiation missile seeker
- (2) Complete fabrication of feasibility model
- (3) Design adaptive electronic warfare environment receiver preprocessor for final system design of missile threat receiver
- (4) Develop Chaff
- (5) Demonstrate millimeter wave traveling wave tube
- (6) Integrate decoys with counter-surveillance jamming in sea trials
- (7) Complete definition of, and requirements for, command, control, and communications control functions pursuant to major new command, control, and communications thrust planned for FY 1984

c. (U) FY 1984 Planned Program:

- (1) Conduct anti-radiation missile-countermeasures effectiveness evaluation
- (2) Increase airborne jammer technologies
- (3) Concentrated efforts in aircraft decoy techniques
- (4) Develop technologies to defeat radars/targeting devices with target discriminant circuits/logics
- (5) Investigate absorbent chaff and aerosols
- (6) Field test decoy
- (7) Begin major new thrust (technical option) in command, control, and communications

d. (U) Program to Completion: This is a continuing program.

4. (U) Project F34-373, Explosive Ordnance Disposal Equipment/Technology

- Develops those technologies required for locating, examining, and rendering safe conventional and nuclear devices
- Navy is assigned total explosive ordnance disposal responsibility for the Department of Defense and provides assistance to the Departments of Energy and Justice in this technology area

Program Element: 62734N

Title: Countermeasures Technology

a. (U) FY 1982 Program:

- (1) Demonstrated methods for nonviolent entry to ordnance casings
- (2) Developed materials to ensure safety of handling demolition materials in the stray Radio Frequency environment
- (3) Successfully demonstrate technologies for nonviolent entry of ordnance casings

b. (U) FY 1983 Program:

- (1) Develop and test concepts for remotely initiating and/or disabling ordnance fuses
- (2) Develop and test concepts for searching for removing or disposing of ordnance items from large areas and for defeating area entry chemical systems (both ordnance and non-ordnance items)
- (3) Develop means to examine foreign ordnance without having to disassemble it (inherently dangerous)

c. (U) FY 1984 Planned Program:

- (1) Build and demonstrate remote fuse actuator brassboard
- (2) Fabricate prototype ] system to defeat area entry denial systems
- (3) Build and test full scale isotope protection package
- (4) Pursue technologies to demonstrate low signature ordnance location sensors which have low power consumption to facilitate use in remote areas
- (5) Begin major new thrust to provide means for neutralization of improvised nuclear devices

d. (U) Program to Completion: This is a continuing program.

5. (U) Project F34-374, Satellite Countermeasures and Defense:

- This project will pursue advanced technologies which will reduce the susceptibility of U.S. Satellite systems to jamming and physical destruction
- Additionally, those technologies will be pursued which deny information about U.S. Fleet units [

a. (U) FY 1982 Program:

- (1) ] program formulated and coordinated within tri-service and the National Security Agency. Detailed technologies to be pursued. Can be briefed on a strict "need to know" basis
- (2) Acquired and installed two radars to begin ] measurements of surface combatants
- (3) Refined concepts for masking/modifying characteristics of U.S. shipborne radars
- (4) Completed Control Surface experiments associated with Space Shuttle tests. Final report provided to NASA

b. (U) FY 1983 Program:

- (1) Integrate and test hardware and software for Tactical Intelligence Production Enhancement program
- (2) Assess vulnerability of U.S. Fleet units to Soviet Bi-Static radar exploitation
- (3) Fabricate and test brassboard to demonstrate ] U.S. shipborne radar characteristics

c. (U) FY 1984 Planned Program:

- (1) Tactical Intelligence Production Enhancement on-site installation and demonstration

Program Element: 62734W

Title: Countermeasures Technology

- (2) Investigate [ ] techniques for U.S. Ships
- (3) Validate [ ] parameters

d. (U) Program to Completion: This is a continuing program.

6. (U) Project F34-375, Optical/Infrared/Ultraviolet Countermeasures:

- Project applies advanced technologies to [ ] systems which utilize electro optical/infrared/ultraviolet for detection/classification/guidance/targeting
- This project includes development of countermeasures [ ]

a. (U) FY 1982 Program:

- (1) Completed concepts and specifications for airborne [ ] Receiver
- (2) Demonstrated Helicopter Detection system and transitioned to advanced development
- (3) Began evaluation of airborne [ ] decoy materials
- (4) Completed engagement analysis on aircraft [ ] Missile Warning Receiver
- (5) The basic atmospheric and signature analysis programs were completed (Tri-Service program)
- (6) Successfully field tested full scale [ ] chaff rounds for surface ships
- (7) Completed design requirements for [ ] simulator brassboard

b. (U) FY 1983 Program:

- (1) Begin fabrication of [ ] Receiver brassboard
- (2) Deliver and demonstrate experimental [ ] decoys
- (3) Define filter design for airborne [ ] filter
- (4) Conduct [ ] warning receiver field experiments
- (5) Build and test [ ] simulator brassboard
- (6) Field test hybrid [ ] chaff rounds for surface ships
- (7) Begin development of [ ] technologies

c. (U) FY 1984 Planned Program:

- (1) Begin development of an Integrated Tactical Electronic Warfare System (ITWS) for use onboard aircraft [ ]
- (2) Initiate high repetition rate [ ] development for aircraft countermeasure employment
- (3) Complete material selections for [ ] Hybrid chaff rounds and transition to advanced development
- (4) Concentrate on exploitation of [ ] technologies for surface ships

d. (U) Program to Completion: This is a continuing program.

7. (U) Project F34-376, Mine Countermeasures:

- This project pursues the technologies which will enhance the U.S. Forces ability to detect, classify, and neutralize enemy waterborne mines
- Includes development of technologies to optimize use of mine countermeasure equipment [ ] remotely from these units wherever practicable [ ]

Program Element: 64/34B

Title: Countermeasures Technology

- a. (U) FY 1961 Program:
- (1) Determined target/environmental limits of proposed future Mine Countermeasures sonar
  - (2) Completed feasibility demonstration of High Rate Volume Mine Neutralization concept and transitioned to advanced development
  - (3) Completed Shaped Charge Neutralizer Feasibility demonstration
  - (4) Macker/Jammer/Decoy Concept Assessment completed
  - (5) Conducted at-sea evaluation of minehunting sonar body model
  - (6) Began at-sea evaluation of experimental towlines
  - (7) Completed analysis of multiple influence sweep
- b. (U) FY 1962 Program:
- (1) Complete Remote Undersea Mine Countermeasures Technology Feasibility Demonstration
  - (2) Complete Target Ship Self Protection Passive Mine Countermeasures System Field Trials
  - (3) Sea test advanced clearance helicopter (airborne)
  - (4) Determine/validate projected volume for mine countermeasures
  - (5) Finalize requirements for night on/recovery airborne mine countermeasures operations
  - (6) Assess HH-53E Helicopter vulnerability to influence mines
  - (7) Demonstrate the feasibility of explosive mine neutralization concepts which will at least double current neutralization rates
  - (8) Demonstrate the feasibility of neutralizing sea mines by sympathetic detonation using a pattern of shaped charges dispersed at a given height above the sea bottom
  - (9) Develop an active broadband sonar technology for detection and avoidance of mines
- c. (U) FY 1964 Planned Program:
- (1) Begin major mine countermeasures effort in support of amphibious operations
  - (2) Complete at sea tests of explosive neutralization methods
  - (3) Develop technical guidance for surface/air launched explosive neutralization systems
  - (4) Begin major effort to provide technologies for active countermeasures to mines (to be installed in fleet units)
- d. (U) Program to Completion: This is a continuing program.
- e. (U) Project F34-377, Special Warfare Technology:
- Naval Special Warfare encompasses that set of Naval operations generally accepted as being non-conventional in nature and in many cases including utilization of specially trained forces assigned to conduct Special Action Operations, i.e.,

a. FY 1962 Program:

- (1) New Start; requirements defined for FY 1963 and out-years
- (2) Began packaging developments for Fuel Air Explosives

Program Element: 62/34H

Title: Countermeasures Technology

b. (U) FY 1983 Program:

- (1) Develop an Fuel Air Explosive Weapon
- (2) Investigate methods to increase life support systems effectiveness
- (3) Define requirements for a system which will allow swimmer sustained surface/submerged transit

c. (U) FY 1984 Planned Program:

- (1) Identify technical approaches for non-lethal weapons development
- (2) Begin development of a sensor capability

d. (U) Program to Completion: This is a continuing program.

9. (U) Project F34-393, U.S. Marine Corps Land Mine Countermeasures:

- This subproject area encompasses the development of technology for countermeasures to land mines, obstacles and booby traps used against U.S. Marine Corps forces engaged in amphibious assaults on hostile shores and during the establishment of beachheads as well as subsequent operation ashore
- The development of technology in this area will provide the means to defeat land mines, obstacles and booby traps or other barriers through the use of weapons, weapon associated devices and detection methods of a usual or unconventional nature

a. (U) FY 1982 Program:

- (1) Continued Land Mine Countermeasure threat update, computer model development, and systems effectiveness measurement effort
- (2) Completed NATO Land Mine Concept Survey
- (3) Completed Fuel-Air Explosive and Liquid-Burst Fuel-Air Explosive tests and evaluated results for advanced development
- (4) Completed land minefield field assistance device breadboard
- (5) Developed Advanced Systems Concept for Minefield Planning Aid System
- (6) Conducted assessment of track-width plows for land mine neutralization in desert and beach areas and transitioned to advanced development
- (7) Established initial facilities for acquisition of Mine/Countermine information [ ] Initiated training; designed and conducted tests; evaluated results

b. (U) FY 1983 Program:

- (1) Complete full scale computer modeling capability inputs and in depth systems analysis of advanced countermine concept; report assessment of modeling
- (2) Update algorithm for combat analysis model; report algorithm modifications
- (3) Identify program for initiating and developing system concepts; continue Fuel Air Explosives Warhead Optimization; develop Advanced Fuel Air Explosives Concept
- (4) Develop test designs for effectiveness/performance measurements; report on test/data
- (5) Complete development of prototype simulation model and prepare specification for advanced development model; complete specifications



Program Element: 62734H

Title: Countermeasures Technology

- (6) Test vulnerability of mines against shaped charge technology; report on shaped charge test
- (7) Research technology for mine charge initiation; report on technology
- (8) Conduct assessment of attenuation of explosive charges in snow and permafrost; report results of assessment
- (9) Conduct field tests with cooperation of U.S. Army in cold weather to verify mine response versus pressure/impulse
- (10) Establish facilities and initiate training in open environment; design and conduct tests to establish range of performance; develop localization and marking techniques; report open environment tests

c. (U) FY 1964 Planned Program:

- (1) Continue fuel-air explosives (FAE) warhead optimization design analysis, development and test to provide for weaponization. Develop FAE multi-modal configurations, develop system concepts and perform system analysis to determine impact of design parameters on performance effectiveness. Determine optimum trade-offs between enhanced FAE line charge configurations and weapon delivery techniques
- (2) Begin development of technologies to support "single marine" employed mine neutralization equipment
- (3) Selected candidate system for neutralization of magnetic influence land mines from amphibious vehicles will be identified, fabricated and tested
- (4) Develop test plan and conduct test for detection of surf mines and mines/minefields in selected variety of conditions. Analyze data to determine electro-optical system performance effectiveness. Conduct system and trade-off analysis
- (5) Begin technical option to decrease vulnerabilities of equipment/personnel to land mine explosions

d. (U) Program to Completion: This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1964: Not applicable

# FY 1984 BDT&E DESCRIPTIVE SUMMARY

Program Element: 62735H

DoD Mission Area: 521 - Electronic and Physical Sciences

Title: High Energy Laser Technology

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>          | 57,487         | 60,976           | 67,902           | 70,530           | Continuing               | Continuing           |
| F35-342     | High Energy Laser Weaponry and Technology | 57,487         | 60,976           | 67,902           | 70,530           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- This program develops High Energy Laser technology and is structured to resolve critical technical issues related to the potential use of a continuous wave laser in an anti-ship missile defense application
- The program, named SEA LITE, is planned to demonstrate the effectiveness of an experimental chemical laser. Testing will occur at the White Sands Missile Range beginning in 1984
- The results of these demonstrations will be used to evaluate the feasibility of a High Energy Laser weapon for ship based applications
- The SEA LITE system will also provide the capability to generate test data for other potential High Energy Laser applications of interest in DoD

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between funding profiles shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a decrease of 2,234 in FY 1983 as a result of Congressional action and a revised cost estimate and a decrease of 1,530 in FY 1984 as a result of revised cost estimates including escalation

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                   | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>        | 38,276         | 57,487           | 63,210           | 69,440           | Continuing               | Continuing           |
| F35-346     | High Energy Laser Weaponry & Technology | 38,276         | 57,487           | 63,210           | 69,440           | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

## F. (U) RELATED ACTIVITIES

- The National High Energy Laser Test Range (Program Element 63006A) supports White Sands Missile Range activities to equip the High Energy Laser System Test Facility with support subsystems and hardware necessary to make it an operating test facility; much of that hardware is essential to the Navy SEA LITE program
- Although High Energy Laser technology is being developed under other Army, Air Force, and DARPA BDT&E program elements, that work does not directly support the work under this P.E., nor does that work duplicate in any way the work under this P.E. The combination of work under this P.E. plus work being done under Army, Air Force, and DARPA programs, however, does represent an approach coordinated by the Office of the Under Secretary of Defense for Research and Engineering (Directed Energy Weapons) to address principal issues and potential applications for High Energy Laser technology

Program Element: 62735W

Title: High Energy Laser Technology

- Program Element 62768W, Directed Energy Technology, is supporting advanced laser technologies such as pulsed chemical lasers and free electron lasers which, although less mature than the continuous-wave chemical laser employed in the SEA LITE program, may eventually offer performance and system advantages

G. (U) WORK PERFORMED BY

- IN-HOUSE - Lead Laboratory: None. Others: Fleet Analysis Center, Corona, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Ft. Huachuca, CA; Naval Surface Weapons Center, Dahlgren, VA
- INDUSTRIAL - Prime Contractor: None. Others: Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; Science Applications, Inc., Arlington, VA; Hughes Aircraft Company, El Segundo, CA; Sperry Systems Management, Great Neck, NY; TRW Defense and Space Systems Group, Redondo Beach, CA; MIT Lincoln Laboratory, Lexington, MA; Bendix Guidance Systems Division, Mishawaka, IN; Teledyne Ryan Aeronautical Corp., San Diego, CA; Sperry Flight Systems, Albuquerque, NM
- ACADEMIC - None

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984: None

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(A) (U) Project F35-342, High Energy Laser Weaponry and Technology:

1. (U) DESCRIPTION (Requirement and Project):

- A weapon with very fast response time, high fire power, and ability to engage maneuvering, crossing, and diving targets is needed to defeat increasing numbers of sophisticated Soviet anti-ship missile threats
- A high energy laser weapon has the potential to deliver lethal energy to the target at the speed of light. This results in very short reaction time and large target handling capability. The laser has the potential to engage crossing, maneuvering or diving targets under conditions beyond the capability of conventional systems.
- The experimental laser system will consist of a [ ] and a precision beam director with a [ ] The laser has already achieved its design output power during factory tests at TRW, Inc. The beam director is being fabricated by Hughes Aircraft Company
- The laser system will be installed and tested at White Sands Missile Range in the DoD High Energy Laser System Test Facility, being constructed with MILCON funds

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- (1) Developing contractor (TRW) completed performance characterization tests of [ ] All parameters, [ ] met or exceeded design goals. [ ] will be started in FY 1983. TRW began disassembly of laser for move to White Sands Missile Range.
- (2) Hughes Aircraft Company completed fabrication of 60% of the components for the beam director.
- (3) Completed field tests of the Automatic Aimpoint Selection and Maintenance subsystem which will be incorporated in the beam director. Tests were done at White Sands Missile Range. [ ] Hand over from range radars to the infrared tracker was demonstrated.

Program Element: 62735N

Title: High Energy Laser Technology

Test results indicate the Automatic Aimpoint Selection and Maintenance Subsystem will meet the needs of the SEA LITE test program

(4) The Navy's chemical laser was used to investigate the laser beam while constrained to a test stand. Diagnostic instruments indicate A second test on another gave similar results. These tests provided the first confirmation that

b. (U) FY 1983 Program:

- (1) The chemical laser will be reassembled in the High Energy Laser Test Facility at White Sands. The laser will be integrated with support subsystems (reactant supply and pressure recovery) provided by White Sands. Initial check-out tests prior to lasing will occur during the last quarter of the fiscal year.
- (2) A modified mounting plate for the missile modules in the laser will be designed. The new plate will be installed in FY 1985 during the time the optical train is being put into place.
- (3) Fabrication of component and subsystem integration for the beam director will be completed by the end of the fiscal year. Design of a hot spot tracker for eventual incorporation in the beam director will begin, with preliminary design review occurring by the end of the year. The hot spot tracker provides the "fine tuning" in the beam steering system. It will keep the beam from drifting off the desired aimpoint once the laser has been turned on.
- (4) A prototype of the instrumentation package for the targets will be completed and production will begin. A prototype of the containing the instrumentation package and modifications for range safety will be completed. Work on a prototype of the will be 30% complete. Production of the will start.
- (5) The Navy chemical laser at TNW's Capistrano Test Site will be used to investigate damage mechanisms on subsystems and components of the SEA LITE targets. Tests will concentrate on aimpoints not investigated in prior damage and vulnerability experiments. The goal is to develop an understanding of the damage mechanisms that are expected to occur during the lethality tests at White Sands.
- (6) An experimental adaptive optics subsystem will be designed and assembly will begin in FY 1983. The subsystem will employ a cooled deformable metal mirror developed several years ago. The immediate goal is to refurbish the hardware and assemble a laboratory system which can be used to investigate sensor and control loop alternatives.

c. (U) FY 1984 Planned Program:

- (1) The chemical laser will be fully checked-out and its lasing performance reconfirmed during the first half of the year. Optics will be installed to take the beam to a test area where laser damage experiments can be performed. During the second half of the year, damage tests will be run on components of the SEA LITE targets to better understand which were seen in two brief tests with the done in FY 1982.
- (2) Integration and factory testing of the beam director will be completed. Disassembly and shipment to White Sands Missile Range will get underway. Design of the hot spot tracker will be finished and fabrication will begin about mid-year. Integration into the beam director will occur at White Sands Missile Range in FY 1985.

Program Element: 62735N

Title: High Energy Laser Technology

- (3) Production of instrumentation packages for the targets will be completed, as will production of the required number of [containing those instrumentation packages and modifications to satisfy range safety requirements. A prototype of the [will be finished by mid-year and production of the targets for the lethality tests will begin.
  - (4) Assembly of the experimental adaptive optics system will be completed and laboratory tests will be conducted during the first half of the year to investigate alternative approaches to configuring sensors and control loops that drive the deformable mirrors. The system is intended to correct for atmospheric turbulence and thermal distortions along the beam path between the laser system and the target. In the second half of the year, the experimental system will be moved to TRW's Capistrano Test Site where it will be tested with the Navy Chemical laser. The tests will be done jointly with the Air Force. The Air Force application for adaptive optics requires correction of turbulence and thermally induced beam distortion only close to the beam director aperture for long beam path applications. The Navy on the other hand, is interested in correcting for thermally induced distortion distributed along the entire beam path, but over much shorter total distances. These differences lead to different requirements on sensors and control loops; one system will not satisfy both applications. Nevertheless, common system elements allow some shared development and testing at this stage, and result in cost saving to both Services.
- d. (U) Program to Completion:
- \* A decision on proceeding with an Advanced Development Model of a laser weapon for shipboard installation and testing will be made on the basis of SEA LITE data and considerations of mission need, cost and technical risk.
- e. (U) Milestones: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62757N

Title: Human Factors and Simulation Technology

DoD Mission Area: 522 - Environmental and Life Sciences

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>6,378</b>   | <b>9,155</b>     | <b>8,366</b>     | <b>9,300</b>     | Continuing               | Continuing           |
| F57-242     | Tactical Information Correlation | -              | -                | 98               | 220              | Continuing               | Continuing           |
| F57-525     | Human Factors Technology         | 2,819          | 4,926            | 3,689            | 4,169            | Continuing               | Continuing           |
| F57-526     | Simulation Technology            | 3,210          | 3,861            | 4,201            | 4,510            | Continuing               | Continuing           |
| F57-701     | Small Business                   | 349            | 368              | 378              | 401              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

This program develops technology in the areas of human factors and simulation. Need for the effort stems from the following key issues:

- Present automated information systems are inadequate in a multiple-threat warfare environment
- Successful operation of future weapon systems is dependent on the effective integration of the human operator/maintainer into the weapon system
- Cost, scarcity and potential hazards of operational equipment for use in training in the actual environment poses serious restrictions on effective training
- Development of an effective man-machine-mission relationship is required to assure that the demands and environment created by the equipment are compatible with abilities and characteristics of the human operator and maintainer
- Development of improved visual and weapons simulation capabilities and individualized automated training techniques is needed to minimize the expensive use of operational equipment for training

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a net decrease in the program element total of 109 in FY 1982; an increase of 1,100 in FY 1983; and a decrease of 81 in FY 1984. The increase in the Program Element and in Project F57-525 for FY 1983 results from a transfer of Exploratory Development resources from P.E. 62763N, Personnel and Training Technology, for an effort begun in FY 1982. This work involves demonstration and evaluation of a computer system incorporating advanced man-machine communication techniques on the USS CARL VINSON (CVN 70). In FY 1984, the decrease of 330 in Project F57-525 results from improved cost estimates while the increase of 159 in Project F57-526 will permit the completion of the evaluation of the prototype missile envelope recognition trainer. The remaining changes result from minor adjustments characteristic of research and exploratory development.
- In addition, the program structure has been changed to include in FY 1984 the new Project F57-242 to evaluate use of interactive displays for tactical information comprehension

Program Element: 62757N

Title: Human Factors and Simulation Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 5,863          | 6,487            | 8,053            | 8,447            | Continuing               | Continuing           |
| F57-525     | Human Factors Technology  | 2,211          | 2,879            | 3,801            | 4,019            | Continuing               | Continuing           |
| F57-526     | Simulation Technology     | 3,652          | 3,308            | 3,886            | 4,042            | Continuing               | Continuing           |
| F57-701     | Small Business            | 0              | 300              | 368              | 386              | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Related research, advanced development and engineering development program elements within the Navy are the following (letters within parentheses indicate relevance to either Human Factors or Training Devices and Simulation): 61153N, Defense Research Sciences (R); 63701N, Human Factors Engineering Development (H); 63733N, Training Devices Technology (T); 64703N, Training and Personnel Systems Development (T); 64714N, Air Warfare Training Devices (T); 64715N, Surface Warfare Training Devices (T); and 64716N, Submarine Warfare Training Devices (T). Related Army and Air Force exploratory development program elements are: 62716A, Human Factors Engineering in Systems Development (H); 62717A, Human Performance Effectiveness and Simulation (H,T); 62727A, Non-System Training Devices Technology (T); 62202F, Aerospace Biotechnology (H); and 62205F, Training and Simulation Technology (T)
- To ensure coordination among these program elements and to prevent unnecessary duplication of efforts, a variety of formal and informal means are used to promote communication at both working and management levels. Information is regularly exchanged with the other services, non-DoD agencies, private industry and universities by such means as Tri-service Technical Advisory Groups, special planning meetings, workshops, conferences and symposia, and wide dissemination of technical reports

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Training Equipment Center, Orlando, FL; Naval Air Development Center, Warminster, PA; Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA; Navy Personnel R&D Center, San Diego, CA
- INDUSTRIAL - Applimation, Orlando, FL; American Airlines, Dallas, TX; Singer-Link Division, Binghamton, NY; Applicon Inc., Rockville, MD; Hewlett-Packard, Palo Alto, CA; McDonnell Douglas Corp., St. Louis, MO; Honeywell Inc., Minneapolis, MN; Analytica Inc., Willow Grove, PA; Signal Technology Inc., Santa Barbara, CA
- ACADEMIC - University of South Carolina, Columbia, SC; Ohio State University Research Foundation, Columbus, OH

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F57-242, Tactical Information Correlation. This new project is planned for initiation in FY 1984
  - The project will support improvements in the ability of decision makers to understand information from various sensors through the use of adaptive interactive displays
  - a. (U) FY 1982 Program:  
Not applicable
  - b. (U) FY 1983 Program:

Program Element: 62757H

Title: Human Factors and Simulation Technology

Not applicable

- c. (U) FY 1984 Planned Program: (New start)
- (1) Initiate effort to examine the ability of decision-makers to understand information displayed by various pictorial and alphanumeric methods
- d. (U) Program to Completion: This is a continuing program
2. (U) Project F57-525, Human Factors Technology. This project supports:
- Development of design criteria that will reduce the level of human workload and skill required for system operation and maintenance, thereby increasing system effectiveness, safety and reliability and decreasing life-cycle costs
  - Development of decision aids to enhance the ability of the man-machine system to integrate, evaluate and respond to rapidly changing information
  - Improvements in the performance of complex systems by minimizing the effects of multiple environmental stressors acting upon the operator
- a. (U) FY 1982 Program:
- (1) Developed a prototype tactical decision aid for planning ASW sonobuoy patterns. Decision aid reduces workload 18% and improves mission achievement covering such factors as deployment time and time to first detection by 87%
  - (2) Developed methodology for identifying voice functions for airborne voice-interactive control systems, and completed design specification for an airborne continuous speech recognition system
  - (3) Initiated man-in-the-loop tests of missile guidance and control requirements for ship targets
  - (4) Accelerated efforts to improve the performance of ship propulsion plant personnel in both watchstanding and maintenance through the application of human factors technology
  - (5) Initiated development of data to increase the probability of radar detection of airborne targets by ship personnel
  - (6) Developed and validated new decision aiding concepts for attack submarine operations, resulting in significant projected improvements in range estimation performance
  - (7) Developed specification for a data retrieval system to improve human factors engineering support during the weapon system acquisition process
- b. (U) FY 1983 Program:
- (1) Complete the development of performance standards for an airborne voice interactive system
  - (2) Complete development of a matrix which relates capability/utility of visual, tactile, speech, and auditory channels in a normal operational environment
  - (3) Initiate human factors engineering evaluation of maintainability of shipboard propulsion systems
  - (4) Complete comparison evaluation of analog and digital radar target acquisition techniques on detection/tracking of airborne targets
  - (5) Initiate development of quantitative models of human decision processes for surface ships ASW tactical operations
  - (6) Complete identification of combat decision making functions that are most vulnerable to degradation in high threat density conditions
  - (7) Complete installation of a computerized information system on board the USS CARL VINSON, and evaluate its usefulness as an aid to shipboard management and technical information presentation



Program Element: 62757N

Title: Human Factors and Simulation Technology

c. (U) FY 1984 Planned Program:

- (1) Complete F-18 flight tests to demonstrate utility of interactive voice command techniques in fighter/attack aircraft
- (2) Initiate evaluation of new concepts in operator-computer interaction in the monitoring and dynamic controlling of shipboard engineering systems
- (3) Expand matrix relating capability/utility of visual, tactile, speech and auditory channels to the gravitational environment and movement constraints experienced in aircraft such as the F-18 and F-14
- (4) Complete handbook providing design guidelines and methodologies for designing decision augmentation systems
- (5) Initiate efforts to determine the degree of application of voice for direct communication with on-board computers in combat aircraft
- (6) Complete human factors design guidelines for propulsion display and controls subsystem for potential application to the DDG-51

d. (U) Program to Completion: This is a continuing program

3. (U) Project F57-526, Simulation Technology. This project supports:

- Development of improved visual simulation techniques to support training of a greater number of visually demanding tasks, to provide increased training effectiveness, and to lower the cost of training devices
- Development of sensor simulation with a capability for providing coordinated displays of inputs from multi-spectral sensors
- Development of techniques which improve the instructional use of simulation hardware and software
- Development of techniques to enhance training device utilization through increased trainee and instructor acceptance

a. (U) FY 1982 Program

- (1) Developed a helmet-mounted laser display prototype integrated with an eye-tracking mechanism to provide the wide field-of-view and high display resolution required for effective training of many flight tasks. Will transition in FY 1983 to advanced development (P.E. 63733N, Training Devices Technology). Potential for 5-10 million dollar savings per simulator
- (2) Developed and successfully demonstrated a computer generated imagery concept for the simulation of thermal sensors in correlation with visual displays. Concept will transition in FY 1983 to advanced development (P.E. 63733N)
- (3) Developed a small, portable, electronic maintenance trouble shooting aid which will reduce maintenance training time and will permit performance of maintenance by lower aptitude personnel. Transitioned to prototype development under a joint service program (P.E. 64709N, Prototype Manpower/Personnel System)
- (4) Initiated the evaluation of artificial intelligence techniques potentially useful for transferring knowledge held by subject matter experts into a data base which can be accessed by a training device

b. (U) FY 1983 Program

- (1) Initiate development and evaluation of a motion cueing system for vertical take-off and landing (helicopter) simulator application
- (2) Complete design for a part task missile envelope recognition trainer
- (3) Initiate evaluation of the acoustic target and ocean models for real-time acoustic signal generation for the ASW training function

Program Element: 62757N

Title: Human Factors and Simulation Technology

- (4) Complete field test of the automated performance assessment and remedial training system for use by the Landing Signal Officer in training pilots for night carrier landing
- (5) Initiate evaluation of application of very high speed integrated circuits to the design of training devices to identify any cost-effective benefits
- (6) Complete smoke generator design for firefighting trainer
- c. (U) FY 1984 Planned Program
  - (1) Complete field evaluation of missile envelope recognition trainer
  - (2) Conduct demonstration of automated voice technology applications for ASW team training
  - (3) Initiate the identification of simulator design features and relevant individual differences among trainees that may predispose a trainee to simulator sickness
  - (4) Complete the development of a breadboard model of a low cost electronic warfare trainer using novel techniques for storing and displaying electronic warfare signals for training
  - (5) Complete evaluation of potential pay-offs of the very high speed integrated circuits to training devices
  - (6) The increase in the project of \$340 thousand over the FY 1983 total will permit initiation of efforts to identify simulator features which cause or contribute to physiological disturbances to the trainees following utilization of flight simulators
- d. Program to Completion: This is a continuing program
- 4. (U) Project F57-701, Small Business.
  - This project is part of the DoD Small Business Advanced Technology Program to utilize the capabilities of small science and technology based firms in DoD R&D
  - a. (U) FY 1982 Program
    - (1) Contracts have been let for the five following efforts: Averaged Digital Sextant; Military Standard and Failsafe Computer; Automated Mass Storage Data Retrieval System; Development of a User Oriented Data Classifier; and Software Systems Acquisition
  - b. (U) FY 1983 Program
    - (1) Evaluation of Phase I contracts progress
    - (2) Determination of which Phase II contracts should be funded
  - c. (U) FY 1984 Planned Program
    - (1) Dependent on progress in Phase II
  - d. Program to Completion: This is a continuing program
- 1. (U) PROJECTS OVER \$10 MILLION IN FY 1984

Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62758N

DoD Mission Area: 522 - Environmental and Life Sciences

Title: Biomedical Technology

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                    | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                         | <b>10,596</b>  | <b>8,721</b>     | <b>8,905</b>     | <b>9,288</b>     | <b>Continuing</b>        | <b>Continuing</b>    |
| F58-523     | Personnel Protective and Survival Equipment and Clothing | 1,392          | 1,189            | 1,381            | 1,497            | Continuing               | Continuing           |
| F58-524     | Injury and Disease Prevention                            | 5,022          | 4,021            | 3,633            | 4,115            | Continuing               | Continuing           |
| F58-527     | Casualty Care                                            | 2,484          | 2,107            | 2,875            | 2,611            | Continuing               | Continuing           |
| F58-528     | Personnel Performance Assessment and Enhancement         | 1,698          | 1,404            | 1,016            | 1,065            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Element funds a comprehensive research and development program directed toward the development of technologies essential to protect Navy and Marine Corps personnel deployed in hazardous physical, chemical, biological, and psychological environments, to provide care to casualties sustained during combat operation, and to improve performance of critical tasks.
- Development of technologies in this program will prevent or mitigate threats to personnel health and degradation of performance and measurably improve the probability of mission success.
- Technologies under development in this program are not being addressed by the civilian community.
- This program will continue development of new fibers for protective clothing; aircraft life support, survival, rescue, and emergency egress systems; methodologies for improved G-tolerance; criteria for protection against Navy relevant chemical and physical hazards; systems for prevention, diagnosis, and treatment of disease and injury; and criteria to assess and insure maximum performance of personnel.

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a decrease of 23 in FY 1982 and a decrease of 2,275 in FY 1983 due to reprogramming; and a decrease of 684 in FY 1984 due to shifts in program emphasis and refined budget estimates.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                                    | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                         | <b>10,061</b>  | <b>10,619</b>    | <b>8,996</b>     | <b>9,589</b>     | <b>Continuing</b>        | <b>Continuing</b>    |
| F58-523     | Personnel Protective and Survival Equipment and Clothing | 1,695          | 1,445            | 1,244            | 1,388            | Continuing               | Continuing           |
| F58-524     | Injury and Disease Prevention                            | 5,112          | 5,431            | 4,329            | 4,466            | Continuing               | Continuing           |
| F58-527     | Casualty Care                                            | 1,729          | 2,088            | 2,106            | 2,287            | Continuing               | Continuing           |
| F58-528     | Personnel Performance Assessment Enhancement             | 1,525          | 1,655            | 1,317            | 1,448            | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

Program Element: 62758N

Title: Biomedical Technology

**F. (U) RELATED ACTIVITIES**

- Coordination and integration of Navy work in this area with other DoD programs occurs through Joint Technology Coordinating Groups of the Armed Services Biomedical Research Evaluation and Management Committee
- Systematic exchange of reports, attendance at meetings, workshops, study panels, and symposia facilitate coordination and cooperation with other military services, U.S. governmental and international agencies

**G. (U) WORK PERFORMED BY**

- IN-HOUSE - Naval Medical Research Institute, Bethesda, MD; Naval Aerospace Medical Research Laboratory, Pensacola, FL; Naval Air Development Center, Warminster, PA; Naval Biodynamics Laboratory, New Orleans, LA; Naval Biosciences Laboratory, Oakland, CA; Naval Clothing and Textile Research Facility, Natick, MA; Naval Submarine Medical Research Laboratory, Groton, CT; Naval Dental Research Institute, Great Lakes, IL; Naval Health Research Center, San Diego CA
- ACADEMIC - University of California, Berkeley, CA; Georgetown University, Washington, DC; Uniformed Services University of the Health Sciences, Bethesda, MD; and others

**H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984**

**1. (U) Project F58-523, Personnel Protective and Survival Equipment and Clothing:**

- This project is directed towards the development of clothing and equipment to protect Navy and Marine Corps personnel from injury and performance degradation and to assure their survivability when conducting operations in hazardous environments
- The objectives of this project include the continued development of lightweight, cold weather protective clothing for Marine Corps use; development of clothing for protection against heat, fire, and hazardous chemicals; development of life support devices for use with protective clothing; aircrew protective devices; and development of survival and rescue equipment
- Special areas of interest include the design and development of protective clothing that minimize physical and chemical injury as well as heat stress

**a. (U) FY 1982 Program:**

- (1) Developed techniques to seal holographic multi-wavelength laser protective system within aviator helmet visors
- (2) Began development of devices to enhance communications by selectively blocking out high intensity noise
- (3) Concluded evaluation of a ballistic protective helmet for use by helicopter crew members
- (4) Began development of new technology for miniature, maintenance free, long duration emergency aircrew high pressure breathing systems
- (5) Completed assessment of problems associated with extended range search and rescue of downed aircrewmen
- (6) Completed evaluation of ejection seat restraint and survival equipment storage package
- (7) Began development of minicomputer/radio technology for escape, evasion and rescue of downed aircrewmen
- (8) Began development of a personal, disposable, chemical heat generating device for emergency anti-exposure protection
- (9) Continued development of waterproof, lightweight, cold weather clothing for USMC amphibious operations (Combat Immersion Suit)

**b. (U) FY 1983 Program:**

- (1) Continue development of devices to enhance communications in high-intensity noise environments
- (2) Continue development of emergency aircrew breathing systems, devices for anti-exposure protection, and non-stretch fabrics for inflatable life vests and rafts

Program Element: 62758N

Title: Biomedical Technology

- (3) Continue development of USMC Combat Immersion Suit
- (4) Continue development of design parameters and materials for clothing capable of providing protection against fire, chemical hazards and temperature extremes
- (5) Initiate development of lightweight body armor for aircrew protection

c. (U) FY 1984 Planned Program:

- (1) Continue development of aircrew emergency breathing systems, devices for anti-exposure protection, and non-stretch fabrics for inflatable life vests and rafts
- (2) Continue development of USMC Combat Immersion Suit
- (3) Continue development of design parameters and materials for clothing capable of providing protection against fire, chemical hazards, and temperature extremes
- (4) Continue development of lightweight body armor for aircrews
- (5) Continue development of life support devices for protective clothing and equipment

d. (U) Program to Completion: This is a continuing program

2. (U) Project F58-524, Injury and Disease Prevention:

- Navy and Marine Corps personnel are required to perform effectively in a wide variety of environments and on complex weapons systems platforms
- The hazards to which they are exposed threaten their combat effectiveness
- This project is directed towards the development of technologies or methods for the elimination or control of these adverse impacts
- The objectives of this project include continuing development of methods of minimizing hazards that are a consequence of Navy operations; techniques, equipment, systems, drugs, and biologicals for the prevention of injury and disease associated with operational environments; and the development of physiological standards to guide the development of life support systems for Naval and Marine Corps weapons platforms
- Special areas of interest include development of methods to minimize hazards caused by toxic chemicals, noise, heat, electromagnetic radiation, pressure, motion, submarine and aviation environments, and insect pests

a. (U) FY 1982 Program:

- (1) Completed development of exposure limits for JP-5 and Diesel Fuel, Marine
- (2) Continued development of exposure limits for torpedo propellants and initiated development of limits for glycol-based hydraulic fluids
- (3) Completed development of testing devices to assess hearing protection
- (4) Continued development of heat acclimatization protocols for LHA ship class
- (5) Determined threshold for effects of microwaves on brain metabolism, vigilance behavior, and the immune system
- (6) Continued evaluation of microwave effects on the central nervous system and behavior
- (7) Continued development of microwave dosimetry technology for hazard assessment
- (8) Initiated assessment of experimental gas mixtures for use in deep diving and decompression
- (9) Completed development of ship-motion testing facility and associated control and data acquisition systems and continued assessments of ship-motion effects on human performance.
- (10) Continued analysis of nuclear submariners for exposure histories and morbidity/mortality rates
- (11) Continued development of chemical methods of dispersing dental plaque
- (12) Continued development of physiological standards for evaluation of techniques to enhance G-tolerance, tolerance to sustained acceleration, and for design of protective clothing and life support devices
- (13) Initiated assessment of cardiovascular deconditioning on sonar-task performance

Program Element: 62758N

Title: Biomedical Technology

- (14) Completed development of new techniques for controlling insect populations on ships
- (15) Continued development of cancer risk prediction model in shipyard asbestos workers

b. (U) FY 1983 Program:

- (1) Continue and expand development of exposure limits to toxic naval chemicals including foam fire suppressants, hydraulic fluids, fuels and lubricant additives, and torpedo propellants
- (2) Complete heat acclimatization protocols for LHA ship class
- (3) Continue evaluation of microwave effects on the central nervous system and behavior
- (4) Continue development of microwave dosimetry technology for hazard assessment
- (5) Continue assessment of new experimental gas mixtures for diving and decompression
- (6) Continue assessment of ship-motion effects on human performance and cardiovascular deconditioning on sonar-task performance
- (7) Continue epidemiologic survey of submariners
- (8) Complete development of chemical dispersion methods for dental plaque control
- (9) Initiate development of non-toxic pest management system for control of shipboard insect pests
- (10) Continue development of physiological standards for predicting G-tolerance, tolerance to acceleration, and design of protective clothing and life support devices
- (11) Continue development of risk prediction model for asbestos workers

c. (U) FY 1984 Planned Program:

- (1) Continue development of exposure limits for toxic naval chemicals, fuels, and lubricants
- (2) Continue cancer risk prediction model in asbestos workers
- (3) Continue development of acute exposure standards for microwave exposure and dosimetry technology for hazard assessment
- (4) Continue epidemiologic survey of submariners
- (5) Continue assessment of ship-motion effects and cardiovascular deconditioning on human performance
- (6) Initiate development of new pesticide delivery systems and strategies for use in controlling insect populations in Marine Corps operational areas
- (7) Continue development of physiological standards for design of protective and fire resistant clothing

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F58-527, Casualty Care:

- Modern Navy and Marine Corps combat scenarios project high-intensity, short-term warfare involving modern weapons capable of causing a multiplicity of wounds to a large number of personnel
- Under these conditions, effective treatment systems will greatly improve the probability of survival
- This project is directed towards the development of medical management procedures to detect, diagnose, treat and evacuate combat casualties effectively and increase return-to-duty rates
- Special areas of interest include the development of methods to treat radiation casualties; improve wound and nerve healing; improve triage, diagnosis and treatment; reduce logistic requirements through development of universal donor blood; and improve methods for treating cold weather casualties

a. (U) FY 1982 Program:

- (1) Completed development of immunosuppressant procedure to reduce transplant rejection by host

Program Element: 62758N

Title: Biomedical Technology

- (2) Completed development of systems to assess drug effects on nerve regeneration and to monitor physiological function of regenerating nerves
- (3) Continued and expanded development of systems to produce cell growth factor
- (4) Initiated development of model systems to evaluate medical and surgical techniques for the treatment of nuclear radiation injuries
- (5) Completed development of computer-assisted diagnostic program for abdominal pain and initiated development of additional diagnostic programs for shipboard use
- (6) Initiated development of methods to repair damaged blood vessels without sutures
- (7) Continued development of enzyme-based methods to convert types A and B blood to type O universal donor blood
- (8) Initiated development of microwave-based remote casualty detection and diagnostic devices
- (9) Continued development of casualty treatment methods for cold weather environments
- (10) Developed prototype rewarming device for hypothermic casualties

b. (U) FY 1983 Program:

- (1) Continue development of methodologies for diagnosis and treatment of nuclear radiation casualties
- (2) Complete development of systems to produce cell growth factors
- (3) Complete development of methods to repair damaged blood vessels without sutures
- (4) Continue development of computer-assisted medical diagnostic programs for shipboard use
- (5) Continue development of microwave-based remote casualty detection and diagnostic device
- (6) Continue development of methodologies for preparing universal donor blood
- (7) Continue development of casualty treatment methods for use in cold weather environments

c. (U) FY 1984 Planned Program:

- (1) Continue development of methodologies for diagnosis and treatment of nuclear radiation casualties
- (2) Continue development of universal donor blood system
- (3) Continue development of remote casualty detection and diagnostic devices
- (4) Continue development of computer-assisted medical diagnostic systems for shipboard use

d. (U) Program to Completion: This is a continuing program.

4. (U) Project #58-528, Personnel Performance Assessment and Enhancement:

- Navy and Marine Corps personnel are required to operate advanced and complex weapon systems that demand maximum effective performance of the operator to insure mission success
- These demands, coupled with stresses imposed by hostile tactical environments, make it imperative that only those personnel who are medically suited to perform such tasks be selected and retained
- The objectives of this project are to develop technologies for assessing capabilities of personnel to perform demanding tasks required in critical combat specialties and to develop methods for enhancing or extending personnel performance in stressful environments
- Special areas of interest include development of methods to enhance physiological performance, development of methods to assess performance in stressful environments, and methods to extend or enhance performance

a. (U) FY 1982 Program:

- (1) Continued development of methods to produce and assess the mode of action of synthetic prostaglandin polymers (PGTx)
- (2) Continued development of methods to increase G-tolerance for aircrew personnel
- (3) Developed methods of testing and evaluating concepts in aircrew positioning and restraint

Program Element: 62758N

Title: Biomedical Technology

- (4) Continued aircrew anthropometric correlation with T-2C, A-7, and AV-8 aircraft cockpit design parameters
- (5) Initiated development of device to simulate human exposure to extreme temperatures
- (6) Continued determination of limits for sustained physical performance in Marine Corps combat personnel
- (7) Continued development of auditory screening test for submarine sonar technicians and tests for assessing physiological competence of aviators without respect to age
- (8) Continued evaluation of vocal and linguistic factors critical to aircraft control
- (9) Developed methods for reducing visual distortion associated with aircraft roll maneuvers at high peak angular velocities

b. (U) FY 1983 Program:

- (1) Continue development of methods to produce prostaglandin polymers (PGBx) and assess its mode of action
- (2) Continue development of methods to increase G-tolerance for aircrew personnel
- (3) Complete aircrew anthropometric correlation with T-2C, A-7, and AV-8 aircraft
- (4) Complete development of new concepts in aircrew positioning and restraint
- (5) Continue development of cold exposure simulation device
- (6) Continue development of test system for assessing physiological competence of aviators
- (7) Complete assessment of vocal and linguistic factors critical for aircraft control and complete determination of sustained physical performance limits

c. (U) FY 1984 Planned Program:

- (1) Complete development and feasibility testing of prostaglandin polymers (PGBx)
- (2) Continue development of methods to improve G-tolerance for aircrew members
- (3) Initiate development of model of thermal exchange in protectively clothed personnel
- (4) Complete development of cold exposure simulation device
- (5) Complete development of human factors specifications for voice and linguistic factors critical in aircraft control
- (6) Complete development of test system to assess physiological competence of aviators
- (7) Initiate development of neuroelectric measures for use in screening sonar-technician and aviation candidates

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable



# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62759N

Title: Ocean and Atmospheric Support Technology

DoD Mission Area: 522 - Environmental and Life Sciences

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.                      | Title                               | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|-------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                     | <b>22,027</b>  | <b>20,257</b>    | <b>19,474</b>    | <b>21,124</b>    | Continuing               | Continuing           |
| F59-121                          | Surveillance Vertical Array         | ---            | ---              | 491              | 196              | Continuing               | Continuing           |
| F59-220                          | Improved Submarine Communication    | ---            | ---              | 49               | 69               | Continuing               | Continuing           |
| F59-550                          | Marine Physics Lab Support          | ---            | ---              | 319              | 76               | Continuing               | Continuing           |
| F59-551                          | Atmospheric Modeling and Prediction | 4,727          | 4,751            | 4,801            | 5,232            | Continuing               | Continuing           |
| F59-552                          | Applied Ocean Acoustics             | 8,540          | 7,765            | 7,655            | 8,357            | Continuing               | Continuing           |
| F59-553                          | Environmental Remote Sensing        | 1,968          | 1,689            | 1,644            | 1,539            | Continuing               | Continuing           |
| F59-554                          | Astronomy and Astrophysics          | 1,250          | 1,133            | 1,177            | 1,294            | Continuing               | Continuing           |
| F59-555                          | Arctic Environmental Acoustics      | 3,290          | 2,531            | 1,440            | 3,310            | Continuing               | Continuing           |
| F59-557                          | Ocean Modeling and Prediction       | 1,295          | 1,333            | 1,039            | 1,126            | Continuing               | Continuing           |
| F59-558                          | Marine Biology                      | 770            | 646              | 642              | 695              | Continuing               | Continuing           |
| F59-701                          | Small Business                      | 187            | 409              | 217              | 230              | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

- Provides for exploratory and applied research in support of Navy environmental needs for weapons and sensor system planning/analysis, design/development, and deployment/operation.
- Develops techniques and prototype equipment to improve the Navy's capability to measure and predict geophysical parameters on a worldwide basis.
- Develops technology for conversion of geophysical parameters into militarily significant terms, displaying data in suitable formats, and distributing predictions in a timely manner.

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follow:
  - FY 1982. Changes of - 930 in project F59-552 and +1,640 in project F59-555 reflect a transfer of effort in ocean acoustics to ASW in the Arctic. Changes in other projects are the result of minor adjustments in program priorities and revision of cost estimates.
  - FY 1983. Increases of 900 in project F59-555 and 508 in project F59-552 reflect a reordering of program priorities to respond to urgent requirements in Arctic ASW. Increases in these two projects was accomplished from reprogramming within the program element, which results in a deferral of planned expansion in project F59-554. Other changes result from revision of cost estimates.
  - FY 1984. Total program element decrease of 2,353 results from constraints during budget development.

Program Element: 62759N

Title: Ocean and Atmospheric Support Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                               | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>    | <b>22,545</b>  | <b>21,585</b>    | <b>20,557</b>    | <b>21,827</b>    | Continuing               | Continuing           |
| F59-551     | Atmospheric Modeling and Prediction | 4,125          | 4,850            | 4,861            | 5,289            | Continuing               | Continuing           |
| F59-552     | Applied Ocean Acoustics             | 8,300          | 9,470            | 7,257            | 7,765            | Continuing               | Continuing           |
| F59-553     | Environmental Remote Sensing        | 2,352          | 1,950            | 1,920            | 1,975            | Continuing               | Continuing           |
| F59-554     | Astronomy and Astrophysics          | 1,200          | 1,250            | 2,421            | 2,834            | Continuing               | Continuing           |
| F59-555     | Arctic Environmental Acoustics      | 2,316          | 1,650            | 1,631            | 1,548            | Continuing               | Continuing           |
| F59-556     | Ocean Facilities Engineering        | 1,620          | 0                | 0                | 0                | -                        | -                    |
| F59-557     | Ocean Modeling and Prediction       | 1,672          | 1,465            | 1,512            | 1,408            | Continuing               | Continuing           |
| F59-558     | Marine Biology                      | 960            | 750              | 746              | 790              | Continuing               | Continuing           |
| F59-701     | Small Business                      | 0              | 200              | 209              | 218              | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES:

- Meteorological Research, Development, Test, and Evaluation is coordinated with other service efforts by the Under Secretary of Defense (Research and Engineering)
- The oceanographic program is related to and supports all other Navy underwater acoustic programs including Program Elements 62711N Undersea Target Surveillance; 62633N, Undersea Warfare Weaponry; and 63785N, Long Range Acoustic Propagation
- Coordination is accomplished through formal and informal working groups such as Underwater Acoustics Symposium, classified USN Journal of Underwater Acoustics, and through frequent interaction with the Chief of Naval Research and the Office of the Chief of Naval Operations
- Coordination of polar research is facilitated through the Interagency Arctic Research Working Group under the National Science Foundation, the Office of Naval Research, and the Office of the Chief of Naval Operations

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Environmental Prediction Research Facility, Monterey, CA; Naval Coastal Systems Center, Panama City, FL; Naval Observatory, Washington, DC; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Underwater Systems Center, New London, CT
- ACADEMIC - Applied Physics Laboratory, University of Washington, Seattle, WA; Applied Research Laboratory, Pennsylvania State University, State College, PA; Applied Research Laboratory, University of Texas, Austin, TX; Marine Physical Laboratory, Scripps Institution of Oceanography, La Jolla, CA; Woods Hole Oceanographic Institution, Woods Hole, MA

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F59-121, Surveillance Vertical Array (New start):

- This project, which shares funding with and supports project F11-121 in PE 62711N (Undersea Target Surveillance).
- The project will be initiated in FY 1984 with analysis of data to determine environmental effects on interarray processing

Program Element: 62759N

Title: Ocean and Atmospheric Support Technology

- a. (U) FY 1982 Program:  
(1) Not Applicable
  - b. (U) FY 1983 Program:  
(1) Not Applicable
  - c. (U) FY 1984 Planned Program:  
(1) Analyze data to determine environmental effects
  - d. (U) Program to Completion: This is a continuing program.
2. (U) Project F59-220, Improved Submarine Communication (New start):
- This project, which shares funding with and supports project F21-223 PB 62721N (Command and Control), will characterize acoustic propagation in the Arctic as it relates to underwater. The project will begin in FY 1984.
- a. (U) FY 1982 Program:  
(1) Not applicable
  - b. (U) FY 1983 Program:  
(1) Not applicable
  - c. (U) FY 1984 Planned Program:  
(1) Characterize acoustic propagation in the Arctic as it relates to underwater
  - d. (U) Program to Completion: This is a continuing program.
3. (U) Project F59-550, Marine Physical Lab Support (New start):
- This project will investigate geomagnetic anomalies as applied to future magnetic detection system design. Work will begin in FY 1984.
- a. (U) FY 1982 Program:  
(1) Not applicable
  - b. (U) FY 1983 Program:  
(1) Not applicable

Program Element: 62759H

Title: Ocean and Atmospheric Support Technology

- c. (U) FY 1984 Planned Program:
  - (1) Investigate geomagnetic anomalies as applied to future magnetic detection system design.
- d. (U) Program to Completion: This is a continuing program.
- 4. (U) Project F59-351, Atmospheric Modeling and Prediction:
  - This project addresses atmospheric prediction and instrumentation requirements of Naval operational support systems
  - a. (U) FY 1982 Program:
    - (1) Support requirements for Navy weapons and sensors systems were analyzed, and a marine boundary layer model was refined and tested
  - b. (U) FY 1983 Program:
    - (1) Upgrade atmospheric model to provide for a simulation of satellite remote sensing data
    - (2) Improve resolution and precipitation physics in regional atmospheric prediction models
    - (3) Develop single station visibility forecast capability for on-board prediction systems
    - (4) Design and evaluate instrumentation for atmospheric density measurements
  - c. (U) FY 1984 Planned Program:
    - (1) Provide a capability to accurately measure, model, and predict the effect of marine atmosphere on transmission
    - (2) Develop and test higher resolution atmospheric models and expand prediction from three up to twelve days
  - d. (U) Program to Completion: This is a continuing program.
- 5. (U) Project F59-352, Applied Ocean Acoustics:
  - This project provides environmental acoustic support for the design and operation of tactical anti-submarine warfare sensors and weapons
  - a. (U) FY 1982 Program:
    - (1) Developed and validated predictive capability for propagation loss
    - (2) Developed methodology to account for system and area specific differences in spatial and spectral characteristics of ambient ocean noise
    - (3) Measured experimentally very low frequency wind wave, surf and ship radiated ambient noise components
    - (4) Obtained high resolution surface and bottom backscattering data to support ASW system
    - (5) Developed acoustic processing technique
  - b. (U) FY 1983 Program:
    - (1) Develop fundamental understanding of acoustic bottom interaction in order to develop capability to predict and describe effects of bottom interaction on acoustic transmission

Program Element: 62759H

Title: Ocean and Atmospheric Support Technology

- (2) Measure and characterize spectral, temporal, and spatial properties of low frequency, long range surface and bottom reverberation to assess feasibility
- (3) Analyze ambient noise experimental data and develop noise fluctuation characteristics
- (4) Develop acoustic beamforming techniques for air deployed acoustic arrays
- (5) Initiate program to quantify the statistics of acoustic fields and determine the constraints imposed by environmental variability

c. (U) FY 1984 Planned Program:

- (1) Apply specific knowledge of the parameters of the ocean environment to improvements in acoustic sensor systems
- (2) Transition environmental acoustic technology on a continuous basis to combat system designers, operators, and tacticians
- (3) Develop a tested performance estimation capability, along with guidelines for design and development, for tactical ASW/USW systems
- (4) Characterize acoustic back-and forward-scattering
- (5) Characterize acoustic Transmission loss from bottom interaction and relate to physical character of sediment
- (6) Determine limitation to acoustic transmission imposed by spatial and temporal variability of the ocean medium
- (7) Develop and test models which will characterize the major features of the reverberation process and provide a quantitative prediction capability for exploratory design and development

d. (U) Program to Completion: This is a continuing program.

6. (U) Project P59-553, Environmental Remote Sensing:

- \* This project exploits airborne, shipborne and satellite sensors, data processing and display techniques to obtain environmental data for fleet support, and to explore environmental remote sensing technology for Naval applications

a. (U) FY 1982 Program:

- (1) Demonstrated and transitioned to Advanced Development passive microwave techniques for remotely measuring ocean surface temperature and wind speed
- (2) Developed mass retrieval algorithm for satellite atmospheric sounder which will enable accurate determination of atmospheric thickness for initialization of regional models
- (3) Developed man-machine techniques for extraction and display of operationally significant environmental data from satellite imagery
- (4) Transitioned technique for removing clouds from satellite remote sensing sea surface temperature data

b. (U) FY 1983 Program:

- (1) Develop retrieval algorithm to obtain information on atmospheric winds and clouds from geostationary operational environmental satellite data
- (2) Explore active microwave sensing techniques for directional wave energy measurement

c. (U) FY 1984 Planned Program:

- (1) Exploit existing airborne, shipborne, and satellite sensors and data processing/display techniques to obtain environmental data for fleet support

Program Element: 62739N

Title: Ocean and Atmospheric Support Technology

- (2) Explore remote sensing technology options for Navy applications and use of multisensor data to derive basic environmental parameters needed to predict weapon system performance
- d. (U) Program to Completion: This is a continuing program.
- 7. (U) Project F59-554, Astronomy and Astrophysics:
  - \* This project supports R&D efforts at the Naval Observatory in four task areas: precise time and time interval, earth rotation and polar motion, improved star and planet positions and supporting observations
  - a. (U) FY 1982 Program:
    - (1) Established an operating laser time transfer link between Goddard Space Flight Center and the Naval Observatory with  $\pm 2$  nanosecond accuracy
    - (2) Developed electrographic camera which has achieved 25 to 50 times greater efficiency than that of conventional astrophotography
  - b. (U) FY 1983 Program:
    - (1) Evaluate a technique to transfer time using a laser via satellite
    - (2) Continue studies of astronomical refraction and new ultraprecise optical star positioning methods
  - c. (U) FY 1984 Planned Program
    - (1) Improve time transfer around the globe from the present 100 nanosecond level to the 1-5 nanosecond level in five to seven years
    - (2) Provide the Navy and DOD real-time source of Earth rotation prediction, independent of foreign input
    - (3) Improve star position measurement techniques to support new navigational systems
  - d. (U) Program to Completion: This is a continuing program.
- 8. (U) Project F59-555, Arctic Environmental Acoustics:
  - \* This project addresses the aspects of ASW environmental acoustics support which are unique to the Arctic region
  - a. (U) FY 1982 Program:
    - (1) Deployed vertical array and obtained noise and signal data in connection with FRAM IV experiment
    - (2) Evaluated MK 48 torpedo performance
  - b. (U) FY 1983 Program:
    - (1) Continue experiments and data analysis
    - (2) Analyze data to determine ambient noise
    - (3) Obtain environmental acoustic data
    - (4) Characterize the Arctic acoustic environment

Program Element: 62759N

Title: Ocean and Atmospheric Support Technology

c. (U) FY 1984 Planned Program:

- (1) Support readiness of submarine forces to operate
- (2) Obtain sufficient understanding of the signal-to-noise performance for simple sensors and arrays to allow reliable prediction of noise levels and
- (3) Investigate acoustic transmission phenomena to allow reliable prediction of transmission loss, signal arrival angles, and signal distortion for frequencies of interest
- (4) Develop basis for
- (5) Determine applicability

d. (U) Program to Completion: This is a continuing program.

9. (U) Project F59-557, Ocean Modeling and Prediction:

- This project concentrates on developing technology for improved ocean forecasting effort. This work couples closely with project F59-551.

a. (U) FY 1982 Program:

- (1) Refined a mixed layer ocean prediction model that is now undergoing testing at the Fleet Numerical Oceanographic Center, Monterey, CA

b. (U) FY 1983 Program:

- (1) Test and compare several mixed layer models at selected locations
- (2) Adapt and develop regressive forecasting techniques for atmospheric density profiles
- (3) Expand development of the 3-dimensional regional prediction model to investigate response to a traveling hurricane

c. (U) FY 1984 Planned Program:

- (1) Initiate and expand development of techniques for blending high density satellite data with sparse subsurface thermal data
- (2) Initiate work to determine atmospheric effects on the transmission of millimeter waves
- (3) Improve the Navy's capability to map and chart the marine environment
- (4) Analyze and predict the ocean thermal and current systems through development of valid forecast models, including
  - Turbulence and Mixed Layer Modeling
  - Numerical Modeling Development
  - Satellite Modeling Interaction
- (5) Develop a spectral wave model for ship seakeeping performance assessment

d. (U) Program to Completion: This is a continuing program.

10. (U) Project F59-558, Marine Biology:

- This project develops an understanding of Navy problems

Program Element: 62759N

Title: Ocean and Atmospheric Support Technology

a. (U) FY 1982 Program:

(1) Demonstrated feasibility [

b. (U) FY 1983 Program:

(1) [

(2) [

c. (U) FY 1984 Planned Program:

d. (U) Program to Completion: This is a continuing program.

11. (U) Project P59-701, Small Business:

\* This project is part of the DOD Small Business Advanced Technology Program, addressing ocean physics and engineering research and development

a. (U) FY 1982 Program:

(1) Low cost navigation for drifting buoys

(2) Investigation of seafloor geoaoustic properties

(3) Development of a sensor to measure ocean internal waves

(4) Development of a Helium/carbon dioxide/hydrogen sensor system for self-contained underwater breathing apparatus (SCUBA)

b. (U) FY 1983 Program:

(1) Being formulated

c. (U) FY 1984 Planned Program

(1) Being formulated

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984

Not applicable



# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62760N  
DoD Mission Area: 523 - Engineering Technology

Title: Logistics Technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                           | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                | <b>13,263</b>  | <b>13,786</b>    | <b>15,327</b>    | <b>16,665</b>    | Continuing               | Continuing           |
| F60-531     | Fleet Logistics Readiness Technology            | 6,348          | 6,737            | 7,772            | 8,340            | Continuing               | Continuing           |
| F60-533     | Acquisition and Financial Management Technology | 1,040          | 1,029            | 588              | 1,174            | Continuing               | Continuing           |
| F60-534     | Shore/Offshore Facilities Support Technology    | 2,317          | 2,115            | 3,312            | 3,012            | Continuing               | Continuing           |
| F60-536     | Amphibious/Advanced Base Technology             | 3,558          | 3,905            | 3,655            | 4,139            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Provides the Navy with improved capabilities to control, position, store, and distribute logistic supplies ashore and aboard ship under both normal and rapid deployment operational conditions
- Develops improved procedures to allow the Navy/merchant shipping to supply deployed units without dependence on forward bases
- Develops technology to improve the Navy's system acquisition process and financial management systems
- Develops improved design and construction methods for Navy shore and advanced base facilities
- Develops innovative techniques for the movement of supplies from offshore to advanced bases
- Develops techniques, procedures, and equipment to expedite ocean construction and underwater repair capabilities

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a net change for the program element of -77 in FY 1982; -391 in FY 1983; and -397 in FY 1984. These changes and the small project total changes in FY 1982 and FY 1983 result from minor adjustments characteristic of exploratory development
- Decrease of 212 in FY 1984 in Project F60-533 results from planned completion in FY 1983 of effort in techniques for estimating submarine overhaul costs and in modeling allotment pay operations
- Decrease of 971 in Project F60-536 in FY 1984 results from the planned completions in FY 1983 of components for a P-3 aircraft expeditionary hanger; improved aircraft runway repair and bomb damage repair for advanced base environments; and specification guidelines for embedded anchor downhaul cables
- 912 increase in FY 1984 for Project F60-534 will permit initiation of the development of technology to provide a capability for unmanned ocean platforms which can be employed in water depths up to 6000 feet to support a'r combat test and training operations and to initiate development of techniques to enhance the transfer of bulk fuel from offshore tankers to forces ashore

Program Element: 62760N

Title: Logistics Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                           | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                       | 11,808         | 13,340           | 14,177           | 15,724           | Continuing               | Continuing           |
| F60-511     | Acquisition and Financial Management Technology | 1,222          | *                | *                | *                | Continuing               | Continuing           |
| F60-531     | Fleet Logistics Readiness Technology            | 5,026          | 6,354            | 6,747            | 7,898            | Continuing               | Continuing           |
| F60-532     | Development Engineering                         | 806            | **               | **               | **               |                          |                      |
| F60-533     | Acquisition and Financial Management Technology | —              | 1,100            | 1,070            | 800              | Continuing               | Continuing           |
| F60-534     | Shore/Offshore Facilities Support Technology    | 1,717          | 2,317            | 2,265            | 2,400            | Continuing               | Continuing           |
| F60-536     | Amphibious/Advanced Base Technology             | 3,037          | 3,569            | 4,095            | 4,626            | Continuing               | Continuing           |

\* Funding and effort transferred to Project F60-533 (Acquisition and Financial Management Technology)

\*\* Effort incorporated into Project F60-531 (Fleet Logistics Readiness Technology)

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Many elements of logistics are common to the other Services; therefore, close coordination among the Services in seeking solutions to common problems is general policy and is in consonance with the policy of the Department of Defense
- The Department of Defense Logistics System Plan provides a continuing framework for the development of logistics systems within the Services and requires component participation in its implementation

G. (U) WORK PERFORMED BY

- IN-HOUSE - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Civil Engineering Laboratory, Fort Huachuca, CA; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; and Naval Surface Weapons Center, White Oak Laboratory, White Oak, MD
- INDUSTRIAL - Resources Consultants Inc., McLean, VA; CACI, Mechanicsburg, PA; IBM, Armonck, NY; Applicon, Burlington, MA; Southwest Research Institute, San Antonio, TX; Sandia National Laboratories, Albuquerque, NM; Amtek Offshore Research and Engineering Division, Santa Barbara, CA; Brown & Root Development Co., Houston, TX; Lockheed Georgia, Marietta, GA
- ACADEMIC - University of Michigan, Ann Arbor, MI; University of Minnesota, Minneapolis, MN; Naval Postgraduate School, Monterey, CA; Massachusetts Institute of Technology, Cambridge, MA; University of Cincinnati, Cincinnati, OH

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F60-531, Fleet Logistics Readiness Technology: This project supports

- Development of technology for controlling, positioning, and management of material
- Development of techniques for utilization of merchant ships in naval support roles
- Development of methodology for improving performance of maintenance functions at Naval aircraft repair facilities
- Evaluation of robotic and other automation technologies for application to the performance of logistic functions

a. (U) FY 1982 Program:

- Developed a minicomputer network for automating the current manual personal property movement and storage system. Estimated savings of \$700,000 annually in Military Personnel funds

Program Element: 62760M

Title: Logistics Technology

- (2) Evaluated retardation and flotation system for recovery of high value cargo inadvertently dropped during vertical replenishment
- (3) Initiated development of techniques for modifying inexpensive, commercially available, pressboard pallets to meet Navy requirements
- (4) Completed design of an improved experimental fueling-at-sea system using a strengthened hose to eliminate the tensioned hi-line
- (5) Completed pilot system detail design for Navy Print-On-Demand concept to minimize the need for warehouse space and storing of documents in advance of need

b. (U) FY 1983 Program:

- (1) Initiate technology assessment of automation, artificial intelligence techniques, and robotics technology applied to shipboard logistics operations
- (2) Complete initial evaluation of improved experimental tensioned hose fueling-at-sea system which eliminates need for a tensioned hi-line
- (3) Complete feasibility evaluation of a simulator for the existing Conventional Ammunition Integrated Management System which can be used for contingency training exercises without disrupting normal operations
- (4) Complete evaluation of a prototype, inexpensive, commercially available pressboard pallet to meet Navy performance requirements
- (5) Initiate development of "parts on demand" concept by identifying repair parts which could be produced by integrating robotics and automated manufacturing techniques where the original source for producing these items no longer exists
- (6) Continue development of a liquid spring accumulator which utilizes aircraft systems hydraulic fluid compressibility characteristics to increase hydraulic system reliability and decrease maintenance requirements

c. (U) FY 1984 Planned Program:

- (1) Complete evaluation and transition to operational use computer model to forecast first destination transportation requirements
- (2) Initiate development of techniques and methodologies which will facilitate maritime prepositioning of military supplies and equipment and rapid deployment
- (3) Complete evaluation of applications of robotics technology to aircraft maintenance tasks
- (4) Initiate development of design/material concepts to enhance transfer of fuel from offshore tankers to forces ashore
- (5) Complete development of automated techniques and software to link bar code reader to stock point mini-computers to increase speed and accuracy of the receipt processing function
- (6) Initiate evaluation of tertiary treatment processes that can cost effectively reclaim waste petroleum products into useful functional products required by the Navy
- (7) Complete evaluation of liquid spring accumulator to increase aircraft hydraulic system reliability and decrease maintenance requirements
- (8) Continue development of a robotic vehicle to perform hull inspections and other maintenance functions at-sea
- (9) Initiate development of materials handling equipment to improve methods for vertically moving shipboard materials between decks and to decrease the manual labor required
- (10) The increase in this project (\$1,035,000) in FY 1984 over FY 1983 will permit initiations of efforts in maritime prepositioning of military supplies and rapid deployment and the initiation of the evaluation of tertiary treatment processes to reclaim waste petroleum products into useful end products for the Navy

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F60-533, Acquisition and Financial Management Technology:

- Development of methodology for use in improving the effectiveness of the Navy's system acquisition process

Program Element: 62760M

Title: Logistics Technology

- Development of technology in data processing, telecommunications, and information design to improve the Navy's financial management system
- a. (U) FY 1982 Program:
  - (1) Developed data for planning and estimating submarine overhaul costs
  - (2) Developed methodology for assessing cost realism of offerer's bids in cost reimbursable R&D acquisitions
  - (3) Initiated development of methods to analyze, predict, and control overhead costs of defense aircraft manufacturers
- b. (U) FY 1983 Program:
  - (1) Continue development of methods to quantify risk and to establish budgeting strategies for technological uncertainties
  - (2) Develop technology which will permit acquisition managers to evaluate viable acquisition strategies
  - (3) Complete modifications to the internal control evaluation model of allotment pay operations
  - (4) Complete development of additional budget categories for new cost-of-ownership methods, especially property depreciation and joint costs supporting several weapons programs
  - (5) Complete guidelines for planning and estimating submarine overhaul costs
- c. (U) FY 1984 Planned Program:
  - (1) Continue development of acquisition strategies to include ships and ship systems
  - (2) Complete the development of data bases and the evaluation of models for predicting and controlling overhead costs of defense aircraft manufacturers
- d. (U) Program to Completion: This is a continuing program.
- 3. (U) Project F60-534, Shore/Offshore Facilities Support:
  - Development of technology to design and construct shore and offshore facilities to enhance operational readiness
  - Development of improved inspection and maintenance procedures to minimize facility failures and premature replacement of components
  - Development of power distribution systems of adequate quality to prevent damage to critical shipboard equipment in ships while using shore power
- a. (U) FY 1982 Program:
  - (1) Established criteria for eliminating vents in earth-covered magazines for arms, ammunition, and explosives which will save \$150,000 per year in construction and maintenance costs for these facilities as well as improving security
  - (2) Developed mechanical equipment to minimize wear and tear and reduce manhandling time by 50% for connecting and disconnecting shore power cables to pierside. Estimated savings of \$50,000 per year at Naval Station, San Diego
  - (3) Modified automatic voltage regulator concept to provide electrical power with plus or minus 5 percent voltage regulation capability to meet ships requirements for in-port weapons training
  - (4) Completed technology assessment of non-destructive inspection techniques for underwater steel structures
- b. (U) FY 1983 Program:
  - (1) Complete evaluation of a one kilowatt breadboard model of a solid state, high speed switching device to improve quality of power supplied to ships while in port

Program Element: 62760N

Title: Logistics Technology

- (2) Demonstrate the feasibility of determining the physical condition of dry dock foundations by monitoring its movements during flooding/dewatering cycles
- (3) Complete feasibility determination of articulated boom and mobile utility barge concepts for the handling of shore to ship utility cables for nested ships
- (4) Initiate development of inspection frequency requirements based on construction materials, age, environment and condition on last inspection

c. (U) FY 1984 Planned Program:

- (1) Complete evaluation of experimental automatic voltage regulator and remote sensing device to provide power to meet ships requirements while in port
- (2) Initiate development of selected components for an experimental 10 kilowatt solid state high speed switching power conditioning unit
- (3) Complete feasibility determination of nondestructive inspection techniques for underwater concrete and wood waterfront structures
- (4) Demonstrate at a Navy activity the methodology developed for upgrading existing facilities to meet seismic hazards to Navy installations
- (5) Initiate development of advanced concepts to improve time, weight and manpower requirements of "state-of-the-art" methods for transferring bulk fuel from tankers offshore to forces ashore
- (6) Initiate development of technology for reliable, efficient, unmanned ocean platforms to support air combat test and training operations
- (7) The increase in this project of \$1,197,000 in FY 1984 over the FY 1983 total will permit the early completion of efforts to improve the quality of electrical shore power supplied to ships while in port so that the ships do not have to operate their own generators, and the initiation of technology development for unmanned ocean platforms to make it feasible to locate tactical aircrew combat training facilities offshore

d. (U) Program to Completion: This is a continuing program.

4. (U) Project F60-536, Amphibious/Advanced Base Technology: This project supports

- Development of improved procedures to allow Navy/marchant shipping to supply deployed units without dependence on forward bases
- Development of design and construction techniques for advanced base facilities
- Development of improved techniques for logistic support to mobile forces for ammunition, supplies, maintenance, expedient construction and improved fresh water supply
- Development of techniques and procedures to expedite ocean construction and underwater repair capabilities

a. (U) FY 1982 Program:

- (1) Developed fiberglass plastic cover for battle damage repair of airfield runway surfaces. Plastic cover reduces patch height of current AM-2 matting and reduces costs from \$22.0 to \$4.5 per square foot
- (2) Completed evaluation of lightweight hose for the transfer of petroleum products in support of Marine Corps amphibious operations
- (3) Completed fabrication and evaluation of an experimental model of a reverse osmosis pretreatment unit for providing potable water at advanced bases
- (4) Initiated development of penetration, anchoring and mooring concepts for an advanced cargo transfer facility
- (5) Completed stress analyses of aluminum arches for a sectionalized hangar suitable for housing F-3 aircraft at an expeditionary base

Program Element: 62760W

Title: Logistics Technology

b. (U) FY 1983 Program:

- (1) Initiate design of an experimental fuel container which can be towed behind user vehicles in an expeditionary operation
- (2) Initiate testing of selected concepts to improve field performance of reverse osmosis systems to produce potable water to support expeditionary forces in desert or arid regions
- (3) Complete design for lightweight modular ramp for off-loading roll-on/roll-off ships in up to sea state three conditions as part of an advanced cargo transfer facility
- (4) Complete verification of feasibility of a sectionalized arch-formed expeditionary hangar for P-3 aircraft
- (5) Initiate development of a diver tracking, navigation and surveying system
- (6) Evaluate concepts for an underwater buried cable detector and experimental tracking sensor
- (7) Complete development of capabilities for airfield runway repair and bomb damage repair at advance bases
- (8) Initiate development of technology to design systems capability of holding and controlling nested cargo ships in the offshore environment

c. (U) FY 1984 Planned Program:

- (1) Complete evaluation of underwater buried cable detector and tracking sensor and transition to Advanced Development
- (2) Evaluate fuel containers which can be towed behind user vehicles to enhance forward refueling of combat vehicles
- (3) Initiate evaluation of a high output reverse osmosis system for producing potable water at advanced bases
- (4) Complete feasibility testing of the lightweight modular aluminum ramp for off-loading roll-on/roll-off ships as part of an advanced cargo transfer capability
- (5) Complete field test of a 20,000 pound holding capacity propellant embedded anchor
- (6) Establish feasibility of a diver tracking, navigation and survey system for safety and control of divers while installing facilities or repairing damage to advanced bases
- (7) Complete determination of feasibility of using lightweight pipe to replace the present 8" steel pipe for the offshore bulk fuel system to provide a 50% weight saving and a 50% reduction in manpower requirements

d. (U) Program to Completion: This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984

Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62761N  
DoD Mission Area: 523 - Engineering Technology

Title: Materials Technology  
Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                 | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT             | 33,637         | 33,162           | 38,243           | 43,891           | Continuing               | Continuing           |
| F61-541     | Seaborne Materials                    | 11,178         | 11,314           | 13,258           | 15,758           | Continuing               | Continuing           |
| F61-542     | Airborne Materials                    | 6,112          | 5,555            | 8,322            | 9,046            | Continuing               | Continuing           |
| F61-543     | Missile Materials                     | 8,231          | 8,178            | 9,756            | 11,041           | Continuing               | Continuing           |
| F61-544     | System Support Materials              | 6,933          | 6,539            | 4,713            | 5,690            | Continuing               | Continuing           |
| F61-545     | Design Options for Critical Materials | 1,000          | 1,200            | 1,616            | 1,955            | Continuing               | Continuing           |
| F61-701     | Small Business                        | 183            | 366              | 378              | 401              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Advanced materials and associated technology are required which will provide new operational capabilities, improved performance, increased reliability and survivability, and reduced life cycle costs of advanced naval weapons systems
- Supports these naval requirements through the development of metallic alloys, rapid solidification rate process alloys, ceramics, organic materials, and organic and metallic composite materials, fabrication techniques, nondestructive testing, protective coatings, and critical materials substitution and conservation
- External factors such as safety and environmental regulations and limitations on the availability of critical raw materials influence program direction

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The major changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:
- The net change in FY 1982 (+316) results from program refinements
- The change in FY 1983 (+143) results from refinement of program costs
- The change in FY 1984 (+2368) results from new joint program element efforts in Surface Launched Missile Technology (P.E. 62761N/P.E. 62331N/P.E. 62332N); composites for Naval Ship Structures (P.E. 62761N/P.E. 62543N) and an Advanced Marine Corps Electric Propulsion Composite Vehicle (P.E. 62761N/P.E. 62543N), as well as increased efforts in rapid solidification technology

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 29,777         | 33,121           | 33,019           | 35,875           | Continuing               | Continuing           |
| F61-541     | Seaborne Materials        | 9,657          | 10,400           | 9,590            | 11,130           | Continuing               | Continuing           |
| F61-542     | Airborne Materials        | 5,119          | 6,010            | 6,220            | 7,110            | Continuing               | Continuing           |
| F61-543     | Missile Materials         | 8,154          | 8,439            | 8,963            | 8,895            | Continuing               | Continuing           |
| F61-544     | System Support Materials  | 6,847          | 7,980            | 7,880            | 8,359            | Continuing               | Continuing           |
| F61-701     | Small Business            | -              | 292              | 356              | 381              | Continuing               | Continuing           |

Program Element: 62761N

Title: Materials Technology

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- The Navy interacts through planning sessions, working and review groups, joint symposia, and related activities with the Army, Air Force, the Office of Naval Research, Defense Advanced Research Projects Agency, Defense Intelligence Agency, Central Intelligence Agency, NASA and the National Academy of Sciences in the selection of National Materials Advisory Board projects, the periodic revisions to the Materials Technology Coordinating Paper, the review and coordination of the Directed Energy Hardened Materials and Structures Program, the Metal Matrix Composite Program, as coordinated by the Office of the Under Secretary of Defense for Research and Engineering. Related efforts are also coordinated with the Joint Logistics Commanders Committees as well as the Electric Power Research Institute, Nuclear Regulatory Agency, Environmental Protection Agency (EPA), the National Bureau of Standards, and the Bureau of Mines

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Civil Engineering Laboratory, Port Hueneme, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD and Annapolis, MD; Naval Air Development Center, Warminster, PA; Naval Air Propulsion Center, Trenton, NJ; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA and White Oak, Silver Spring, MD; Naval Weapons Center, China Lake, CA; Naval Postgraduate School, Monterey, CA; U.S. Naval Academy, Annapolis, MD
- INDUSTRIAL - Among 73 contractors are: Aerospace Corporation, Los Angeles, CA; Allegheny Ludlum, Pittsburgh, PA; Aluminum Company of America, Alcoa Center, PA; Babcock and Wilcox, Barberton, OH; Atlantic Research Corporation, Alexandria, VA; Avco, Waltham, MA; Boeing Corporation, Seattle, WA; Carnegie Mellon Institute, Pittsburgh, PA; Fiber Materials, Inc., Biddeford, ME; General Electric Company, Avondale, OH and Valley Forge, PA; Georgia Technical Research Institute, Atlanta, GA; Grumman Aerospace Corporation, Bethpage, NY; Harris Corporation, Melbourne, FL; International Nickel Company, Wrightsville Beach, NC and Sufferin, NY; Lockheed California Company, Burbank, CA; Lockheed Missiles and Space Company, Sunnyvale, CA; Materials Concepts, Inc., Columbus, OH; McDonnell-Douglas Aerospace Corporation, St. Louis, MO and Los Angeles, CA; North American Rockwell, Los Angeles, CA; Pratt & Whitney Aircraft Division, UTC, West Palm Beach, FL; Scripps Institute of Oceanography, La Jolla, CA; SKF Industries, Inc., King of Prussia, PA; Southwest Research Institute, San Antonio, TX; Titanium Metal Corporation, Henderson, NV; TRW, Cleveland, OH; Union Carbide, Parma, OH and Tarrytown, NY; Vought Corporation, Dallas, TX
- ACADEMIC - Johns Hopkins University, Baltimore, MD; Ohio State University, Columbus, OH; Colorado School of Mines, Golden, CO; Massachusetts Institute of Technology, Boston, MA; Oklahoma State University, Stillwater, OK; Polytechnic Institute of New York, Brooklyn, NY; Washington University, St. Louis, MO

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F61-342, Airborne Materials:

- Covers materials and processes needed for construction, quality control, operation, and maintenance of aircraft and related weapons systems
- Program results from recognition that performance improvement, reliability, survivability, and life cycle cost reduction are greatly dependent on the physical and mechanical properties of the available materials and processes
- Major emphasis is on improved materials for lighter aircraft, more fuel efficient engines, and improved protective systems for better environmental resistance, advanced composites, new aluminum and titanium base alloys, and advanced high temperature alloys for airframe, propulsion and sensor applications



Program Element: 62761N

Title: Materials Technology

a. (U) FY 1982 Program:

- (1) Significance of 2-Dimensioned and 3-Dimensioned composite defects in graphite fiber reinforced composites determined
- (2) Cooperative corrosion fatigue testing program with NATO allies completed
- (3) HARPOON J402 engine test with silicon-nitride bearings underway as planned
- (4) Hydrogen-detecting "band-aid barnacle" electrode cell developed and transitioned to fleet use
- (5) Development of plastic radome thermal and erosion prediction methodologies completed for aircraft launched tactical missile
- (6) Development of high temperature, water-based, solid film lubricant completed
- (7) Rapidly solidified aluminum alloy development initiated
- (8) Rapidly solidified superalloy design initiated
- (9) Rapidly solidified refractory alloy program initiated
- (10) Optimization of titanium adhesive bonding process completed

b. (U) FY 1983 Program:

- (1) Optimize adhesive and ambient storage prepreg composite for field repair
- (2) Complete study of composite multiple delaminations under biaxial loading
- (3) Evaluate new single crystal superalloy turbine blade materials
- (4) Complete carbon-carbon composite, high temperature coating development and demonstrate on a prototype turbine disk
- (5) Complete elevated crack growth studies of Waspaloy and Rene 95 alloys
- (6) Complete engine tests of N-4 superalloy turbine blade material
- (7) Complete rain erosion studies on ternary sulfide dome materials
- (8) Develop paint strippers for composite materials
- (9) Evaluate properties of rapidly solidified superalloys
- (10) Continue examination of rapidly solidified refractory alloys
- (11) Continue development of rapidly solidified aluminum alloys

c. (U) FY 1984 Planned Program:

- (1) Continue graphite fiber composite field repair development
- (2) Transition high stiffness, aluminum-lithium alloy to Manufacturing Technology Program
- (3) Initiate broad-base program in rapid solidification technology
- (4) Transition Corona-5 titanium alloy development to Manufacturing Technology Program
- (5) Complete development of paint strippers for composite materials

d. (U) Program to Completion: This is a continuing program

2. (U) Project F61-543, Missile Materials:

- The initial program thrust was directed toward the development of high performance reentry vehicle nosetips for Navy missiles. It involved the development of high strain graphite and fine weave carbon-carbon composites
- Initiated subsequent tasks in response to requirements for improved propulsion system nozzle materials and replacement materials for reentry vehicle substructures. Metal matrix composites were identified as a potential replacement for these structures
- Improvements in nosetip and rocket nozzle performance surfaced new problems in reentry vehicle heat shields and nozzle exit cones, and identified a requirement for a new sensor window material for reentry vehicle terminal guidance systems

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Program Element: 62761N

Title: Materials Technology

a. (U) FY 1982 Program:

- (1) Three "full contour" graphite/carbon-carbon tactical missile rocket nozzles tested
- (2) Carbon-carbon heat shield fabrication concept selected, demonstrated and transitioned to Navy Manufacturing Technology Program
- (3) Thin-walled, pseudo-3D carbon-carbon extendable exit cone fabrication and testing completed. Development transitioned to Navy Manufacturing Technology Program
- (4) Development of fabrication method and material composition for reentry vehicle substructure completed
- (5) Baseline materials and fabrication processing established for 12 inch and 21 inch diameter underwater torpedo pressure hulls
- (6) Full scale, metal matrix composite MK-48 torpedo transducer webbing plate ready for test and evaluation
- (7) Graphite aluminum composite tactical missile fins flight tested
- (8) Completed definition of materials requirements for tactical missile sensor windows
- (9) Fabricated selected sensor window materials and evaluated thermal, mechanical, and electromagnetic properties
- (10) Evaluated oxidation resistant coating concepts for tactical missile propulsion systems components

b. (U) FY 1983 Program:

- (1) Complete full-scale flight test of high performance graphite material for ballistic reentry vehicle nosetips
- (2) Demonstrate feasibility of advanced nosetip concepts for high accuracy ballistic vehicles
- (3) Characterize boron-nitride reinforced/silicon oxide ( $\text{BN/SiO}_2$ ) high temperature dielectric material for hypersonic reentry vehicle sensor windows
- (4) Complete Phase I of oxidation resistant carbon-carbon development
- (5) Identify space structure components requiring graphite-magnesium metal matrix composites
- (6) Feasibility of pultruded metal matrix shapes for space structures to be demonstrated
- (7) Test full scale MK-48 transducer webbing plate
- (8) Fabricate and laboratory test full scale (12 3/4 inch diameter) metal matrix-hull section for Advanced Lightweight Torpedo (ALWT)
- (9) Complete Phase I studies on fatigue and corrosion characteristics of silicon carbide/aluminum metal matrix composite
- (10) Demonstrate on-line, non-destructive inspection process controls for metal matrix composite wire
- (11) Complete baseline design and definition of material requirements for supersonic missile fuse antenna windows
- (12) Complete fabrication of Phase I reinforced silica radome materials
- (13) Complete fabrication and screening of refractory oxidation resistant intermetallic compounds for hypersonic missile airframes

c. (U) FY 1984 Planned Program:

- (1) Initiate Phase II of oxidation resistant carbon-carbon development
- (2) Transition to industry advanced hot ball and socket components for test firings
- (3) Establish parameters for netallizing woven silicon carbide tape
- (4) Select space systems structural components for fabrication demonstration
- (5) Conduct in-water test run on metal matrix composite torpedo hull
- (6) Demonstrate feasibility for fabricating alternative metal matrix composite systems
- (7) Model mechanical properties of mixed reinforcement metal matrix composites
- (8) Complete high temperature characterization of candidate infrared windows for hypersonic missiles

d. (U) Program to Completion: This is a continuing program

Program Element: 62761N

Title: Materials Technology

3. (M) Project F61-544, System Support Materials

- Supports multiplatform Naval applications of materials that provide increased capabilities
- Develops materials and structural concepts to harden systems against directed energy weapons
- Develops the understanding of fracture in metals and composites
- Develops Non-Destructive Inspection and Evaluation technology for naval applications
- Develops lightweight radar-absorbing coatings and structures
- Supports the reduction in the life cycle cost of Navy shore facilities
- Provides direct support of the Department of Defense materials thrust in metal matrix composites technology

a. (V) FY 1982 Program

- (1) Continued experimental evaluation of detector degradation of common-MOD forward-looking infrared (FLIR) arrays to laser irradiation
- (2) Continued fabrication and testing of laser resistant radar dome materials
- (3) Completed initial phase of hardened coating system for airframe composite materials
- (4)
- (5) Selected lightweight composite armor candidate material for Marine Corps vehicles
- (6) Large scale, fiber reinforced lead grids produced for submarine batteries
- (7) Military Standard test method for corrosion fatigue crack growth of naval structural materials developed
- (8) Crack tolerance criterion for controllable pitch ship propellers formulated
- (9) Continued field tests of coated panels with varying surface profiles
- (10) Laboratory screening of candidate marine wood preservative materials completed
- (11) Synthesis of silicon carbide (SiC) polymer demonstrated
- (12) Techniques to hot press complex shaped parts from stacked arrays of silicon carbide (SiC) fiber reinforced glass ceramic matrix broad goods developed
- (13) Fabricated and tested panels of heat resistant, concrete and modified asphalt concretes for V/STOL aircraft

b. (V) FY 1983 Program

- (1) Conclude evaluations of detector degradation for common-MOD forward-looking infrared (FLIR) arrays
- (2) Investigate combining laser/radar absorbing material (RAM) protection
- (3)
- (4) Determine the response of structural composites to high energy laser threats by investigating panel post-buckling behavior and joint vulnerability
- (5) Complete full-scale, metal matrix composite, high energy laser mirror design analysis and initiate fabrication
- (6) Full-scale submarine battery prototype with lead metal matrix separators charge/discharge cyclic testing to be completed
- (7) Develop multilayer structure defect data acquisition and signal processing techniques
- (8) Complete field testing of coated panels and prepare preliminary specifications for steel surface profiles
- (9) Investigate techniques for treating wood pilings with selected preservatives
- (10) Use of silicon carbide fiber reinforced glass ceramic materials in gas-turbine operations to be examined
- (11) Demonstrate feasibility of producing silicon carbide or silicon nitride ceramic and ceramic composites using ceramic processing techniques
- (12) Conduct V/STOL tests on 10 foot by 10 foot panels of heat resistant concrete or asphalt concretes
- (13) Complete ballistic evaluation of most inexpensive armor material candidates for Marine Corps vehicles

Program Element: 62761N

Title: Materials Technology

c. (U) FY 1984 Planned Program

- (1) Conduct analytic simulation of full-scale aircraft structural failure due to slowed laser irradiation
- (2) Complete studies of structural composites response to high energy laser irradiation
- (3) [
- (4) Complete conformal testing of metal matrix laser mirror
- (5) Conduct evaluation of metal matrix composites performance to nuclear blast
- (6) Develop selection criteria for ship structural crack arrester strakes
- (7) Develop non-destructive eddy current detection technology for location and assessment of subsurface cracks in naval alloys
- (8) Prepare performance criteria for surface preparation prior to painting with latex paints
- (9) Complete laboratory evaluations of the effect of marine wood preservatives on structural performance
- (10) Complete evaluation of coated rebars for marine concrete structures
- (11) Complete development of silicon carbide or silicon nitride fiberglass/ceramic materials
- (12) Continue investigation of conductive polymers for signature reduction applications

d. (U) Program to Completion: This is a continuing program

4. (U) Project F61-545, Design Options for Critical Materials

- Develop and demonstrate conservation methods and new materials compositions which will significantly reduce Navy dependence on foreign supply of critical/strategic materials
- Identify conservation/cost reduction fabrication and processing procedures
- Develop new materials and design options based on utilization of abundant materials

a. (U) FY 1982 Program

- (1) Completed assessment and identification of domestic materials suitable for potential substitution
- (2) Fabricated magnet materials by rapid solidification process
- (3) Initiated characterization of cobalt-free cutting tool materials

b. (U) FY 1983 Program

- (1) Complete assessment of metal matrix composites as substitutes for critical materials
- (2) Conduct complex assessment of carbon-carbon composite substitutes for high temperature superalloys
- (3) Evaluate rapid crystallization casting process
- (4) Characterize substitutes for thermal battery component
- (5) Identify fabrication procedures for bulk nickel substitutes
- (6) Complete fabrication of borocarbide metals for cutting tool application

c. (U) FY 1984 Planned Program

- (1) Demonstrate metal matrix systems as substitutes in selected sub-components
- (2) Complete evaluation of oxidation resistant graphite fibers
- (3) Optimize rapid crystallization casting process and complete scale-up process
- (4) Fabricate sub-scale mica free thermal batteries

Program Element: 62761N

Title: Materials Technology

- d. (U) Program to Completion: This is a continuing program
  - 5. (U) Project F61-701, Small Business
    - Fund that part of the Department of Defense's small business advanced technology program (DESAT) which is of interest to the Navy
    - Areas of interest include physics of semiconductor crystal growth, removal of coatings, non-destructive evaluation of materials and structures, and bearing/lubricant performance
  - a. (U) FY 1982 Program
    - (1) Seven proposals were selected and funded in Phase I
  - b. (U) FY 1983 Program
    - (1) Assess results of Phase I studies and select proposals for Phase II
  - c. (U) FY 1984 Planned Program
    - (1) Continue Phase II programs
  - d. (U) Program to Completion: This is a continuing program
- I. (U) PROJECTS OVER \$10 MILLION IN FY 1984
- (A) (U) Project F61-541, Seaborne Materials:
- 1. (U) DESCRIPTION (Requirement and Project):
    - Covers a broad spectrum of materials required for the construction, operation, and maintenance of advanced naval seaborne vessels and their equipment including the development of the materials themselves and the processes for production, fabrication, and inspection as well as preservation to prevent environmental degradation
    - The program resulted from the recognition that performance enhancement, survivability, and life cycle cost reduction are usually limited by the attributes of the available materials and processes
    - Major emphasis is on the development of Naval vessel hull material, environmentally resistant coatings, improved welding and quality control methods, low cost manufacturing techniques, metal and composite joining technology, and materials characterization methodology
  - 2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:
    - a. (U) FY 1982 Program:
      - (1) Developed specification guideline for stress corrosion resistant, high strength, thin gauge CS-19 weldments
      - (2) Produced draft fabrication procedure for 2869 filament superconducting wire for application to shipboard advanced electrical machinery
      - (3) Completed draft fabrication procedure for adhesive bonded, thin-gauge panels
      - (4) Established feasibility of the Alforge-process for the production of aluminum shipboard structures to transition to the Manufacturing Technology Program

Program Element: 62761N

Title: Materials Technology

- (5) Documented technology guidelines for improved subcritical crack resistant High Yield (HY) steel weldments
- (6) Initiated one-inch thick high strength, low alloy (HSLA) steel plate evaluations
- (7) Completed laboratory evaluation of Nopcoide and Organometallic Polymer (OMP) camouflage antifouling coatings. Terminated program due to marginal performance of coatings
- (8) Prepared draft procedures for producing high quality castings by high pressure
- (9) Conducted filament wound composite ship hull feasibility study
- (10) Initiated phase II of geodesic composite propeller shroud (fabrication and evaluation of test articles)
- (11) Field trials of sealed, prelubricated, anti-friction bearing for Marine Corps applications conducted

b. (U) FY 1983 Program:

- (1) Continue hull composite filament winding feasibility study/demonstrations
- (2) Complete investigation of water lubricated sliding surfaces and prepare a draft specification for fleet use
- (3) Characterize thick plate, High Strength, Low Alloy (HSLA) welds
- (4) Complete feasibility investigation of seam welded piping and prepare draft specification
- (5) Complete improved shipboard incinerator fiber reinforced ceramic matrix materials development and prepare draft fabrication/installation procedures
- (6) Fire resistant habitability foam evaluations to be completed and draft specification to be prepared
- (7) Design prototype in-process weld control system and initiate evaluation
- (8) Establish data base on effect of initial fire repair on the fatigue life of aluminum weldments
- (9) Conduct shipboard evaluation of low maintenance exterior coatings
- (10) Determine laser beam welding feasibility for up to 1-inch thick steel weldments
- (11) Continue development of fire resistant submarine hull installation
- (12) Establish feasibility and candidates for high strength, aluminum powder alloys for submersible hull structures

c. (U) FY 1984 Planned Program:

- (1) Complete feasibility study and demonstrations of filament winding for composite hull
- (2) Continue characterization of thick plate, high strength, low alloy (HSLA) welds
- (3) Continue evaluation of prototype in-process weld control system
- (4) Continue shipboard evaluation of low maintenance coatings
- (5) Continue evaluation of fire resistant submarine hull insulation
- (6) Continue evaluation of high strength aluminum powder alloys for submersible hull structures
- (7) Determine design and material requirements, and procure quiet roller bearings
- (8) Complete initial phase of high quality castings by pressure application
- (9) Complete broad spectrum anti-fouling coating evaluation
- (10) Evaluate new fire resistant hydraulic fluids
- (11) Complete ship evaluation of open boiler waterside corrosion control coating system
- (12) Initiate focused effort in fiber reinforced composites for ship and submarine structures
- (13) Initiate development of automated welding methods using both robotics and computer feedback technology

d. (U) Program to Completion: This is a continuing program

e. (U) Milestones: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62762N Title: Electronic Device Technology  
DoD Mission Area: S21 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | <b>25,939</b>  | <b>25,872</b>    | <b>30,190</b>    | <b>31,359</b>    | Continuing               | Continuing           |
| F62-580     | (Higher Classification Project)                  | 300            | 400              | 343              | 345              | Continuing               | Continuing           |
| F62-581     | Microwave and Radio Frequency Technology         | 6,576          | 5,850            | 5,206            | 4,889            | Continuing               | Continuing           |
| F62-582     | Analog and Digital Integrated Circuit Technology | 6,256          | 6,624            | 10,758           | 11,376           | Continuing               | Continuing           |
| F62-583     | Electro-Optical Technology                       | 5,386          | 5,409            | 5,876            | 6,115            | Continuing               | Continuing           |
| F62-584     | Millimeter Wave Technology                       | 3,575          | 3,942            | 3,064            | 3,426            | Continuing               | Continuing           |
| F62-585     | Special Avionic Devices                          | 540            | 550              | 294              | 337              | Continuing               | Continuing           |
| F62-586     | Testing Technology                               | 964            | 780              | 714              | 764              | Continuing               | Continuing           |
| F62-587     | Electronic Materials                             | 2,112          | 2,317            | 3,935            | 4,107            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports Radio Frequency and Microwave Technologies that address the power, frequency, and bandwidth requirements of Communication, Radar and Electronic Warfare systems at frequencies below 26 gigahertz (GHz).
- Addresses the requirement to develop Millimeter Wave Technology (26 GHz to 140 GHz) to counter the known threat in this frequency range and to provide for new Communication, Radar and Electronic Warfare capabilities for smaller and more covert systems
- Addresses the Command and Control need for increased signal processing speeds via improvements in electronic and optical processing techniques
- Supports materials development in areas where advances would significantly improve device technology
- Supports the development of automatic testing technology for improved readiness of shipboard combat and communication systems

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

The major changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:

- (FY 1982) - F62-581 - 1,030 transferred from F62-581 to F62-584 to accelerate Millimeter Wave Technology development. Other changes due to minor program adjustments
- (FY 1983) - 952 transferred from F62-581 - (Microwave and Radio Frequency Technology) to F62-584 (Millimeter Wave Technology) (+472) and F62-586 (Testing Technology) (+480)
- Other changes are due to budget reductions
- (FY 1984) - F62-581 (Microwave and Radio Frequency Technology) decreased by \$442 in order to provide funds for Acceleration of Non-Volatile Cross-Tie Random Access Memory Development under F62-582
- F62-582 (Analog/Digital Integrated Circuit Technology) increased by 1,793 to provide funding for the Cross-Tie Random Access Memory, a higher speed Microwave Receiver Subsystem, and for increased Very High Speed Integrated Circuit support

Program Element: 62762N

Title: Electronic Device Technology

- F62-583 (Electro-Optical Technology) decreased by 564 because of directed reprogramming to higher classification subprojects in other Elements
- F62-584 (Millimeter Wave Technology) decreased by 881 because of transfer of tube cathode work from F62-584 to F62-581 (Microwave and Radio Frequency Technology)
- F62-585 (Special Avionics Device) decreased by 306 to increase efforts in F62-582
- F62-586 (Testing Technology) increased by 404 because of program re-assessment
- F62-587 (Electronic Materials) increased by 852 to support increased effort on Indium Phosphide Device Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | <b>24,010</b>  | <b>26,076</b>    | <b>27,134</b>    | <b>29,341</b>    | Continuing               | Continuing           |
| F62-580     | (Higher Classification Project)                  | 0              | 300              | 400              | 350              | Continuing               | Continuing           |
| F62-581     | Microwave and Radio Frequency Technology         | 8,896          | 7,642            | 7,277            | 5,648            | Continuing               | Continuing           |
| F62-582     | Analog and Digital Integrated Circuit Technology | 4,698          | 6,295            | 6,859            | 8,965            | Continuing               | Continuing           |
| F62-583     | Electro-Optical Technology                       | 6,525          | 5,675            | 5,811            | 6,440            | Continuing               | Continuing           |
| F62-584     | Millimeter Wave Technology                       | 400            | 2,545            | 3,470            | 3,945            | Continuing               | Continuing           |
| F62-585     | Special Avionic Devices                          | 825            | 550              | 550              | 600              | Continuing               | Continuing           |
| F62-586     | Testing Technology                               | 779            | 1,000            | 300              | 310              | Continuing               | Continuing           |
| F62-587     | Electronic Materials                             | 1,887          | 2,069            | 2,467            | 3,083            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATION FUNDS: None.

F. (U) RELATED ACTIVITIES

Governmental, industrial, and academic efforts are coordinated by the Advisory Group on Electronic Devices (AGED) to the Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E). This group which is composed of leading members of the government, industrial and academic communities, reviews all electronic device proposed contracts for technical merit and integration into National thrusts in electronic development. Tri-Service Committees on Microwaves, Microelectronics and Electro-Optics meet periodically to integrate service contract activities so as to maximize the use of fiscal resources. Annual Tri-Service Integration Plans are developed and made available by the Advisory Group on Electronic Devices (AGED) and the Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E).

G. (U) WORK PERFORMED BY

**IN-HOUSE** - Naval Air Development Center, Warminster, PA; Naval Avionics Center, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA.

**INDUSTRIAL** - General Electric, Syracuse, NY; Hughes Aircraft, Torrance, CA; Litton, San Carlos, CA; Raytheon, Waltham, MA; RCA, Camden, NJ; Rockwell International, Anaheim, CA; Texas Instruments, Dallas, TX; United Technologies, East Hartford, CT; Varian Associates, Beverly, MA and Palo Alto, CA; and others.

**ACADEMIC** - Cornell, Ithaca, NY; Georgia Tech, Atlanta, GA; University of California at San Diego, San Diego, CA; North Carolina State University, Raleigh, NC; University of Michigan, Ann Arbor, MI



Program Element: 62762N

Title: Electronic Device Technology

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

I. (U) Project F62-581 Microwave and Radio Frequency Technology, and Project F62-584, Millimeter Wave Technology.

These projects are described as a unit because the technical issues are differentiated mainly by frequency. Most of the Navy's radar communications and electronic warfare systems presently operate at frequencies below 26 GHz. Significant technology improvements are needed and can be achieved from the tubes and solid state devices being developed for these systems. Emphasis is on higher power and greater bandwidth from crossed-field amplifier (CFA) and travelling wave tubes and on solid state silicon and gallium arsenide transmitter and receiver elements for greater reliability and lifetime.

Millimeter wave technology addresses the need to develop radar, electronic warfare and communication capabilities at higher frequencies (26 GHz to 140GHz) in order to reduce electronic countermeasure (ECM) susceptibility prevalent in the microwave spectrum; increase surveillance and tracking effectiveness via greater bandwidth; and reduce system size for aircraft, remotely piloted vehicles and missile seeker application. Needed areas of development are high power large bandwidth gyrotrons; monolithic gallium arsenide receivers; high burnout diode mixers; protection devices such as field effect transistor switches; and control components such as power combiners, circulators and isolators.

a. (U) FY 1982 Program:

The following are examples of the accomplishments that supported the Element and Mission need in FY 1982

- (1) Completed development of a 26-40 GHz gallium arsenide field effect transistor amplifier for use in electronic warfare systems.
- (2) Developed a high performance, high burnout resistant gallium arsenide mixer diode for millimeterwave use
- (3) Developed an indium phosphide device that developed 9.2 watts of peak power at 33 GHz for use in a radar transmitter.
- (4) Completed development of a 600 watt silicon bipolar transistor module for a 3 gigahertz radar
- (5) Demonstrated 200 amperes per square centimeter emission density from a field emission array of 5000 tips spaced 10 micrometers apart. This emission density is approximately 100 times greater than that of the thermionic cathodes used in traveling wave tubes
- (6) Produced both high peak and very high average millimeter wave power from a helix traveling wave tube for use in an active missile seeker radar
- (7) Transitioned a high gain crossed field amplifier to a manufacturing methods technology program in order to prepare for use in an ASW radar
- (8) Developed an octave bandwidth, 8-16 GHz, high power (up to 4 KW average power) circulator for use in electronic warfare transmitters

b. (U) FY 1983 Program:

- (1) Complete the development of a 3 GHz high gain, high peak and average power crossed field amplifier for use in ships multifunction radar
- (2) Complete the development of a dual mode traveling wave tube for use in a search or track ships point defense system radar
- (3) Develop a monolithic 18-26 GHz gallium arsenide distributed amplifier having 40 dB gain and a noise figure of less than 10 dB for use in electronic warfare systems
- (4) Complete the development of a prototype high peak power gyrotron tube at 35 GHz for use in a fire control radar transmitter
- (5) Start development of a bulk silicon window waveguide switch with 26-40 GHz bandwidth and capability of switching kilowatts of average power

Program Element: 62762N

Title: Electronic Device Technology

- (6) Initiate monolithic mixer development in the 75-110 GHz range for millimeter wave receiver use
- (7) Complete material and particle size optimization of secondary emission cathodes in order to increase cathode life of crossed field amplifiers in field use
- (8) Complete fabrication of niobium nitride devices and demonstrate millimeter wave mixer action

c. (U) FY 1984 Planned Program:

- (1) Complete the development of a 20% bandwidth traveling wave tube centered at 90 GHz that uses a fabrication and assembly technology expected to show reduced cost when compared to more conventional methods
- (2) Complete the development of 80 watt traveling wave tubes for use in the communications transmitter of ship-to-satellite links
- (3) Start monolithic source development in the 75-110 GHz range and complete the initial feasibility demonstration of a monolithic receiver technology at these frequencies
- (4) Continue the development of superconducting devices with transition temperatures above 150K
- (5) Develop millimeter wave Schottky barrier mixer diodes using refractory metallizations for burnout resistance capability
- (6) Complete the development of 2 watt impact avalanche transit time diodes and 2-diode modules for operation in a millimeter wave amplifier for possible use in the Navy EHF Satellite program
- (7) Complete the development of a monolithic broad band (2-30 GHz) distributed solid state amplifier
- (8) Utilize high power waveguide window switch to make a 26-40 GHz phase shifter and transfer to manufacturing methods technology program

d. (U) Program to Completion: This is a continuing program

2. (U) Project F62-583, Electro-Optical Technology

This project investigates the advantages of the optical spectrum for communications, surveillance and guidance systems and the integration of optical and electronic devices required for complete systems. Technology developments are: single mode, low loss optical fibers, and 1.55 micrometer infrared sources and detectors for long undersea data links and high data rate communication links; one joule per pulse, 108-1010 pulse lifetime blue green lasers for communication and surface and space surveillance; and staring and scanning 3-5 micrometer and 8-12 micrometer infrared detector arrays for detection, tracking, identification and weapons guidance

a. (U) FY 1982 Program:

- (1) Bathymetry laser subsystems were tested successfully and will be integrated into the system
- (2) Mercury bromide blue-green laser pulse shortening succeeded in generating 9 nanosecond pulses. Microwave excitation experiments demonstrated inefficient excitation of blue-green radiation from mercury bromide
- (3) A scanned mercury cadmium telluride charge coupled device (CCD) focal plane array (FPA) with high-density cell structure was demonstrated and a 64 x 32 CCD array for demonstrating imaging was designed
- (4) Architectural design of a staring mercury cadmium telluride hybrid focal plane array was accomplished. It will permit division of a 128 x 128 array into four 64 x 64 detector elements for high speed readout without loss of sensitivity at the boundaries between the subarrays
- (5) Very low loss (0.5 dB) single mode access couplers were produced and used in a data bus demonstration (15 terminals, 500 M bit/sec data rate). Polarization-independent 2 x 2 switches with low cross talk (-20 dB) were developed for data bus application
- (6) A short focal length (1.2 cm) geodesic lens was developed using lithium niobate and efficient coupling (70%) from a diode laser to the lens was demonstrated. Application is to an Acousto-Optical spectrum analyzer for electronic warfare identification and direction finding

Program Element: 62762N

Title: Electronic Device Technology

b. (U) FY 1983 Program

- (1) Complete the development of an acousto-optic processor for doppler frequency measurement of bi-phase coded signals without the need for discrete filter banks
- (2) Start development of a fiber optic cable capable of withstanding a 350°C avionics environment
- (3) Start the development of a monolithic mercury cadmium telluride 64x32 scanning focal plane array
- (4) Complete the evaluation of focal plane arrays for a two color (3-5 micrometer and 8-12 micrometer) hybrid infrared imager
- (5) Deliver a 64x64 hybrid mercury cadmium telluride staring focal plane array along with Dewar assembly; start development of a 128x128 focal plane array
- (6) Develop a 1 joule, 10 nanosecond pulse, single shot mercury bromide laser

c. (U) FY 1984 Planned Program:

- (1) Start development contract (DARPA/Navy) on a 4 joule, 20 pulses per second blue-green laser
- (2) Develop and deliver a scanned monolithic 64 x 32 mercury cadmium telluride charge coupled device focal plane array (3-5 micrometers) complete with Dewar assembly
- (3) Complete the development of a high temperature (350°C) fiber optic cable for avionics use
- (4) Start development of hetero-junction infrared detectors in the 2-3.5 micrometer range as a replacement for present detector materials and devices
- (5) Start development of stabilized laser transmitters at 0.8 micrometers for use in fiber optic long line undersea communications
- (6) Continue development of a staring 128 x 128 mercury cadmium telluride hybrid focal plane array (3-5 micrometers)
- (7) Complete the development of a fiber optic delay line (1 millisecond delay and 1.5 GHz bandwidth) for radar moving target acquisition
- (8) Initiate program for a scanned monolithic mercury cadmium telluride charge coupled device focal plane array (8-12 micrometers)

d. (U) Program to Completion: This is a continuing program

3. (U) Project F62-585, Special Avionic Devices

This project addresses high temperature electronics for in-situ application to variable cycle aircraft engines, and energy efficient, smaller volume AC to DC power conversion for general avionic equipment

a. (U) FY 1982 Program:

- (1) Integrated injection logic (I<sup>2</sup>L) ring oscillator and flip flop digital circuits have been tested up to 275°C in order to determine speed-power trade-off and leakage current effects for high temperature avionic electronics
- (2) A newly developed refractory metallization was reliable up to 3600 under test

b. (U) FY 1983 Program:

- (1) Develop a two-level high temperature (350°C) metallization system for use in the high temperature avionic devices technology development
- (2) Complete the development and testing of a high power metal-oxide semiconductor field effect transistor (MOSFET)

Program Element: 62762N

Title: Electronic Device Technology

c. (U) FY 1984 Planned Program:

- (1) Continue analysis and experimentation of power conversion concepts
- (2) Develop algorithms for optimum design of power supply inductors and transformers for minimum size and weight

d. (U) Program to Completion: This is a continuing program

4. (U) Project F62-586, Testing Technology

This project addresses the Navy's need to improve the process and reduce the time required for evaluation of the readiness of shipboard systems. At the present time such readiness evaluation is too manpower intensive, requires manpower at too high an educational level, and would not be effective in short-notice tactical scenarios. Areas of development include design of electronics for testability, built-in testing circuits, interfacing DoD testing software with commercial electronic equipment and development of a test bed for evaluation of a fault monitoring display system

a. (U) FY 1982 Program:

- (1) Demonstrated the feasibility of using a controller to configure or reconfigure general purpose commercial test equipment to eliminate the need for specialized test equipment
- (2) Characterized and demonstrated the utility of a figure-of-merit in order to quantitatively measure the testability of digital modules

b. (U) FY 1983 Program:

- (1) Evaluate advanced algorithms for fault location in microelectronic circuits
- (2) Develop the methodology for establishing testability requirements in military specifications and for trading off testability design techniques

c. (U) FY 1984 Planned Program:

- (1) Design, fabricate, and test the reconfigurable general purpose test equipment needed to demonstrate Intermediate and Organizational Level test capability
- (2) Continue evaluation and improvement of algorithms for fault location and demonstrate on Navy equipment

d. (U) Program to Completion: This is a continuing program

5. (U) Project F62-587, Electronic Materials

This project addresses the development of materials that have potential for significant impact on device technology

a. (U) FY 1982 Program:

- (1) Grew large (3-inch diameter) uniform yttrium aluminum garnet (YAG) crystals by the Heat Exchanger Method to control thermal gradients during growth; the crystals exhibit negligible light scattering and therefore greater laser efficiency and lower cost per rod when used for target designator lasers
- (2) In situ compounding and fabrication of indium phosphide was achieved and 2 inch diameter crystals grown on the (100) plane using a one step fabrication process that is faster, less complicated and cheaper for growing millimeter wave substrate material
- (3) Ion implanted layers in gallium arsenide have been activated using a photo-anneal process that minimizes surface damage; this technique will provide superior processing for microwave integrated circuits

Program Element: 62762N

Title: Electronic Device Technology

- (4) Grow tungsten surfaces by chemical vapor deposition having differing but controlled crystal orientations; the result will be more uniform thermionic cathode surfaces with greater emission densities than are presently available in microwave and millimeter wave tubes

b. (U) FY 1983 Program:

- (1) Characterize and control the material variations in the lead sulfide selenide two color infrared detector and prepare for transition to manufacturing methods technology
- (2) Develop a technique to more uniformly dope yttrium aluminum garnet (YAG) with neodymium for less costly laser rod production
- (3) Develop prototype directional hydrophone sensors for dipping-sonar use
- (4) Demonstrate laser drilled oriented crystal surfaces for high performance, controlled porosity dispensing, thermionic cathodes for use in travelling wave tubes for millimeter wave radar electronic warfare systems

c. (U) FY 1984 Planned Program:

- (1) Grow 2-inch diameter liquid encapsulated Crochralski cadmium telluride bulk crystals for use in infra-red detector fabrication
- (2) Develop magnetic pressure and strain sensors
- (3) Initiate growth of 3-inch diameter crystals of semi-insulating indium phosphide in a reproducible and uniform manner so that high grade electronic substrates can be fabricated for millimeter wave sources and detectors and 1.8 micrometer electro-optic lasers
- (4) Transition the lead sulfide selenide 2 color infrared detector to manufacturing methods technology
- (5) Start development of silicon carbide devices with high power, high temperature capabilities
- (6) Evaluate application of oxide insulators on indium phosphide for digital circuits

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984

(A) (U) Project F62-582, Analog and Digital Integrated Circuit Technology:

1. (U) DESCRIPTION (Requirement and Project):

Real time signal processing is required in most military weapons and related electronic systems in order to completely utilize the information potential of the incoming electromagnetic spectrum of signals. At present, much useful information is discarded at the input of electronic systems because of lack of adequate signal processing speed and capacity

This project encompasses technology directed at increasing the speed at which signals derived from radar, communications and electronic warfare systems can be received, stored, and analyzed, and at increasing the reliability of these processes. Areas of development include electromagnetic to digital signal converters, techniques for integrated circuit densities significantly greater than those to be achieved by the Very High Speed Integrated Circuit (VHSIC) Program, fault tolerant circuit designs to maximize reliability and minimize maintenance of systems, and integrated circuits from new materials such as indium phosphide to improve intrinsic device speed

Program Element: 62762N

Title: Electronic Device Technology

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- (1) Developed an electro-optical signal processor and demonstrated the ability to perform 128-point discrete Fourier transforms on a real time signal at a 5 MHz rate. This translates to a processing rate of greater than a billion multiplications per second
- (2) Designed and fabricated a signal processor using charge coupled device technology. A transfer efficiency of greater than 99.8% was obtained with a transfer rate of 50 MHz analog to digital conversion of greater than 100 MHz signals should now be possible
- (3) Developed and tested an intermediate length array (>100 elements) for use in the development of the detector-preprocessor for the integrated optic spectrum analyzer to be used for electronic warfare identification and direction finding signal analysis
- (4) An 8x8 systolic array test bed was developed and fabricated to investigate parallel processing. Software development has proceeded to where a simple matrix-matrix multiplication can be demonstrated
- (5) Demonstrated high temperature operation (385°C) of a gallium aluminum arsenide/gallium arsenide bipolar transistor as part of the high temperature avionics device technology development
- (6) An integrated circuit which contains all of the circuit functions (except filters) needed for the Global Positioning Satellite (GPS) receiver has been fabricated and tested
- (7) A frequency synthesizer compatible with the Joint Tactical Information Distribution System (JTIDS) was delivered to a Navy laboratory for initial test
- (8) A prototype 4 x 64 bit cross-tie random access memory has demonstrated a 20 nanosecond access time and demonstrated non-volatility with temperature and radiation testing
- (9) The cryocooler on-a-chip concept has demonstrated 0.5 watt of cooling capacity at 80°K using a single stage open cycle Joule-Thomson machine. The objective is to provide a cooling engine for operation of superconducting electronic devices
- (10) Demonstrated the potential of masked ion beam lithography (MIBL) for use in high throughput circuit production (1.5 sec/cm<sup>2</sup>) of microelectronic circuits
- (11) Two candidate architectures for a fault tolerant computer were identified and compared in preparation for a choice of standard architecture for use on the design of the fault tolerant computer

b. FY 1983 Program:

- (1) Complete the evaluation, at a Navy laboratory, of the frequency synthesizer for possible use in Tactical Information Distribution System (JTIDS). In addition, the use of the synthesizer in an advanced radar will be assessed
- (2) Start construction of a multi-stage 20°K closed cycle Joule Thomson cryocooler system. The closed cycle feature will permit cryogenic refrigeration without the need of constant recharging
- (3) Demonstrate that the focussed ion beam and masked ion beam concept have applicability for the development of 0.3 micrometer and smaller design rules for semiconductor device processing. Compatible design rules for a 0.1 micrometer processing technology will be explored
- (4) Complete the initial design of a high speed indium phosphide analog to digital converter for high speed signal processing. The device, when fabricated, will be evaluated for possible use as an interface with Very High Speed Integrated Circuit (VHSIC) signal processing devices
- (5) Design and fabricate an improved intermediate length (>100 elements) linear detector-preprocessor for the integrated optics spectrum analyzer
- (6) Demonstrate matrix multiplication and decomposition on the systolic array processor and also demonstrate advanced beamforming algorithm performance. Parallel processing is being developed in order to meet real time processing requirements

Program Element: 62762N

Title: Electronic Device Technology

- (7) Start the development of a 128 x 4 bit, 1 nanosecond access time gallium arsenide cache memory in order to demonstrate its high speed, low power, radiation hard performance
- (8) The standard architecture for the fault tolerant computer will be selected and the advanced development package prepared
- (9) Design a high speed charge coupled device (CCD) sampler and summer (detector integrator) and demonstrate a summer module
- (10) Demonstrate the performance of a 1.5 gigahertz, 4-bit optical analog to digital converter

c. (U) FY 1984 Planned Program

- (1) Complete the very high speed integrated circuit (VHSIC) brass board chip set demonstration of advanced signal processing for the F-18 radar and an anti-jam communications link
- (2) Develop and demonstrate the first high speed indium phosphide analog to digital converter
- (3) Deliver and demonstrate novel performance of a 128 x 4 bit dual-port gallium arsenide memory and contract for a 1K x 4 bit 1 nanosecond dual-port memory
- (4) Design and start development of a long length (>500 elements) linear detector-preprocessor array to interface between the acousto-optical electronic warfare input signals and a Very High Speed Integrated Circuit (VHSIC) signal processor and complete the intermediate length (>100 elements) detector preprocessor
- (5) The advanced development model of a fault tolerant computer will be developed and tested
- (6) Determine the optimum fabrication techniques and materials for the cross-tie random access memory and demonstrate a 100 x 64 bit array complete with on-chip electronics at 1 gigahertz clock rate
- (7) Evaluate the 200K cryocooler and start construction of a 40K multi-stage closed cycle Joule-Thomson machine
- (8) Complete the assessment of magnetic signature of the small cryocooler
- (9) Start development of a 20 megahertz 14 bit analog to digital converter
- (10) Start development of a brass-board electronic warfare monolithic sensor-processor subsystem assembly. Define the system requirements and interfaces; design and develop devices and circuits
- (11) Integrate the frequency synthesizer into an advanced ship frequency agile radar design
- (12) The increase in funding from FY 1983 to 1984 is due to the expanded program in brassboard demonstration of Very High Speed Integrated Circuit program and two new starts in monolithic sensors and processors and in the Cross-Tie Random Access Memory developments.

d. (U) Program to Completion: This is a continuing program.

e. (U) Milestones: Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62763M

Title: Personnel and Training Technology

DoD Mission Area: 322 - Environmental and Life Sciences

Budget Activity: 1 - Technology Base

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | <b>8,084</b>   | <b>6,845</b>     | <b>7,746</b>     | <b>8,192</b>     | Continuing               | Continuing           |
| F63-521     | Manpower and Personnel Technology                | 6,497          | 4,959            | 5,292            | 5,779            | Continuing               | Continuing           |
| F63-522     | Computer-Aided Education and Classroom Training  | 1,587          | 1,886            | 2,064            | 2,147            | Continuing               | Continuing           |
| F63-528     | Personnel Performance Assessment and Enhancement |                |                  | 390              | 266              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

This program develops technology in the areas of manpower, personnel, training and education. Need for the effort stems from the following key issues:

- Cost of military manpower exceeds 50% of the defense budget
- Trained personnel are required to operate increasingly complex fleet equipment
- More efficient and effective methods are needed for the recruiting, management and retention of personnel.
- Strong emphasis must be placed on the development of computer-aided and computer-managed training, new personnel training techniques, and improved methodology for evaluating training effectiveness through measurement of individual, team, and unit performance.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: for the element a net increase of 1,707 in FY 1982; a decrease of 414 in FY 1983; and an increase of 10 in FY 1984. The increase in FY 1982 reflects a reprogramming of Exploratory Development resources to Project F63-521 to support the initiation of an effort to demonstrate on the USS CARL VINSON (CVN 70) advanced man-machine interface techniques to support the ship's management, operation, training and maintenance needs. Additionally, the changes in Project F63-521 reflect the combining of F63-500 with F63-521 in order to provide for better management of the related technical efforts in manpower and personnel technology. In FY 1983, the Program Element total decrease of 414, the Project F63-500/521 decrease of 254, and the Project F63-522 decrease of 160 result from directed Congressional reduction in the Program Element. FY 1984 funding reflects the addition of a new project, F63-528, Personnel Performance Assessment and Enhancement. The remaining decreases (168 in F63-500/521 for 1984; 190 in F63-522 for FY 1982; and 212 in F63-522 for FY 1984) result from adjustments characteristic of research and exploratory development.



Program Element: 62763N

Title: Personnel and Training Technology

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                           | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                | <b>5,734</b>   | <b>6,377</b>     | <b>7,259</b>     | <b>7,736</b>     | <b>Continuing</b>        | <b>Continuing</b>    |
| F63-500     | USMC Personnel Resources Management             | 1,352          | 1,352            | 1,352            | 1,400            | Continuing               | Continuing           |
| F63-521     | Manpower and Personnel Technology               | 2,937          | 3,248            | 3,861            | 4,060            | Continuing               | Continuing           |
| F63-522     | Computer-Aided Education and Classroom Training | 1,445          | 1,777            | 2,046            | 2,276            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- Related research, advanced development and engineering development program elements within the Navy and Marine Corps are the following (letters within parentheses indicate relevance to Manpower and Personnel or Computer Aided Education and Classroom Training): 61153N, Defense Research Sciences (M,E); 63707N, Manpower Control System Development (M); 63720N, Education and Training (E); 63727N, Navy Technical Information Presentation System (E); 63732N, Marine Corps Advanced Manpower/Training Systems (M,E); and 64709N, Joint Manpower/Personnel Prototypes (M). Related Army and Air Force exploratory development program elements are: 62722A, Manpower, Personnel and Training (M,E); 62205P, Training and Simulation Technology (E); and 62703P, Personnel Utilization Technology (M).
- To ensure coordination among these program elements and to prevent unnecessary duplication of efforts, a variety of formal and informal means are used to promote communication at both working and management levels. Information is regularly exchanged with the other services, non-DoD agencies, private industry and universities by such means as triservice Technical Advisory Groups, special planning meetings, workshops, conferences and symposia, and wide dissemination of technical reports.

G. (U) WORK PERFORMED BY

- IN-HOUSE - Navy Personnel Research and Development Center, San Diego, CA
- INDUSTRIAL - Institute for Research Studies, Athens, OH; Human Resources Research Organization, Alexandria, VA; Systems Exploration Inc., San Diego, CA; Digital Equipment Corp., San Diego, CA; Development Research Assn., Reston, VA; Personnel Decision Research Institute, Minneapolis, MN
- ACADEMIC - University of California, Los Angeles, CA; Duke University, Durham, NC; University of Illinois, Champaign, IL; University of Michigan, Ann Arbor, MI; Ohio State University, Columbus, OH; Penn State University, University Park, PA; Naval Academy, Annapolis, MD; University of Washington, Seattle, WA; University of Minnesota, Minneapolis, MN

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F63-521, Manpower and Personnel Technology. This project supports:

- Development of effective methods for the recruitment, management and motivation of personnel
- Development of procedures to reduce attrition and increase retention of personnel
- Development of procedures and criteria for more effective utilization of personnel
- Development of improved techniques to predict performance of Navy personnel

a. (U) FY 1982 Program:

- (1) Developed data on surface warfare officers relating to optimal length, specialization and rotation, and identified career patterns that will appeal to high quality surface warfare officers with strong retention potential

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Program Element: 62763N

Title: Personnel and Training Technology

- (2) Determined that prospects for lateral entry into the Navy by skilled people from the labor market had low payoff
  - (3) Initiated development of techniques for identifying prior-service personnel with a high propensity to enlist
  - (4) Completed development of a computer model which determines levels of recruitment necessary to satisfy operational billets, training billets, and manpower overhead
  - (5) Continued tracking a selected group of Marines to determine reasons influencing their decision to stay in or leave the service
  - (6) Completed specification of management methods to be used to reduce attrition and developed final plans for testing of these methods
  - (7) Initiated demonstration of advanced man-machine interface techniques on the USS CARL VINSON (CVN-70) to support automated management, technical training and maintenance in a shipboard operational environment.
- b. (U) FY 1983 Program:
- (1) Complete testing of Marine recruits to validate the predictive utility of computerized adaptive tests for the selection and classification of personnel
  - (2) Initiate design of an experimental artificial intelligence methodology for aptitude measurement
  - (3) Complete test and evaluation of prototype training system for Marine landing force close air support in urban areas
  - (4) Initiate development of procedures to validate training requirement scales to determine the extent to which a training objective is required for successful task performance
  - (5) Complete the identification of pertinent characteristics of former naval personnel who are most likely to enlist
  - (6) Initiate the systematic collection of attitudes of Marines towards the Marine Corps and its policies using the prototype officer and enlisted separation questionnaires
  - (7) Complete evaluation of the Special Assignment Battery for selecting good recruiters of officers
- c. (U) FY 1984 Planned Program:
- (1) Complete final structure of the enlisted individual retention model incorp rating determinants of enlisted retention to provide estimates of re-enlistment rates
  - (2) Complete the determination of the effects of performance standards and incentive sharing rates on goal setting and productivity within an organization
  - (3) Initiate development of improved techniques for estimating manpower costs early in the weapons system development cycle
  - (4) Complete the development of an experimental methodology based on artificial intelligence for selecting personnel to high technology ratings where current aptitude measures are insufficient
  - (5) Complete the development and validation of measures that will predict actual job performance instead of school performance
  - (6) Complete evaluation of pilot programs to reduce the attrition of women Marines
  - (7) Complete four year tracking of a selected group of Marines to determine reasons influencing their decision to stay in or leave the service
- d. (U) Program to Completion: This is a continuing program
2. (U) Project F63-522, Computer-Aided Education and Classroom Training. This project supports:
- Development of computer-aided and computer-managed training
  - Development of timely and efficient on-site training techniques
  - Development of methodology for evaluating training effectiveness through measurement of individual, team, and unit performance
  - Development of improved methods for training lower aptitude personnel and personnel with language and mathematics skill deficiencies

Program Element: 62763N

Title: Personnel and Training Technology

a. (U) FY 1982 Program:

- (1) Completed development and a situation of a program for testing and instruction in mathematical skills within the electronics training pipeline which resulted in more efficient training and in faster average course completion time
- (2) Developed an ASW Pretraining Guide identifying specific objectives of the training program, scoring procedures and performance standards which shipboard ASW teams can use to improve their performance on the 14A2 Trainer at ASW Training Centers
- (3) Completed development of advanced tactical knowledge training methods for the Tactical Action Officer course
- (4) Developed conceptual framework for relating personnel and training factors to fleet readiness
- (5) Initiated evaluation of a microcomputer prototype system using interactive graphics for teaching the skills needed to solve ship maneuvering board problems

b. (U) FY 1983 Program:

- (1) Determine team training errors in ASW shipboard training by using objective measures
- (2) Complete initial behavioral model which relates personnel performance to system operational readiness
- (3) Initiate assessment of the English language difficulties among bilingual personnel and develop procedures to overcome these deficiencies
- (4) Complete evaluation of a microcomputer employing interactive graphics for teaching the skills required for solving ship maneuvering board problems
- (5) Initiate development of optimal testing strategies for use in an operational computer-based training system
- (6) Continue development of procedures to design training and to structure job conditions to minimize performance deterioration due to forgetting

c. (U) FY 1984 Planned Program:

- (1) Initiate efforts to couple maintenance training simulators with computer coaches that use artificial intelligence techniques for teaching troubleshooting skills in order to reduce training time and instructor resources
- (2) Initiate the identification of training segments that could be improved through computer based techniques
- (3) Complete initial testing of mathematical model which relates personnel performance factors to system operational readiness
- (4) Initiate development of a generic model which defines the underlying mental processes and skills that enhance problem solving
- (5) Develop methods for detailed tracking of student progress through selected programs in electronic trouble-shooting

d. (U) Program to Completion: This is a continuing program

3. (U) Project F63-528, Personnel Performance Assessment and Enhancement. (New start)

- This is a new project planned for initiation in FY 1984. The project will determine the feasibility of using measures of electrical activity in the brain to assess the complex mental skills required of aviators and sonar operators

a. (U) FY 1982 Program

Not applicable

b. (U) FY 1983 Program

Not applicable

Program Element: 62763N

Title: Personnel and Training Technology

c. (U) FY 1984 Planned Program

- (1) Initiate determination of using measures of electrical activity in the brain for identifying personnel with the special skills/capabilities required for successful completion of training if selected for aviator and/or sonar operator duties

d. (U) Program to Completion: This is a continuing program

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984

Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62764N

Title: Chemical, Biological and Radiological Defense Technology

DoD Mission Area: 522 - Environmental and Life Sciences

Budget Activity: 1 - Technology Base

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>       | <b>1,776</b>   | <b>1,789</b>     | <b>4,124</b>     | <b>5,278</b>     | Continuing               | Continuing           |
| F64-561     | Chemical/Biological Defense Technology | 903            | 873              | 3,317            | 4,364            | Continuing               | Continuing           |
| F64-562     | Radiological Defense Technology        | 873            | 916              | 807              | 914              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED**

- This program element funds the Navy's portion of a coordinated Army/Navy/Air Force program in chemical, biological and nuclear radiation defense technology research
- Addresses Navy chemical and biological personnel protective equipment (individual and collective), detection and warning equipment, decontamination equipment, and diagnosis of biological agent caused disease
- Develops radiation monitoring instrumentation, and develops nuclear hardening technology through determining effects of blast, pulsed electromagnetic, and nuclear radiation on electronic and electrical equipment

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousand)**

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are an increase of 22 in FY 1982, and an increase of 1,579 in FY 1984, and are the result of pay increases, cost refinement and expansion of the Navy's efforts during the FY 1984 budget development

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY**

| Project No. | Title                                  | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>       | <b>730</b>     | <b>1,754</b>     | <b>1,789</b>     | <b>2,545</b>     | Continuing               | Continuing           |
| F64-561     | Chemical/Biological Defense Technology | 730            | 863              | 873              | 1,310            | Continuing               | Continuing           |
| F64-562     | Radiological Defense Technology        | —              | 891              | 916              | 1,235            | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.**

**F. (U) RELATED ACTIVITIES**

- Coordination with Theater Nuclear Weapons Program Office and Office of Naval Research insures integration of Navy Exploratory Development program with Research and Advanced Engineering Development programs
- Coordination with the U.S. Army and the U.S. Air Force, NATO quadripartite nations, the American Defense Preparedness Association, and the civilian industry

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Program Element: 62764N

Title: Chemical, Biological and Radiological Defense Technology

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA; Naval Surface Weapons Center, White Oak, MD; Naval Biosciences Laboratory, Oakland, CA; Naval Weapons Center, China Lake, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Defense Nuclear Agency, Washington, DC
- INDUSTRIAL - Rohm & Haas Co., Spring House, PA; EAI Corp., Frederick, MD
- ACADEMIC - University of Arizona, Tucson, AZ; Duke University, Durham, NC; Georgetown University, Washington, DC; Los Alamos National Laboratory, Los Alamos, NM

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F64-561, Chemical/Biological Defense Technology

- This project develops technology to support the defense requirements in the event chemical or biological agents are employed against Navy or Marine Corps units. It specifically addresses technology for equipment development that will provide for detection and warning, individual and collective protection, decontamination, and diagnosis of biological agent caused disease in an "at sea" or amphibious environment

a. (U) FY 1982 Program:

- (1) Synthetic absorbents were examined to determine their static and dynamic absorption performance, surface chemical properties and adaptability for chemical warfare agent removal as filtration systems
- (2) The feasibility of utilizing a carbon dioxide pulse technique to determine filter bed life without destruction of the filter bed was examined and found to be accurate and reliable under controlled laboratory conditions
- (3) Computer modeling techniques were employed to develop a predictive model for the location of optimum pressure references on Amphibious/Transport-type superstructure configurations
- (4) Available commercial gas separation membranes were tested for application in collective protection systems and found to be unsuitable for shipboard use
- (5) Began development of piezoelectric crystals for chemical warfare agent detection systems
- (6) Improved shipboard chemical warfare protective clothing criteria and developed requirements in conjunction with exploratory work by the U.S. Army
- (7) Began development of enzyme-linked immunosorbent assay (ELISA) systems using monoclonal antibodies for the rapid detection and identification of biological warfare agents

b. (U) FY 1983 Program:

- (1) Continue development of synthetic polymeric absorbents for use in shipboard chemical warfare collective protection system
- (2) Complete shipboard static pressure survey, flow model prediction validation on a LHA class ship in support of shipboard collective protection systems
- (3) Continue development of absorbing film-coating on piezoelectric crystals for applications in chemical warfare point detection systems
- (4) Continue development of enzyme-linked immunosorbent assay techniques to identify specific biological warfare agents
- (5) Begin development of immobilized protein based chemical/biological warfare filtration systems
- (6) Continue development of remote chemical warfare identification system based on laser-induced breakdown spectroscopy.
- (7) Continue development of improved laboratory demonstration models of Portable Electrostatic Collective Protection System (PECPS) and Chemical Agent Electrostatic Filtration System (CAEFS)
- (8) Initiate evaluation of the drug "Verapamil" for treatment of organophosphate poisoning in animal models

Program Element: 62764N

Title: Chemical, Biological and Radiological Defense Technology

c. (U) FY 1984 Planned Program:

- (1) Continue development and feasibility of testing a high capacity chemical warfare/biological warfare filtration system based on hydrolytic principles which neutralizes toxic agents, provides minimum pressure drop and has superior particulate removal
- (2) Begin development and demonstrate feasibility of silicone based improved micro chemical sensor coatings which entrap and respond to specific chemical warfare agents
- (3) Initiate identification of characteristics for decontamination agents necessary for shipboard use
- (4) Initiate test and evaluation of enzyme-linked immunosorbent assay system using clinical materials and animal model systems
- (5) Continue development of immobilization techniques for incorporating acetylcholinesterase in chemical warfare filtration systems
- (6) The improved designs of the Portable Electrostatic Collective Protection System and Chemical Agent Electrostatic Filtration System will be tested and evaluated
- (7) Continue testing and validation of the laser-induced breakdown spectroscopy for chemical warfare detection
- (8) Continue development and testing of piezoelectric crystal technology for chemical/biological warfare detection
- (9) Increase in funding from FY 1983 to FY 1984 is due to expansion of the Navy's efforts in this area

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F64-562, Radiological Defense Technology

- \* This project develops technology to defend against the effects of nuclear weapons. It addresses radiation monitoring instrumentation, nuclear hardening against blast, electromagnetic pulse (EMP) and effects of radiation on electronic equipment. This program provides technical information on nuclear effects technology needed to solve nuclear survivability problems and to establish the data base for cost-effective hardening specifications

a. (U) FY 1982 Program:

- (1) Results of electromagnetic pulse tests on USS Estocan (FFG-15) were evaluated in support of limited electromagnetic pulse protection being incorporated into the FFG-7 class ships
- (2) Completed jointly funded US/Dutch test of the HMS Callenburgh, which has total ship platform level electromagnetic pulse protection
- (3) Commercially available techniques for production of random access memory devices were identified that will provide for hardened computer memory
- (4) A prompt gamma circumvention technique required for tactical missile hardening was demonstrated using the 8085 microprocessor
- (5) Computerized isodose profiles for neutrons and prompt gamma were developed for use in battle management and missile survivability assessments
- (6) An airblast design guide for deckhouses was generated
- (7) Experimental data have been generated on several thermal coatings proposed as protection against nuclear effects

b. (U) FY 1983 Program:

- (1) Complete evaluation of total ship platform level hardening effectiveness
- (2) Complete development of 10-50 MHz current injection source need to assure the electronic systems/subsystem can withstand the residual electromagnetic pulse threat
- (3) Expand capability of Empress II to include automatic transient digitizers to analyse test data from ship electromagnetic pulse tests and increase the accuracy of the threat extrapolation

Program Element: 62764N

Title: Chemical, Biological and Radiological Defense Technology

- (4) Initiate program to determine the possible advantages of sensor systems that would provide range and azimuth angle for tactical nuclear warfare detonations
- (5) Complete demonstration of a concept of utilizing an "on-line" hardened standby computer memory in a prompt gamma environment.
- (6) Initiate development of cost effective hardness assurance techniques for missile electronics
- (7) Complete determination of survivability level for Random Access Memory
- (8) Complete definition of the airblast-induced shock environment
- (9) Complete update of ship superstructure design guide to include blast and thermal hardening considerations
- (10) Initiate development of a reliable light calibration source for personnel Thermoluminescent Dosimeter equipment

c. (U) FY 1984 Planned Program:

- (1) Refine electromagnetic pulse for survivability high altitude air burst and the tactical nuclear warfare surface burst and fracticide environments
- (2) Test platforms for hardening techniques will be developed and evaluated for transition
- (3) Evaluate effectiveness of ship electromagnetic pulse hardening
- (4) The hardness of emerging electronics and effectiveness of commercial protective devices will be evaluated
- (5) Radiation hardness assurance and maintenance techniques will be developed
- (6) Complete preparation of a ship superstructure hardening design guide
- (7) Experimentally verify expanded computer predictions of underwater reverberations
- (8) Continue to conduct thermal reflection tests/analysis for various coatings and new materials
- (9) Continue development of hardness assurance techniques for airblast, thermal and induced shock
- (10) Continue development of hardening methods for induced shock environments

d. (U) Program to Completion: This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984

Not applicable



# FY 1984 EDT&E DESCRIPTIVE SUMMARY

Program Element: 62765N

DoD Mission Area: 522 - Environmental and Life Sciences

Title: Energy and Environmental Protection Technology

Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                    | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                | 7,313          | 5,053            | 4,359            | 4,932            | Continuing               | Continuing           |
| F65-559     | Environmental Protection                 | 3,691          | 3,597            | 3,118            | 3,374            | Continuing               | Continuing           |
| F65-571     | Energy Technology                        | 2,747          | 1,456            | 1,441            | 1,558            | Continuing               | Continuing           |
| F65-573     | Pyrotechnics/Cartridge Activated Devices | 875            | -0-              | -0-              | -0-              | -----                    | -----                |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports requirements to assess and adapt energy conservation techniques and use alternative sources of energy to satisfy current and future Navy energy needs
- Develops technology needed to meet environmental protection legislation without mission degradation or undue drain on operations resources

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: FY 1983 reductions of 513 in project F65-559 and 205 in F65-571 and FY 1984 reductions of 1,138 in project F65-559 and 311 in project F65-571 result from programming funds to other program elements to support higher priority new initiatives. Project F65-573 has been transferred to Program Elements 62734N and 62241N. Other changes result from minor program and budget adjustments.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                    | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                | 6,550          | 7,443            | 6,451            | 6,728            | Continuing               | Continuing           |
| F65-559     | Environmental Protection                 | 4,096          | 3,876            | 4,110            | 4,256            | Continuing               | Continuing           |
| F65-571     | Energy Technology                        | 2,156          | 2,687            | 1,661            | 1,752            | Continuing               | Continuing           |
| F65-572     | Health Criteria Development              | 298            | -0-              | -0-              | -0-              | -----                    | -----                |
| F65-573     | Pyrotechnics/Cartridge Activated Devices | -0-            | 880              | 680              | 720              | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

## F. (U) RELATED ACTIVITIES

- Technology adapted in this element transitions to advanced and engineering development efforts in Program Element 63724N,

Program Element: 62765N

Title: Energy and Environmental Protection Technology

Navy Energy Program (Advanced); Program Element 63721N, Environmental Protection; Program Element 64710N, Navy Energy Program (Engineering); or directly to test and evaluate Fleet usage  
• Efforts are coordinated with Army, Air Force, Council of Environmental Quality, Environmental Protection Agency, Department of Energy, Department of Commerce, Department of Transportation, Department of the Interior, National Aeronautics and Space Administration, National Science Foundation, and Department of Health and Human Services through formalized interagency agreements

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Civil Engineering Laboratory, Port Hueneme, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Air Development Center, Warminster, PA; Naval Air Propulsion Center, Trenton, NJ; Naval Ocean Systems Center, San Diego, CA; Naval Ordnance Station, Indian Head, MD; Naval Weapons Support Center, Crane, IN; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA
- INDUSTRIAL - ARO, Inc., Tellahoma, TN; Bioresearch, Inc., Farmington, NY; Detroit Diesel Allison, Indianapolis, IN; Exxon Corporation, Linden, NJ; General Electric, Cincinnati, OH; Stanford Research Institute, Menlo Park, CA; United Technologies, West Palm Beach, FL
- ACADEMIC - Cornell University, Ithaca, NY; Duke University, Durham, NC; University of Hawaii, Honolulu, HI; University of Maryland, College Park, MD

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F65-559, Environmental Protection:

- This project provides the technology base necessary to support the National Environmental Policy Act.
- a. (U) FY 1982 Program:
  - (1) Completed evaluation of alternate recovery methods for electroplating process effluents. "Sulfide Precipitation Method" shows promise
  - (2) Completed feasibility study of techniques for shipboard engine test-stand noise suppression and transitioned promising design for full-scale evaluation
  - (3) Completed development of oil/water separator technology for combatant shipboard use
- b. (U) FY 1983 Program:
  - (1) Develop technology for oil/water separator for Navy small craft
  - (2) Assess environmental impact of leaching of new antifouling paints
  - (3) Develop techniques to reduce hazardous noise aboard Naval ships
  - (4) Develop methods to purify industrial wastewater contaminated by substances such as OTTO fuel and explosives
  - (5) Develop chemical and physical processes to separate and reclaim propellant, explosive, and pyrotechnic material
  - (6) Develop practical methods for measuring gas turbine engine exhaust emissions
  - (7) Develop technology to reclaim or minimize pollution from industrial wastes associated with aircraft and ship maintenance
  - (8) Develop technology for suppression of noise and engine exhaust products from jet engine test cells
- c. (U) FY 1984 Planned Program:
  - (1) Continue joint development with the Environmental Protection Agency, Army and Air Force on water/wastewater reuse concepts for shore installation

Program Element: 62765N

Title: Energy and Environmental Protection Technology

- (2) Initiate a toxic substances control program in response to Environmental Protection Agency regulations and Navy inventory survey
- (3) Develop methods to reuse, reclaim, or to eliminate waste propellant, explosive, and pyrotechnic materials that are currently discharged to the environment
- (4) Advance the technologies of shipboard noise control and abatement to determine more cost-effective means for noise control design

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F65-571, Energy Technology:

\* This project provides technology to meet the goals of the National Energy Program.

a. (U) FY 1982 Program:

- (1) Completed an assessment of the effects of fuel-bound nitrogen on the thermal stability of shale oil derived fuel and determined that concentrations of basic nitrogen compounds must be reduced for the jet fuel to be militarily acceptable

b. (U) FY 1983 Program:

- (1) Complete the development of new acceptance procedures for natural and synthetic fuels which will allow rapid and less costly evaluation of the effects of changes in fuel quality and source
- (2) Evaluate the impact of broadening Navy fuel specifications, considering the performance/durability impacts on operational equipment versus gains in fuel availability/costs
- (3) Improve the technology base concerning the chemical and physical relationships between fuels and their effect on power plant hardware performance to facilitate the evaluation of fuels derived wholly or in part from synthetic crudes

c. (U) FY 1984 Planned Program:

- (1) Continue to examine technology systems to significantly improve the energy efficiency and fuel flexibility of future Naval systems, operations and tactics. The goal is to allow continued improvements in mission capability in spite of anticipated reserve energy cost and availability problems
- (2) Continue technology assessment to improve the energy efficiency of the current fleet of Navy aircraft and transition promising concepts to advanced and engineering development
- (3) Evaluate impact of broadening Navy fuel specifications, considering the performance and durability impacts on operational equipment versus gains in fuel availability and costs
- (4) Improve technology base in chemical and physical property relationships of fuel and their effect on power plant hardware performance to facilitate the future evaluation of fuels derived wholly or in part from synthetic crudes
- (5) Continue investigation of stability and technology base aspects of current lithium batteries

d. (U) Program to Completion: This is a continuing program

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62766N Title: Laboratory Independent Exploratory Development  
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                               | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                                    | <b>11,967</b>  | <b>12,091</b>    | <b>13,146</b>    | <b>14,928</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| F66-111     | Naval Postgraduate School Independent Exploratory Development (IED) | 350            | 348              | 367              | 386              | Continuing               | Continuing           |
| F66-112     | Target Surveillance IED                                             | 1,706          | 1,800            | 2,543            | 2,920            | Continuing               | Continuing           |
| F66-119     | Navy Scientific Assistance Program IED                              | 1,575          | 1,587            | 1,668            | 1,759            | Continuing               | Continuing           |
| F66-212     | Command and Control IED                                             | 1,284          | 1,450            | 748              | 859              | Continuing               | Continuing           |
| F66-312     | Weaponry IED                                                        | 2,924          | 3,425            | 3,290            | 3,767            | Continuing               | Continuing           |
| F66-412     | Naval Vehicles IED                                                  | 1,508          | 1,350            | 2,332            | 2,699            | Continuing               | Continuing           |
| F66-512     | Support Technology IED                                              | 2,620          | 2,131            | 2,178            | 2,538            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Provide means for rapidly capitalizing on in-house ideas for solution of Navy and Marine Corps problems within the mission of the R&D Center
- Covers surveillance, command and control, weaponry, vehicles, and support technology
- Provide quick response development assistance to Navy and Marine Corps operational commands so that technology problems impacting immediate operational readiness can be solved expeditiously
- The work in this element is discretionary by the Technical Directors at the various Navy R&D centers. It is expended yearly on meritorious ideas as they emerge. Long range planning and multi-year efforts are inappropriate and, therefore, no FY 1984 plans appear in this summary.
- Anticipated and completed efforts are subject to intense review at the Centers. Completed efforts are subject to intense review by the Director of Navy Laboratories and the Chief of Naval Research

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary (\$4836 in FY 1984) are the result of refined estimates of cost, including escalation.

(337)

Program Element: 62766N

Title: Laboratory Independent Exploratory Development

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                                                               | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                           | 8,859          | 11,967           | 12,091           | 12,310           | Continuing               | Continuing           |
| F66-111     | Naval Postgraduate School Independent Exploratory Development (IED) | ---            | 350              | 348              | 346              | Continuing               | Continuing           |
| F66-112     | Target Surveillance IED                                             | 1,486          | 2,500            | 2,341            | 2,468            | Continuing               | Continuing           |
| F66-119     | Navy Scientific Assistance Program IED                              | ---            | 1,575            | 1,587            | 1,654            | Continuing               | Continuing           |
| F66-212     | Command and Control IED                                             | 647            | 640              | 702              | 726              | Continuing               | Continuing           |
| F66-312     | Weaponry IED                                                        | 2,987          | 2,640            | 2,649            | 2,688            | Continuing               | Continuing           |
| F66-412     | Naval Vehicles IED                                                  | 1,544          | 2,175            | 2,254            | 2,282            | Continuing               | Continuing           |
| F66-512     | Support Technology IED                                              | 1,995          | 2,087            | 2,210            | 2,146            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- A signal processing technique developed for passive superconducting gradiometers is being used in an exploratory development program for Non-Acoustic Submarine Detection
- A technique for determining soil moisture content has resulted in a continuing exploratory development task for the Marine Corps
- A charge-coupled device seeker has been repackaged into a flight-capable configuration and is a leading candidate for inclusion in the AIM-9M product improvement program (PE 63308N)
- A split-sterling cycle closed-operation cooler has completed development and is entering prototype production for the AIM-9M under Air Force funding
- Use of nonlinear acoustic signal enhancement techniques will continue development under PE 62711N
- Development of performance prediction models for electro-optical imaging systems will continue under PE 62762N
- Advanced infrared detector materials development is continuing in PE 62762N
- Solid fuel integral rocket ramjet technology for advanced fleet defensive and strike weapons co-sponsored by NAVSEA in PE 62331N, PE 62332N, and PE 62761N and by DARPA
- Exploratory development on a very high velocity ordnance system is continuing in PE 62332N

G. (U) WORK PERFORMED BY

- IN-HOUSE - Naval Civil Engineering Laboratory, Fort Monmouth, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Air Development Center, Warminster, PA; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; Navy Personnel Research and Development Center, San Diego, CA; Naval Surface Weapons Center, Dahlgren, VA; Naval Underwater Systems Center, Newport, RI; Naval Weapons Center, China Lake, CA; Naval Postgraduate School, Monterey, CA

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F66-111, Naval Postgraduate School Independent Exploratory Development

- This project comprises academic-based efforts in preliminary formulation of systems concepts, system feasibility, effectiveness, and experimental investigations of system feasibility
- It includes measurement techniques of the environmental phenomena for the purpose of determining feasibility and performance of Navy systems
- Work at the Postgraduate School is transitioned to other projects as appropriate

(240)

Program Element: 62766N

Title: Laboratory Independent Exploratory Development

a. (U) FY 1982 Program

- (1) Laser Doppler Velocimeter, to study the fluid mechanics of buoyant liquid plumes, was assembled
- (2) A towed body and associated probe and electronics, to measure horizontal turbulence distribution, was designed
- (3) A deterministic-predictive method was developed for fatigue under low stress random high cycle loading

b. (U) FY 1983 Program:

- (1)
- (2) Towed body will be used with the Postgraduate school ship to evaluate the effectiveness of new low-noise, low cost approach to the mapping of horizontal turbulence
- (3) A statistical-predictive method for low stress, random, high cycle fatigue will be developed that takes into account the variability of the fatigue damage index

c. (U) FY 1984 Planned Program:

- (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects.

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F11-112, Target Surveillance Independent Exploratory Development

- \* This project area comprises Independent Exploratory Development efforts in the Navy's RUT&S field activities essential to the encouragement of innovation in this Functional Area by laboratory scientific and engineering personnel

a. (U) FY 1982 Program:

- (1) Experiments with a smaller moving coil transducer have shown that the concept of non-conductive coilforms, graphite composite moving parts and fixed shafting significantly improve transducer reliability and performance
- (2) The telemetry for a low powered pulse amplitude modulated array and receiver has been developed and brassboard tests completed. Signal dynamic range of 70 db per channel for a 1000 ft. 4 channel array with up to 1000 Hz bandwidth indicate practical expansion of up to 40 channels is possible
- (3) Techniques have been developed to reduce the jamming vulnerability of air-to-surface tactical radars which will be incorporated into the A-6 update and F-18 programs
- (4) Acoustic backscatter spectra from a scale-model mine have been measured. The results will be used in the development of a theoretical model of acoustic scattering from mines for target classification
- (5) Models and synthesis requirements to stimulate the acoustic processors for wake homing torpedoes, surface ship mine countermeasures, and active-passive mines have been developed. This capability will provide the basis for effective countermeasures development

b. (U) FY 1983 Program:

- (1) Investigation into detection of buried mines was initiated

c. (U) FY 1984 Planned Program:

- (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects.

Program Element: 62766N

Title: Laboratory Independent Exploratory Development

- d. (U) Program to Completion: This is a continuing program.
3. (U) Project F66-119 Navy Scientific Assistance Program Independent Exploratory Development
- \* The Navy Scientific Assistance Program is directed toward providing rapid responses to requests for technological assistance in resolving problems encountered by selected fleet commands
- a. (U) FY 1982 Program:
- (1) More accurate and direct inputs to Navy Tactical Data System were developed and the extent of improvement obtained [using these inputs was determined]
  - (2) A transponder receiver system was demonstrated
  - (3) A plan was developed for the resolution of convergence zone surveillance contacts for a particular convergence zone
- b. (U) FY 1983 Program:
- (1) Twenty-five Navy scientists from nine R&D centers have been assigned to advise fleet units in the Atlantic, Pacific and Mediterranean Commands
- c. (U) FY 1984 Planned Program:
- (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects.
- d. (U) Program to Completion: This is a continuing program.
4. (U) Project F66-212 Command and Control Independent Exploratory Development
- \* This Project Area comprises Independent Exploratory Development efforts in the Navy's RDT&E field activities essential to the encouragement of the innovation in this Functional Area by laboratory scientific and engineering personnel
- a. (U) FY 1982 Program:
- (1) A multiple beam, extremely high frequency satellite antenna system for reception of shipboard satellite communications transmissions was designed
  - (2) Real-time large-screen projection visual imaging has been achieved using a laser-addressed liquid crystal light valve display system
  - (3) Automated reconfiguration and recovery of software for distributed avionics which provides a degraded mode capability was being supplied to the F-14 avionics improvement program
- b. (U) FY 1983 Program:
- (1) Alternate methods to improve signal-to-noise and bias stability of nuclear magnetic resonance devices is being investigated
  - (2) Application of Joint Tactical Information Data System waveforms to the ultra high frequency communication band is being studied
  - (3) Investigations of multiple sensor data transfer, processing and correlation for combat system artificial intelligence are continuing

Program Element: 62766N

Title: Laboratory Independent Exploratory Development

- c. (U) FY 1984 Planned Program:
  - (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects
- d. (U) Program to Completion: This is a continuing program.
- 5. (U) Project F66-312 Weaponry Independent Exploratory Development
  - \* This Project Area comprises Independent Exploratory Development efforts in the Navy's RDT&E field activities essential to the encouragement of innovation in this Functional Area by laboratory scientific and engineering personnel
  - a. (U) FY 1982 Program:
    - (1) Established hardware-in-the-loop simulating techniques for imaging infrared and semi-active radio frequency missile guidance
    - (2) Demonstrated capabilities to classify combatant ships, to a high assurance level, from radar, inverse synthetic aperture radar and imaging infrared sensors
    - (3) Developed a light level control device for focal-plane array seekers
    - (4) Prepared an alternate, less costly synthesis, for a promising new insensitive high explosive
    - (5) Demonstrated efficient combining techniques for radar power sources in active radio frequency missile seekers
    - (6) Successfully completed design, construction and testing of a unique water piston propulsor for underwater weapons
    - (7) Developed method for characterizing aging and deterioration of composite solid propellant surfaces utilizing X-ray photoelectron spectroscopy techniques
  - b. (U) FY 1983 Program:
    - (1) Continue development of microstrip integrated circuits, adaptive antenna arrays and impact diode circuits for missile applications
    - (2) Investigate advanced optical and dual mode infrared/radio frequency seekers and improved radio frequency radio frequency radomes
    - (3) Continue investigation of targeting enhancement techniques, algorithms for automatic classification, and gathering of data
    - (4) Initiate investigations in the areas of radiation cure of explosives, cathode surface treatment for high rate silver oxide-lead batteries and low cost fabrication technique for Vanadium-Gallium-Copper superconductor
    - (5) Initiate characterization of nonvolatile radiation resistant eight thousand bit crossbar random access memory
    - (6) Continue development of multi-color infrared detectors, fuses, and sensors suitable for use in high background clutter environments
  - c. (U) FY 1984 Planned Program:
    - (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects
  - d. (U) Program to Completion: This is a continuing program
- 6. (U) Project F66-412 Naval Vehicles Independent Exploratory Development
  - \* This Project Area comprises Independent Exploratory Development efforts in the Navy's RDT&E field activities essential to the encouragement of innovation in this Functional Area by laboratory scientific and engineering personnel



Program Element: 62766N

Title: Laboratory Independent Exploratory Development

a. (U) FY 1982 Program:

- (1) An analytical method for the design of advanced propulsors which significantly reduces the form drag of full-stern torpedoes was developed
- (2) An approximate, easy-to-use method was developed for estimating the ultimate strength of surface ship hulls in longitudinal bending. This capability is particularly suited for use in preliminary hull design and to define strength margins for both intact and damaged hulls
- (3) Investigations into alternate armor concepts provided the technological basis to defeat anti-ship missiles by a fourth generation ship hull armor protection concept with significant weight savings and potentially reduced fabrication and installation costs

b. (U) FY 1983 Program:

- (1) Develop a relatively simple and inexpensive airborne early warning aircraft concept with short takeoff and landing, several hours of loiter at high altitude and a relatively heavy payload by use of a circulation control wing
- (2) Reduce the risk in further development of a short-shaft propulsor system using contrarotating propellers and electric drive to reduce installed power required, fuel consumption, displacement and cost of ships
- (3) Develop integrated systems for pumping fluids in ships to reduce the weight, energy consumption, and maintenance problem
- (4) Demonstrate an advanced composite pressure hull for a deep submersible

c. (U) FY 1984 Planned Program:

- (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects

d. (U) Program to Completion: This is a continuing program.

7. (U) Project F66-512 Support Technology Independent Exploratory Development

- \* This Project Area comprises Independent Exploratory Development efforts in the Navy's RDT&E field activities essential to the encouragement of innovation in this Functional Area by laboratory scientific and engineering personnel

a. (U) FY 1982 Program:

- (1) A single stage expansion engine used as a helium refrigerator to cool superconductive magnets was operated with a microprocessor which controls valve timing, piston stroke and engine speed with improved efficiency over operating temperatures
- (2) A microcomputer program was developed to train officers to maneuvering procedures while enabling them to simultaneously view the relationship between the maneuvering board and the real world
- (3) Preliminary investigations were made into the potential impact on Navy office workers of automation, technological changes and word processing
- (4) Developed and tested a completely new castable radiation shield material, Polyethylene Filled Polyester (PEF), which is being transitioned to the fleet by the Shipboard Radiation Protection Program through ONR funding
- (5) Developed and tested magnetoresistive materials for use as the active element in a robotic force/torque sensor and a low power, low noise pressure sensor

Program Element: 62766N

Title: Laboratory Independent Exploratory Development

b. (U) FY 1983 Program:

- (1) Study Very High Speed Integrated Circuit application to large avionics systems.
- (2) Continue development of digital personnel dosimeter that capitalizes on semiconductor memory sensitivity to ionizing radiation

c. (U) FY 1984 Planned Program:

- (1) Will be planned during FY 1983 based on review of FY 1983 accomplishments and proposed projects.

d. (U) Program to Completion: This is a continuing program.

i. (U) PROJECT MORE THAN \$10 MILLION IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62768N Title: Directed Energy Technology  
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>5,965</b>   | <b>12,000</b>    | <b>14,636</b>    | <b>15,775</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| F68-311     | Directed Energy Concepts         | 0              | 200              | 587              | 0                | Continuing               | Continuing           |
| F68-342     | Laser Weaponry Technology        | 3,108          | 5,165            | 6,844            | 7,456            | Continuing               | Continuing           |
| F68-343     | Charged Particle Beam Technology | 200            | 1,615            | 1,564            | 2,052            | Continuing               | Continuing           |
| F68-344     | High Power Microwave Technology  | 830            | 2,300            | 2,806            | 3,434            | Continuing               | Continuing           |
| F68-345     | Pulsed Power Technology          | 1,827          | 2,720            | 2,835            | 2,833            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

## B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- The speed-of-light delivery of energy inherent in Directed Energy devices provides the potential for revolutionary capabilities against supersonic, highly maneuverable missiles particularly in crossing trajectories when these devices are coupled to a target acquisition system and high tracking rate beam-director designed to exploit the speed-of-light capability. In addition, the fact that directed energy devices use chemical fuels or electric power as an energy source offers a large "magazine" potential. These capabilities could offer an attractive alternative to conventional guns and missiles in meeting expected operational and technological advances in future threat systems; being a primary candidate for an early application of directed energy technology.
- The technology pursued in this element includes the development of high energy laser devices such as pulsed chemical lasers and free electron lasers; high power microwave devices; charged particle beam devices; and pulsed power technology. These devices, in general, are at an earlier state of development than continuous wave chemical lasers, such as the laser in Program Element 62735N, High Energy Laser Technology, but have the potential for enhanced effectiveness in terms of propagation through the atmosphere and enhanced coupling to targets as well as possible system advantages. The development of these devices, each at different power levels, wavelengths, pulse widths, and frequencies can support a variety of military applications including target destruction, surveillance, countermeasures, and communications.
- P.E. 62735N, High Energy Laser Technology, is a separate program element which is focused to demonstrate High Energy Laser lethality against realistic targets at the White Sands Missile Range

## C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows:
  - The net reduction of 2,916 in FY 1983 is the result of a Congressional reduction
  - Project F68-344, High Power Microwave Technology, was increased by 260 in FY 1982, 300 in FY 1983, and 1,106 in FY 1984
- This funding change is a restructure of the element.
- Funding shown in F68-311, Directed Energy Concepts, for FY 1983 and FY 1984 for work on laser component technology was transferred without change to F68-342, Laser Weaponry Technology.

Program Element: 62768N

Title: Directed Energy Technology

- The net increase in FY 1984 of 875 results from a new start in optical components for high peak-power pulsed-lasers; the enhanced effort in high power microwaves; and refinement of cost estimates.
- All other changes reflect minor adjustments characteristic of research and exploratory development.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY

| Project No. | Title                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT        | 0              | 5,997            | 14,916           | 13,761           | Continuing               | Continuing           |
| F68-311     | Directed Energy Concepts         | 0              | 0                | 716              | 611              | Continuing               | Continuing           |
| F68-342     | Laser Weaponry Technology        | (4,175)*       | 3,000            | 7,200            | 6,600            | Continuing               | Continuing           |
| F68-343     | Charged Particle Beam Technology | (508)*         | 600              | 1,800            | 1,800            | Continuing               | Continuing           |
| F68-344     | High Power Microwave Technology  | (650)*         | 570              | 2,000            | 1,700            | Continuing               | Continuing           |
| F68-345     | Pulsed Power Technology          | (2,000)*       | 1,827            | 3,200            | 3,050            | Continuing               | Continuing           |

\* Work on these projects for FY 1981 was funded under other elements

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES

- The Defense Advanced Research Projects Agency sponsors work in the development of particle beam weapon and visible free electron laser device technology. The Defense Advanced Research Projects Agency has overall management responsibility in DOD for coordinating the National Particle Beam Technology Program of which the Navy program is a part
- The Navy SEA LITE program is conducting a lethality demonstration of continuous-wave chemical-lasers, P.E. 62735N, High Energy Laser Technology
- The Office of Naval Research continues to fund long-term efforts to resolve propagation problems, develops technology for compact accelerators for particle beam application, funds free electron laser research, and is sponsoring a scaling demonstration experiment for excimer lasers
- The Army is funding in P.E. 62307A work starting in FY 1983 for an Army-Navy coordination and planning committee for pulsed chemical lasers has been established
- The Army and Navy have a coordinated program in investigating the
- All DOD-Directed Energy programs are coordinated and reviewed by the Deputy and Assistant for Directed Energy Weapons of the OUSD/WE

G. (U) WORK PERFORMED BY

- IN-HOUSE - Lead Laboratory: None. Others: Lawrence Livermore National Laboratory, Livermore, CA; Los Alamos National Laboratory, Los Alamos, NM; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA
- INDUSTRIAL - Lead Laboratory: None. Others: Boeing, Seattle, WA; BNL, Salem, MA; General Dynamics, Pomona, CA; Physics International, Palo Alto, CA; SAI, San Diego, CA; STD, Pasadena, CA; TRW, Los Angeles, CA; Lincoln Laboratories, Massachusetts Institute of Technology, Lexington, MA;
- ACADEMIC - Old Dominion University, Norfolk, VA; University of California, Santa Barbara, CA; University of Texas, Austin, TX; U.S. Naval Academy, Annapolis, MD; Texas Tech University, Lubbock, TX

Program Element: 62768H

Title: Directed Energy Technology

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984

1. (U) Project F68-311, Directed Energy Concepts:

- Investigates Navy requirements for directed energy weapons in space and other long-range applications
- Provides Navy scenarios and directed energy device parameters to directed energy projects managed by other services and DARPA

a. (U) FY 1982 Program:

- (1) This is a new start in FY 1983

b. (U) FY 1983 Program:

(1) [

(2) [

c. (U) FY 1984 Planned Program:

- (1) Identify specific technology requirements which could serve as Navy inputs to the DARPA/Air Force space based laser program

d. (U) Program to Completion: This is a continuing program.

2. (U) Project F68-342, Laser Weaponry Technology:

- This project develops the technology for advanced laser concepts that offer the potential of improved performance and/or system advantages over state-of-the-art continuous wave chemical lasers
- Continues development of pulsed chemical lasers which are expected to be more effective than their continuous wave counterparts in terms of propagation and damage, and which may provide [
- Develops advanced free electron lasers which offer accessibility to millimeter wave as well as infrared and visible wavelengths, and tunability not available to chemical lasers [
- Develops components to advance the capabilities of pulsed and continuous wave lasers; investigates laser cavities, advanced laser nozzles, beam handling, mirror coatings, and adaptive optics

a. (U) FY 1982 Program:

- (1) The gas handling system and gas mixer for the deuterium fluoride pulsed chemical laser at Boeing was completed for a 100 liter device
- (2) Cold flow interferometry of the Boeing device showed all density profiles to meet specifications
- (3) Reliable repetitive pulse operation was achieved on the 50 liter pulsed chemical laser at TRW with operation at 50 pulses per second for a one second burst
- (4) Repeated single pulse testing at TRW on aircraft aluminum showed high coupling with over 20 repeated pulses in a wind tunnel
- (5) Preliminary data shows that a 50 Megawatt/square centimeter beam at a wavelength of 3.8 micro-meters can be propagated over the ocean without aerosol breakdown

Program Element: 62768N

Title: Directed Energy Technology

- (6) Wide tunability over 60-100 Gigahertz has been demonstrated on a super-radiant free electron laser with a linewidth spread of 6%
- (7) The efficiency of this free electron laser has been doubled over the past year

b. (U) FY 1983 Program:

- (1) Perform power extraction, mirror analysis, and preliminary beam quality tests on the Boeing 100 liter pulsed chemical laser
- (2) Perform single and repetitive pulsed damage tests on window and mirror candidates for pulsed chemical lasers
- (3) Perform damage and vulnerability testing of basic aerospace materials from a pulsed chemical laser
- (4) Initiate infrared free electron laser technology for a single stage device including wiggler development, optical diagnostics, and wavelength scaling
- (5) Continue development of a high power millimeter wave free electron laser oscillator and complete a study of saturated efficiency and coherence
- (6) Both short and long pulse millimeter-wave free electron laser amplifiers will be designed and a short pulse amplifier will be fabricated
- (7) Initiate advanced optics components development program with development of a solid state optical waveguide interferometer to be used as a wavefront analyzer

c. (U) FY 1984 Planned Program:

- (1) Complete technology studies on Boeing and TRW pulsed chemical lasers and initiate program for single contractor high power device
- (2) Select window and mirror materials for pulsed chemical lasers
- (3) Perform propagation tests for thermal blooming for a pulsed chemical laser
- (4)
- (5)
- (6) Continue technology of infrared free electron lasers with studies of emittance and instability effects, and accelerator design parameters
- (7) Work on high power millimeter wave free electron laser oscillators will be deferred
- (8) Initiate the development of advanced continuous wave chemical laser nozzles which will give better beam quality, have more structural rigidity, and be less costly than the current nozzle technology
- (9) Fabricate a 20 element wave guide array for measurements at infrared wavelengths
- (10) Initiate the development of advanced cooled mirrors and actuators required to support a broad range of adaptive optic applications for continuous wave and pulsed lasers

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F68-343, Charged Particle Beam Technology:

- \* Charged particle beam weapons represent the highest payoff as well as the highest risk in directed energy technology with expected near instantaneous catastrophic kills due to in-depth energy deposition
- \* The Navy support of the DARPA coordinated National Charged Particle Beam Technology Program

Program Element: 62768N

Title: Directed Energy Technology

a. (U) FY 1982 Program:

- (1) Initiated the Navy portion of the integrated Navy-DARPA program in Charged Particle Beams at reduced funding level from FY 1983 summary
- (2) Completed simple model of non-relativistic beam effects on materials and started coding for the relativistic beam case
- (3)

b. (U) FY 1983 Program:

- (1) The Lawrence Livermore National Laboratory will be funded to build a materials interaction beam line for the Experimental Test Accelerator
- (2)
- (3)
- (4) The analysis of propagation stability for Wide Interval Pulse trains will be completed
- (5)
- (6) Studies will be initiated to develop fire control technology including beam sensing and beam control to be incorporated in the Advanced Test Accelerator during the FY 1986-1987 time frame

c. (U) FY 1984 Planned Program:

- (1) Construction of the material interaction beam leg at the Experimental Test Accelerator will be completed and interaction experiments will be initiated
- (2) Complete construction of an X-ray cineradiography camera for use as a material interaction diagnostic
- (3)
- (4) Initiate development of beam control hardware suitable for use with the Advanced Test Accelerator
- (5) Evaluate potential Naval applications of particle beam weapons for intrinsic merit and competitiveness with other weapon concepts for specific missions

d. (U) Program to Completion: This is a continuing program.

4. (U) Project F68-344, High Power Microwave Technology:

- 
- 

a. (U) FY 1982 Program:

- (1) The initial experiments on
- (2) Program initiated with General Dynamics to develop
- (3) The 35 Gigahertz gyrotron was upgraded from 150 to 350 Kilocatts and the pulse length extended from 1 to 13 micro-seconds

Program Element: 62768N

Title: Directed Energy Technology

b. (U) FY 1983 Program:

- (1) Initial effects testing at General Dynamics will concentrate on [
- (2) Naval Research Laboratory will establish a test facility for microwave damage experiments using the existing sources of 35 Gigahertz and 94 Gigahertz with power levels of [
- (3) [ the planned program will build on Army (Harry Diamond Laboratory) activities
- (4) Complete the conceptual and detailed design of a [
- (5) Technology for an ultra-high power millimeter-wave source will be initiated with design of an advanced electron gun and high emissivity cathodes

c. (U) FY 1984 Planned Program:

- (1) Complete fabrication of the [
- (2) Continue lethality studies, [ initiate an analytical effort in parallel
- (3) Continue General Dynamics effort and conduct a theoretical effort to extrapolate results to other conditions
- (4) Continue ultra-high power millimeter-wave source technology and extend work to include vacuum breakdown studies, radiative output components, and a high-voltage modulator

d. (U) Program to Completion: This is a continuing program.

3. (U) Project F66-345, Pulsed Power Technology:

- This project is designed to develop all the elements of a pulsed power system needed to supply energy to electrically driven directed energy weapons such as charged particle beams and free electron lasers
- The technology issues include prime power sources, energy storage, switching, pulse conditioning, and pulsed power systems

a. (U) FY 1982 Program:

- (1) In prime power, the full-scale combustor for a 10 Megawatt magneto-hydrodynamic generator has been fabricated and has successfully demonstrated a multiple start-stop capability
- (2) In energy storage, very long intrinsic time constants (tens of milli-seconds) were achieved with cooled water glycol mixtures; this will result in significant simplification and size reduction of pulsed power systems
- (3) In switching, voltage hold-off per stage has been improved to 50 kilovolts per stage for a five stage Hydrogen Thyatron; significant progress has also been achieved in spark gap switches

b. (U) FY 1983 Program:

- (1) In prime power, perform the first full-scale power extraction test for the 10 Megawatt magneto-hydrodynamic generator
- (2) In energy storage, perform repetitive breakdown studies incorporating a cooled water/glycol dielectric; scaling laws for liquid-filled pulse forming networks under long-term charging conditions will be established
- (3) In switching, a five-stage prototype Thyatron capable of holding off 250 Kilovolts at a low pulse rate will be delivered
- (4) In switching, work will initiate in an electron-beam controlled opening switch for use in highly compact pulsed inductive storage systems



Program Element: 62768N

Title: Directed Energy Technology

- (5) A testing facility with a 200 Kilowatt average power capability will be brought on-line at the Naval Surface Weapons Center at Dahlgren, VA

c. (U) FY 1984 Planned Program:

- (1) In prime power, pending successful testing of the 10 Megawatt magneto-hydrodynamic generator, design and initiate fabrication of a
- (2) In energy storage, initiate the development of a 5 Megajoule fast-discharge compensated pulsed alternator and a 30 Megajoule homopolar generator; this work is coupled to the previous work in water/glycol pulse forming lines and will lead to a high-density, high-energy demonstration system
- (3) In switching, work on the 1-10 Kilohertz opening switch prototype will continue

d. (U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63202H  
DoD Mission Area: 551 - Electronic and Physical Sciences

Title: Avionics  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                                        | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                              | 4,181          | 3,150            | 3,834            | 5,196            | Continuing               | Continuing           |
| W0525                     | Advanced Technology Demonstration Laser Gyro | 2,952          | 2,658            | 3,834            | 5,196            | Continuing               | Continuing           |
| W0597                     | Advanced Integrated Display System           | 1,229          | 492              | 0                | 0                | TBD                      | TBD                  |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced avionics systems are developed under this program element with the primary objective of upgrading combat effectiveness at minimum cost. The current and planned projects are those addressing the most critical needs with optimum exploitation of the opportunities afforded by maturing technology.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary result from the following changes: For FY 1982, a total program element overall increase of 436 resulted from refined cost estimates including inflation adjustments (a decrease of 17 for Project W0597 and an increase of 453 in Project W0525). For FY 1983, a decrease in project W0597 of 672 resulted from budgetary constraints during budget development to fund higher priority programs. For FY 1984, a total decrease of 6,508 resulted from budgetary constraints during budget development as follows: a decrease of 1,333 for Project W0525 (Advanced Technology Demonstration Laser Gyro), a decrease of 2,247 (zeroed) for Project W0597 (Advanced Integrated Display System), and a decrease of 2,928 (zeroed) for Project W1400 (Joint Tactical Information Distribution System - Weapon Control System).

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                                        | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                              | 3,314          | 3,745            | 3,822            | 10,342           | Continuing               | Continuing           |
| W0525                     | Advanced Technology Demonstration Laser Gyro | 3,314          | 2,499            | 2,658            | 5,167            | Continuing               | Continuing           |
| W0577                     | Advanced Aircraft Electrical System          | 0              | 0                | 0                | 0                | Continuing               | Continuing           |
| W0597                     | Advanced Integrated Display System           | 0              | 1,246            | 1,164            | 2,247            | Continuing               | Continuing           |
| W1400                     | JTIDS Weapon Control System                  | 0              | 0                | 0                | 2,928            | 14,584                   | 17,512               |

E. (U) OTHER FY 1984 APPROPRIATION FUNDS: None.

F. (U) RELATED ACTIVITIES: Advanced Technology Demonstration Laser Gyro, Project W0525 - Related development work is being performed under Program Element 62721H, Command and Control Technology, Program Element 62204F, Aerospace Avionics; and Program Element 63203F, Advanced Avionics for Aircraft. Coordination is maintained with related guidance developments utilizing Ring Laser Gyro Technology under the Joint Service Medium Range Air-to-Surface Missile Program. Advanced Integrated Display System, Project W0597 - Related to United States Air Force Advanced Development program, Digital Avionics Information System.

Program Element: 63202H

Title: Avionics

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Weapons Center, China Lake, CA; Naval Air Development Center, Warminster, PA; Naval Avionics Center, Indianapolis, IN; Naval Air Test Center, Patuxent River, MD. CONTRACTORS: Honeywell, Inc., Minneapolis, MN; Singer-Kearfott Co., Little Falls, NJ; Litton Industries, Woodland Hills, CA; McDonnell-Douglas Corporation, St. Louis, MO; General Electric Aircraft Equipment Division, Utica, NY; Hughes Aircraft Co., Aerospace Group, Culver City, CA; Intermetrics Corporation, Cambridge, MA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0525, Advanced Technology Demonstration Laser Gyro: This project is using new inertial sensor capabilities to develop a low-cost series of standardized systems for a broad base of navigation and strike avionics. The program currently has two major thrusts to capitalize on maturing laser gyro technology: (1) the Integrated Inertial Sensor Assembly, to provide common, high reliability inertial sensor units for aircraft and (2) High Performance Sensors and Systems, to develop precision accuracy inertial navigation/guidance equipment for advanced cruise missiles and combat aircraft.

(U) In FY 1982, a contract was awarded and work was begun for design and fabrication of the Inertial Sensor Assembly advanced development model. A baseline design was established for alternate source laser gyros, and software was developed for at-sea initialization of laser gyro inertial navigation systems.

(U) The FY 1983 program consists of:

- o Continuing design and fabrication of the Integrated Inertial Sensor Assembly.
- o Continuing Alternate Source Laser Gyro development and test.
- o Transition of High Performance Sensors and Systems Task from studies into design and fabrication.

(U) For FY 1984, it is planned to:

- o Complete build of Integrated Inertial Sensor Assembly and begin laboratory and flight evaluations.
- o Complete Alternate Source Laser Gyro evaluation and review for limited production approval.
- o Continue development, test and evaluation of High Performance Laser Gyro Sensors and Systems.

(U) Program to Completion:

- o Complete flight test and evaluation of the Integrated Inertial Sensor Assembly.
- o Complete development and test of precision High Performance Laser Gyro Sensors and Systems.
- o Develop high performance, quick reaction accelerometers.
- o Develop second generation low-cost, missile-grade laser gyros.

(U) Project W0597, Advanced Integrated Display System: This project is developing advanced cockpit and crew station instrumentation systems with versatile multifunction controls and information displays to provide a state-of-the-art cockpit and crew station environment in future Navy aircraft and in current aircraft which will undergo the Service Life Extension Program or Conversion in Lieu of Procurement (such as F-14, S-3, etc.).

Program Element: 63202N

Title: Avionics

(U) In FY 1982, the cockpit equipment has been installed and integrated; in the area of hardware technology, the diffraction options for the head-up-display has been ground base tested and flight tested in the F-18 aircraft; in the software area, the display formatter has been tested and demonstrated.

(U) The FY 1983 program consists of:

- o Continuing hardware and software integration.
- o Continuing system integration and evaluation.
- o Demonstration of system for F-18 aircraft.

(U) The FY 1984 program plans: Program presently not funded in FY 1984 and subsequent years.

(U) Program to completion: This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

FY 1984 BDT&E DESCRIPTIVE SUMMARY

Program Element: 63207N Title: Environmental Applications  
DoD Mission Area: 552 - Environmental and Life Sciences Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                           | 5,261          | 5,653            | 8,086            | 9,922            | Continuing               | Continuing           |
| W0512                     | Tactical Environmental Support System     | 1,748          | 1,625            | 1,539            | 2,213            | Continuing               | Continuing           |
| W0513                     | Automated Environmental Prediction System | 1,319          | 1,516            | 1,957            | 2,285            | Continuing               | Continuing           |
| W0514                     | Meteorological Measuring System           | 842            | 1,134            | 1,955            | 1,827            | Continuing               | Continuing           |
| W0527                     | Remote Ocean-Surface Measuring System     | 1,240          | 1,120            | 1,956            | 2,821            | Continuing               | Continuing           |
| X0948                     | Precise Time and Time Interval            | 112            | 258              | 270              | 314              | Continuing               | Continuing           |
| S1586                     | Future Integrated Navigation System       | 0              | 0                | 409              | 462              | Continuing               | Continuing           |

As this is a continuing program the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The element consists of four related projects which provide environmental support for global naval operations; i.e., assessment and exploitation of environmental effects on weapon systems, environmental data collection technology, and remote sensing of the ocean/atmosphere environment. A fifth project, Precise Time and Time Interval, will upgrade the Department of Defense time standard operated by the Naval Observatory to the accuracy required by modern communications and weapon systems. The sixth project, Future Integrated Navigation Systems, will upgrade and integrate components of conventional navigation systems onboard surface ships.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and this Descriptive Summary are as follows: The total program for FY 1982 increases by 577. This is the result of reprogramming funds in the following individual projects: W0512 Tactical Environmental Support System increased by 806 due to a decision to transfer the functional responsibility for development of a shipboard environmental display system from W0514 Meteorological Measuring System to W0512. The decrease of 229 in W0514 Meteorological Measuring System is the net result of the transfer of 806 to W0512 and an increase of 577 to support development of wind measuring equipment for use aboard aircraft carriers. The total program for FY 1983 decreases by 1,441. This figure is the result of inflation changes to individual projects of 347 and a Congressional reduction of 1094. The total program for FY 1984 decreases by 1530. This is the result of reprogramming funds from the following individual projects to establish an Engineering Development Project W1752 for the Tactical Environment Support System under Program Element 64218N: W0512 decreased by 154; W0513 decreased by 407; W0514 decreased by 540 and W0527 decreased by 414.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                           | 4,654          | 4,684            | 7,094            | 9,616            | Continuing               | Continuing           |
| W0512                     | Tactical Environmental Support System     | 1,168          | 942              | 2,353            | 1,693            | Continuing               | Continuing           |
| W0513                     | Automated Environmental Prediction System | 1,180          | 1,319            | 1,616            | 2,364            | Continuing               | Continuing           |
| W0514                     | Meteorological Measuring System           | 643            | 1,071            | 1,134            | 2,495            | Continuing               | Continuing           |
| W0527                     | Remote Ocean-Surface Measuring System     | 1,163          | 1,240            | 1,684            | 2,370            | Continuing               | Continuing           |
| X0948                     | Precise Time and Time Interval            | 110            | 112              | 258              | 276              | Continuing               | Continuing           |
| S1586                     | Future Integrated Navigation System       | 0              | 0                | 49               | 418              | Continuing               | Continuing           |

Program Element: 63207N

Title: Environmental Applications

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                     | <u>FY 1982<br/>Actual</u> | <u>FY 1983<br/>Estimate</u> | <u>FY 1984<br/>Estimate</u> | <u>FY 1985<br/>Estimate</u> | <u>Additional<br/>to<br/>Completion</u> | <u>Total<br/>Estimated<br/>Cost</u> |
|---------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------------------|-------------------------------------|
| OPN (BA 2) (333033) | 913                       | 940                         | 965                         | 964                         | 200                                     | 6,280                               |
| OPN (BA 2) (333318) | 1,043                     | 1,091                       | 0                           | 0                           | 0                                       | 2,134                               |

F. (U) RELATED ACTIVITIES: Program Element 35160N, Defense Meteorological Satellite Program, Project W0524, Defense Meteorological Satellite Program - Navy Support. Program Element 35111N, Weather Service, Project W0523, Satellite Data Processing System. Program Element 64218N, Environmental Systems, Project W0532, Environmental Equipment Support. Program Element 62759N, Ocean and Atmospheric Support Technology. Program Element 61153N, Defense Research Sciences.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; Naval Oceanographic Office, Bay St. Louis, MS; Naval Environmental Prediction Research Facility, Monterey, CA; Naval Air Development Center, Warminster, PA; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Fleet Numerical Oceanography Center, Monterey, CA; Naval Research Laboratory, Washington, DC; Naval Observatory, Washington, DC; CONTRACTORS: None.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0512, Tactical Environmental Support System: This project provides for the development of a shipboard, modular, highly automated, interactive environmental data handling system which will support the multi-mission needs of various ship types. This project will develop software to convert oceanic and atmospheric observations into weapon/sensor system performance parameters. This information will be used by the Battle Group Commander to optimize weapon/sensor selection and tactical positioning.

(U) In FY 1982, hardware was designed and its procurement initiated; software development was continued for the Advanced Development Model.

(U) The FY 1983 program consists of:

- o Integrating the Advanced Development Model hardware.
- o Completing development of first phase of the executive software.
- o Continuing development of application software.

(U) For FY 1984, it is planned to continue:

- o Completing development of first phase of the application software.
- o Completing development of second phase of the executive software.
- o Integrating and demonstrating the Advanced Development Model hardware and software.

(U) Program to completion: This is a continuing program.

(U) Project W0513, Automated Environmental Prediction System: This project provides for the design and development of a modern Numerical Prediction System to provide environmental predictions to Navy Command and Control. This project will develop

Program Element: 63207H

Title: Environmental Applications

the software modules to analyze and predict the state of the atmosphere and ocean over the globe. Navy interest is in the Marine Boundary Layer where ships and aircraft operate.

(U) In FY 1982, completed development and commenced operation of the Navy Operational Global Atmospheric Prediction System. Completed operational evaluation of the Tropical Cyclone model.

(U) In FY 1983, development continues with evaluation of the Navy Operational Regional Atmospheric Prediction Subsystem, the Local Atmospheric Prediction subsystem, the mixed-layer ocean prediction model and the Northern Hemisphere polar ice prediction model.

(U) For FY 1984, It is planned to continue:

- o Developing capability for the Global Prediction System to interact with the Regional Prediction System to improve regional forecast accuracy.
- o Incorporating stratospheric-tropospheric interactions into the Global Atmospheric Prediction System.
- o Development of regional ice forecast models, e.g., Bering Sea.
- o Evaluation of global hydrodynamic ocean model.

(U) Program to completion: This is a continuing program.

(U) Project W0314, Meteorological Measuring System: This project provides for the development of airborne and shipborne sensors to measure variability in the local environment. These environmental parameters are needed to predict environmental effects on weapon system performance in support of the task force commander. Included is the development of a system for processing/displaying/storing and communicating environmental information and weapon system performance indices.

(U) In FY 1982, completed development of executive and application software for the Naval Environmental Display Station family. Demonstrated the feasibility of upgrading the performance of the Naval Environmental Display Station. Investigated several alternatives to meet Navy requirements for the upper air measuring system and prepared a plan to develop the most cost-effective alternative.

(U) The FY 1983 program consists of initiating development of the upper air mini-sonde system prototype in accordance with the above plan.

(U) For FY 1984, it is planned to continue:

- o Developing the upper air mini-sonde system prototype.
- o Design and development of a laser radar (lidar) atmospheric profiler and a shipboard meteorological and oceanographic observing system.

(U) Program to completion: This is a continuing program.

(U) Project W0527, Remote Ocean-Surface Measuring System: This project provides for the development of a capability to measure and process ocean surface and marine boundary layer parameters from data provided by operational environmental satellites. In addition, this project provides technology to integrate oceanographic sensors into planned DoD and other national environmental satellites.

(U) In FY 1982, developed algorithms to test satellite altimeter data and convert ocean height information into tactically useful options for Antisubmarine Warfare.

Program Element: 63207M

Title: Environmental Applications

(U) In FY 1983, continue development of software to process satellite altimeter data. Evaluate techniques to derive atmospheric winds and sea surface temperature. Investigate satellite sensors to obtain marine boundary layer humidity measurements to support electro-optic weapon systems.

(U) For FY 1984, it is planned to continue:

- o Evaluating derived oceanographic products produced from satellite altimetry data.
- o Testing techniques for obtaining atmospheric winds from geostationary and polar orbiting satellites.
- o Development of algorithms to extract parameters for electro-optic weapon systems.

(U) Program to completion: This is a continuing program.

(U) Project X0948, Precise Time and Time Interval: This project provides for the upgrade of the U.S. Naval Observatory's Master Clock System from Y-9X10 (to the minus 14) to IX10 (to the minus 16) as a reference system for the Department of Defense including Navy Surface, Subsurface, Air and Shore Platform Communications, Navigation and Weapon Systems, time and frequency requirements.

(U) In FY 1982 purchased and installed the Second Environmentally Controlled Monitor Station. Continued Data Acquisition System hardware and software integration. Purchased two Hydrogen-Masers using related OPN funds.

(U) The FY 1983 program consists of:

- o Acquiring a Mercury Stored ION Device.
- o Continuing Data Acquisition System and Time Scale Integration.
- o Installing and integrating the two Hydrogen-Masers.

(U) For FY 1984, it is planned to continue:

- o Installing and performing system integration and testing on the Mercury Stored ION Device.
- o Acquiring the improved Cesium Beam Frequency Standard or Superconducting Cavity Oscillator.

(U) Program to completion: This is a continuing program.

(U) Project 81586, Future Integrated Navigation System: This project provides for the design and development of improved conventional navigation aids (digital sextant, alidade, plotting devices, etc.) and for the integration of present and future navigation sensors and systems aboard surface ships. This will enable more efficient use of existing navigation sensors and systems and will provide improved navigation capabilities to those ships which do not have sophisticated navigation devices (satellite receivers and other radio aids) or which lose access to such devices due to equipment failure or enemy action.

(U) The FY 1983 program consists of project planning and requirements definition. This project is a new start in FY 1983.

(U) The FY 1984 program consists of system definition and design.

(U) Program to completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984. Not applicable.



# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63210N  
DoD Mission Area: 553 - Engineering Technology

Title: Advanced Aircraft Propulsion Systems  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                 | 9,551          | 10,113           | 6,058            | 20,532           | Continuing               | Continuing           |
| W0580       | Joint Technology Demonstrator Engine      | 5,906          | 5,364            | 3,424            | 7,142            | Continuing               | Continuing           |
| W0582       | Propulsion Component Technology           | 1,954          | 1,538            | 0                | 0                | Continuing               | Continuing           |
| W1548       | Multiple Application Core Engine          | 591            | 1,021            | 983              | 13,390           | 340,509                  | 356,494              |
| W1631       | Increased Capability Auxiliary Power Unit | 1,100          | 2,190            | 1,651            | 0                | 0                        | 4,941                |

As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work and development phases now planned or anticipated through 1985 only, except for Projects W1548 and W1631, for which the above funding includes all work or development phases now planned or anticipated.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element provides for the advanced development of components for aircraft propulsion systems applicable to current and future Navy needs (W0582, Propulsion Component Technology) as well as a means for enhancing propulsion systems capability through advanced technology demonstrator engines which provide a realistic integrated performance and structural assessment of these components (W0580, Joint Technology Demonstrator Engine). Work under Project W0582 is coordinated with the Air Force. Work under Project W0580 is joint with the Air Force. These technology demonstrator engines are applicable to broad classes of future Naval aircraft systems. Contained within the element is a joint Navy/Air Force project (W1548, Multiple Application Core Engine) for development of a Joint Long Range Propulsion Plan which will lead to the design and fabrication of early prototype versions of the next generation of large, high-thrust engines using a common, multiple application engine core. Also within the element is a project (W1631, Increased Capability Auxiliary Power Unit) which provides for the development of an increased capacity auxiliary power unit for the S-3A aircraft, to increase aircraft avionics cooling capability and to power the aircraft independent of ground support equipment.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: A net increase in the Program Element of \$61 in FY 1982 was due to an increase of \$100 for the Increased Capability Auxiliary Power Unit and budgetary adjustments in other projects. A net decrease of \$424 in FY 1984 was due to budget constraints. In FY 1984, Project W0580 was decreased by \$2,885 and Project W0582 was decreased by \$2,076 due to a Navy decision to transfer these amounts into a higher priority program, and Project W1631 was increased by \$60 to enable the program to complete in FY 1984 as originally planned.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                   | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT               | 14,504         | 8,990            | 10,113           | 10,182           | Continuing               | Continuing           |
| W0580       | Joint Technology Demonstrator Engine    | 9,419          | 6,033            | 5,364            | 6,309            | Continuing               | Continuing           |
| W0582       | Propulsion Component Technology         | 5,085          | 2,167            | 1,538            | 2,076            | Continuing               | Continuing           |
| W1548       | Multiple Application Core Engine        | 0              | 790              | 1,021            | 1,006            | 328,443                  | 331,265              |
| W1631       | Increased Capacity Auxiliary Power Unit | 0              | 0                | 2,190            | 791              | 2,800                    | 5,781                |

E. (U) OTHER FY 1983 APPROPRIATIONS FUNDS: None.

Program Element: 63210N

Title: Advanced Aircraft Propulsion Systems

F. (U) RELATED ACTIVITIES: W0580, Joint Technology Demonstrator Engine - Contains related work in W0582, Propulsion Component Technology; PE 63202P, Aircraft Propulsion Subsystem Integration; and PE 63216P, Advanced Turbine Engine Gas Generator. W0582, Propulsion Component Technology - The Air Force has the Advanced Turbine Engine Gas Generator, PE 63216P, and Aircraft Propulsion Subsystem Integration, PE 63202P, underway. These elements are involved with the development and evaluation of advanced propulsion system components. The Navy program coordinates the use of, and incorporates, these components and their related technology insofar as possible. Very close coordination is maintained between the Navy and the Air Force. Air Force and Navy representatives review and concur in proposed work statements, and participate in the evaluation of proposals and the selection of contractors. A Joint Navy/Air Force Turbine Engine Advanced Development Plan has been developed. This plan defines both Navy and Air Force technology and demonstrator engine programs, and advanced component technology for joint or single service support. Outyear plans for both services reflect and include joint service requirements. W1548, Multiple Application Core Engine - This is a joint program with the Air Force. W1631, Increased Capability Auxiliary Power Unit - No related Air Force activities.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Air Propulsion Center, Trenton, NJ; Naval Air Development Center, Warminster, PA; Naval Postgraduate School, Monterey, CA; Naval Air Test Center, Patuxent, MD. CONTRACTORS: General Electric Company, Evendale, OH; Detroit Diesel Allison Division, Indianapolis, IN; Teledyne/CAE, Toledo, OH; Pratt and Whitney Aircraft, West Palm Beach, FL; Garrett Turbine Engine Company, Phoenix, AZ.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0580, Joint Technology Demonstrator Engine: This project provides for the structural and performance evaluation of advanced technology propulsion system components in an integrated engine environment.

(U) In FY 1982, fabrication of the Joint Technology Demonstrator Engine IA engines at the contractors' plants were continued. Several performance runs were conducted at Teledyne/CAE.

(U) The FY 1983 program consists of:

- o Performance and structural tests at all of the contractors' plants.
- o Completion of the design and analysis of the GE Joint Technology Demonstrator Engine Build 3 Mod A high pressure turbine.

(U) For FY 1984, it is planned to:

- o Complete performance and structural testing of the Joint Technology Demonstrator Engine IA.
- o Initiate design and analysis of the Joint Technology Demonstrator IB.
- o Continue fabrication of the GE Joint Technology Demonstration Engine Build 3 Mod A (Applications Concept Vehicle).

(U) Program to Completion: This is a continuing project.

(U) Project W0582, Propulsion Component Technology: This project provides for the design and advanced development of propulsion system components which are necessary to support Navy mission needs.

(U) In FY 1982, testing of the Full Authority Digital Controls was completed. Work was initiated on development of large size monocrystal blades.

Program Element: 63210N

Title: Advanced Aircraft Propulsion Systems

(U) The FY 1983 program consists of:

- o Continued development of the large size monocrystal turbine blades.
- o Characterization of production properties for monocrystal coatings for turbine blades and for small size monocrystal turbine blades.
- o Initiation of an analysis/test program for engine radar cross section reduction.

(U) The FY 1984 program plans: Program presently not funded in FY 1984 and subsequent years.

(U) Project W1548, Multiple Application Core Engine: This project provides for the development of a Joint Long Range Propulsion Plan, which will lead to the design and fabrication of early prototype versions of the next generation of large high-thrust engines using a common, multiple engine core.

(U) In FY 1982, the first phase of the overall program, or Advanced Technology Engine Studies, was completed. The second phase, or Propulsion Assessment for Tactical Systems was initiated.

(U) The FY 1983 program consists of:

- o Completion of the Propulsion Assessment for Tactical Systems phase of the overall program.

(U) For FY 1984, it is planned to:

- o Initiate preliminary design of the proposed multiple engine core.

(U) Program to Completion: Complete development of Joint Long Range Propulsion Plan leading to design and fabrication of early prototype versions of the next generation of large high-thrust engines using a common, multiple engine core.

(U) Project W1631, Increased Capability Auxiliary Power Unit: This project provides for the development of an increased capacity auxiliary power unit for the S-3A aircraft to increase aircraft avionics cooling capability and to power the aircraft independent of ground support equipment.

(U) In FY 1982, development of this increased capacity Auxiliary Power Unit was initiated at Garrett Turbine Engine Company, Phoenix, Arizona.

(U) The FY 1983 program consists of:

- o Completion of the Auxiliary Power Unit development.
- o Performance of qualification tests on the Auxiliary Power Unit at the Naval Air Propulsion Center, Trenton NJ.
- o Initiation of aircraft-installed performance tests at the Naval Air Test Center Patuxent River, MD.

(U) For FY 1984, it is planned to:

- o Complete all testing of the increased capacity Auxiliary Power Unit.
- o Transfer of this program to a production contract.

(U) Program to Completion: This program completes in FY 1984.

I. (U) PROJECT OVER \$10 MILLION in FY 1984. Not Applicable.

# FY 1984 ROT&E DESCRIPTIVE SUMMARY

Program Element: 63216N  
DoD Mission Area: 553 - Engineering Technology

Title: Airborne Life Support System  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                           | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                       | 2,871          | 3,483            | 620              | 690              | Continuing               | Continuing           |
| W0584       | Aircrew Protective Clothing and Devices         | 1,715          | 2,204            | 620              | 690              | Continuing               | Continuing           |
| W0888       | Maximum Performance Ejection System             | 360            | 0                | 0                | 0                | 0                        | 4,772                |
| W1401       | Helio Aircrew Survivability Enhancement Project | 796            | 1,279            | 0                | 0                | 0                        | 2,075                |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element provides for the development of integrated, advanced airborne life support systems designed to protect helicopter, fighter/attack and patrol/transport crews from natural and induced environmental/physiological stresses and/or hazards encountered during military flight operations. These developments are designed to enhance specific mission performance while providing aircrew protection from inflight stresses such as acceleration or G forces, vibration, buffet, debilitating temperatures and harmful radiation. All other protective clothing and devices related to inflight/underwater escape and postflight survival/rescue on land or sea are developed for functional compatibility with normal inflight equipments.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: A total decrease of 269 occurred in FY 1982. Termination of project number W0888, Maximum Performance Escape System, resulted in reduction of 130 and project number W0584, Aircrew Protective Clothing and Devices was reduced by 139 due to budgetary constraints. The FY 1984 budget for W0584, the only active project in FY 1984, was reduced by 2132. Other projects ongoing prior to FY 1983 remain temporarily deferred due to budgetary constraints.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                           | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                       | 4,521          | 3,140            | 3,483            | 2,752            | Continuing               | Continuing           |
| W0584       | Aircrew Protective Clothing and Devices         | 2,198          | 1,854            | 2,204            | 2,752            | Continuing               | Continuing           |
| W0888       | Maximum Performance Ejection System             | 2,323          | 490              | 0                | 0                | 0                        | 4,902                |
| W1401       | Helio Aircrew Survivability Enhancement Project | 0              | 796              | 1,279            | 0                | 0                        | 2,075                |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES: All Aircrew Life Support projects are controlled for duplication and commonality by regular meetings of the Tri-Service Life Support Equipment Steering Committee and the Joint Environmental Working Group (Flight). Aerospace Flight Dynamics PE 62201F; Biomedical Technology, PE 62750N; Aircrew Life Support Systems, 6.4, PE 64264N; and Life Support Equipment, PE 64706F, all perform coordinated projects related to PE 63216N.

Program Element: 63216N

Title: Airborne Life Support System

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is the Naval Air Development Center, Warminster, PA. OTHERS: Naval Air Engineering Center, Lakeland, FL; Naval Weapons Center, China Lake, CA; Naval Ordnance Station, Indian Head, MD; Naval Air Test Center, Patuxent River, MD. CONTRACTORS: Thiokol, Brigham City, UT; Stencel, Asheville, NC; Grumman, Bethpage, NY; McDonald Douglas, Saint Louis, MO; Dayton T. Brown, Bohemia, NY; Sikorsky, Stafford, CT.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0584, Aircrew Protective Clothing and Devices: This project provides each aircrewman with a functionally integrated system of protective clothing and equipments designed to ensure protection against natural and induced environmental or physiological hazards encountered during routine, combat and emergency flight operations as well as during escape, survival and rescue following loss of the aircraft. Technology products for this project seek to integrate aircraft life support and escape subsystems into protective systems compatible with specific Navy mission accomplishment.

(U) In FY 1982, fabrication of system prototypes was initiated for Offensive/Defensive Multi-Wavelength Laser Protection (Prevents eye damage from own or enemy lasers) and the Servo Anti-G Valve (Increases aircrew G tolerance by 1G). Initiated component fabrication for the Advanced Concept Ejection Seat Restraint System (Update of 30 year old design for aircrew positioning and restraint during air combat maneuvers or ejection).

(U) The FY 1983 program consists of:

- o Conclusion of requirements analysis, design tradeoff studies and system design for the Advanced Concept Ejection Seat Restraint System.
- o Completion of Offensive/Defensive Multi-Wavelength Laser Protection System development model, flight tests, evaluation of tests, and transition to Engineering Development in PE 64264N, Life Support Equipment.
- o Conclusion of laboratory tests of the Servo Anti-G Valve, flight tests, evaluation of results and transition to Engineering Development.

(U) For FY 1984, it is planned to:

- o Initiate subsystem fabrication of Advanced Concept Ejection Seat Restraint System.
- o Initiate subsystem testing and evaluation of the Advanced concept Ejection Seat Restraint System as components become available.

(U) Program to completion: This is a continuing program.

(U) Project W1401, Helicopter Aircrew Survivability Enhancement Project This project develops: (1) A helicopter emergency egress system to assist helicopter occupants in locating emergency exits following crashes involving unusual attitudes, submersion or darkness; and (2) A system for floating or slowing down the sink rate of a helicopter following an ocean crash.

(U) In FY 1982 a determination of essential helicopter emergency egress lighting parameters was completed and specific requirements and specifications developed. An evaluation of existing lighting concepts was completed and prototype fabrication initiated. Test plans were completed and developmental components fabricated for Helicopter Flotation/Sink Rate Retardation; tradeoff analyses and developmental testing were initiated.

(U) The FY 1983 program consists of:

- o Fabrication and testing of Helicopter Emergency Egress Lighting systems.

Program Element: 63216N

Title: Airborne Life Support System

- o Evaluation and transition of Emergency Egress Lighting to PE 64264N.
- o Completion of Helicopter Flotation/Sink Rate Retardation tradeoff analyses, developmental testing, evaluation and transition of project to Engineering Development.

(U) This program is scheduled to conclude during FY 1983. All FY 1984 work will continue as a function of engineering development under PE 64264N, Life Support Equipment.

I. (U) PROJECT-OVER \$10 MILLION IN FY 1984. Not Applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63217N  
DoD Mission Area: 553 - Engineering Technology

Title: Advanced Aircraft Subsystems  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                      | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                  | 4,276          | 2,428            | 4,884            | 5,703            | Continuing               | Continuing           |
| W0446       | Advanced Avionics Subsystems (AEW Radar)   | 1,144          | 887              | 3,693            | 4,380            | Continuing               | Continuing           |
| W0516       | Avioptics (Airborne Fiber Optics Systems)  | 950            | 13               | 0                | 0                | TBD                      | TBD                  |
| W0647       | Composite Structures for Advanced Aircraft | *              | *                | 1,191            | 1,323            | Continuing               | Continuing           |
| W0885       | Modular Avionics Packaging                 | 1,102          | 787              | 0                | 0                | TBD                      | TBD                  |
| W0892       | Information Handling System                | 1,080          | 741              | 0                | 0                | TBD                      | TBD                  |

\* Funded in PE 63251N, Aircraft Systems (Advanced) 3,375 in FY 1982 and 1,000 in FY 1983.

As this is a continuing program, the above funding includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced aircraft avionic subsystems are developed with the objective of upgrading system performance, reliability, and survivability while reducing weight, volume, and cost. The projects emphasize the utilization and insertion of new technologies in ongoing systems as well as in their avionic system architectures. Developed also are related physical and electrical standard interfaces which adapt to different platforms thereby facilitating the introduction of new technologies and subsystems.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are: Project W0046, Advanced Avionics Subsystems: Reductions of 300 in FY 1983 and 1,441 in FY 1984 are the result of budgetary constraints during budget development. Due to FY 1984 budgetary constraints, and the high priority of this project, other projects were reduced to zero. Project W0647, Composite Structures for Advanced Aircraft: funded at a level of 1,191 in FY 1984 is scheduled for transfer to Program Element 63217N from Program Element 63251N with the reduction of 5,480 resulting from budgetary constraints during budget development. The reduction of 2,430 in FY 1983 is the result of Congressional action.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                 | 0              | 4,500            | 4,928            | 11,457           | Continuing               | Continuing           |
| W0446       | Advanced Avionics Subsystems (AEW Radar)  | 0              | 1,144            | 1,187            | 5,134            | Continuing               | Continuing           |
| W0516       | Avioptics (Airborne Fiber Optics Systems) | 0              | 1,101            | 1,213            | 1,534            | Continuing               | Continuing           |
| W0885       | Modular Avionics Packaging                | 0              | 1,252            | 1,287            | 2,143            | Continuing               | Continuing           |
| W0892       | Information Handling Systems              | 0              | 1,005            | 1,241            | 2,546            | Continuing               | Continuing           |
| W0647       | Composite Structures for Adv Aircraft*    | (5,005)*       | (3,744)*         | (3,430)*         | (6,671)*         | Continuing*              | Continuing*          |

\* Non Add - Shown in PE 63251N Aircraft Systems (Advanced) in FY 1983 Descriptive Summary.

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

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Program Element: 63217N

Title: Advanced Aircraft Subsystems

F. (U) RELATED ACTIVITIES: W0466, Advanced Avionics Subsystem (ARW Radar): Advanced Surveillance Radar Program, Rome Air Development Center; W0516, Avioptics: United States Air Force Digital Flight Control System Program, Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio; Avionics Components and Subsystems, Program Element 64203N Defense Standardization; Advanced Digital Optic Control System at Army Advanced Technology Laboratory, Fort Eustis, VA; Very High Speed Integrated Circuits program. W0647, Composite Structures for Advanced Aircraft: Continuous information exchange with the Army, Air Force, NASA, industry, and educational institutions in addition to utilizing technologies developed in applicable Exploratory Development program elements. Composite Materials Structures research and development in Program Elements 62761N and 62241N provide the technology base for the Composite Structures for Advanced Aircraft Program. W0685, Modular Avionics Packaging: Navy's Standard Electronic Module Program; Avionics Components and Subsystems, Program Element 64203N (Defense Standardization); Very High Speed Integrated Circuits Program (VHSIC). W0692, Information Handling Systems: Continuous information exchange with the Army, Air Force, NASA, industry, and appropriate educational institutions as well as utilizing technologies developed in applicable Exploratory Development program elements. Program Element 62721N (Command and Control) provides the technology base for the Information Handling Systems Project.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Air Development Center, Warminster, PA; Naval Avionics Center, Indianapolis, IN; Naval Weapons Support Center, Crane, IN; CONTRACTORS: Grumman, Bethpage, NY; Rockwell International, Columbus, OH; ITT Electro-Optics products Division, Roanoke, VA; Lockheed Research Laboratory, Palo Alto, CA; McDonnell Douglas Corporation, St. Louis, MO; Northrop Corporation, Hawthorne, CA; Vought Corporation, Dallas, TX; Lockheed California Company, Burbank, CA; Boeing Military Airplane Company, Seattle, WA; KeyStone Associates, Fort Washington, PA; Draper Labs, Cambridge, MA; Mission Sciences, Commack, NY; General Electric, NY; and General Instrument, Hicksville, NY.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) W0446, Advanced Avionics Subsystems (ARW Radar) - This project provides advanced development for the Navy Airborne Early Warning Receiver

(U) In late FY 1982 the project initiated a contract between Naval Air Development Center and Grumman for development of the test bed. The General Electric Co. is developing the

(U) The FY 1983 program consists of:

o Procurement of brassboard radar equipment.

(U) For FY 1984, it is planned to:

o Test the equipment for performance evaluation in an Electronic Countermeasures Environment.

(U) Program to Completion:

o In FY 1985 it is planned to perform flight tests for the

o This is continuing program.

(U) Project W0516, Avioptics (Airborne Fiber Optics Systems): This project provides the systems engineering necessary to introduce fiber optics technology into fleet aircraft. Fiber optics will provide reliable wide bandwidth information transfer capability unavailable with conventional transmission lines. Enhanced resistance to Electromagnetic Interference and Electromagnetic Pulse threats is provided without need for metal shielding. Fiber optics result in weight reduction, maintainability improvements and potential improvements in reliability and aircraft safety. Improved electrical/electronic system performance results in reduced shielding, reduced need for filtering (and filter pin connectors) and simplified circuit design.



Program Element: 63217N

Title: Advanced Aircraft Subsystems

The result is a major reduction in aircraft life cycle costs. This is especially important for aircraft with extensive use of epoxy composite/conventional metal skin construction. Reliable wideband fiber optics interconnects will provide for effective utilization of Very High Speed Integrated Circuits. Application of fiber optics through the Avionics program will raise the quality of system performance in severe mission environments thereby increasing system readiness.

(U) In FY 1982, flight worthiness tests of MIL-STD-1553-B fiber optics data bus hardware was conducted and a laboratory demonstration of stores interface links successfully completed.

(U) The FY 1983 program consists of:

- o Hardware demonstration of video and high speed digital busses.
- o Breadboard and flight test hardware development for radar, EW, video, high speed digital and electronic countermeasures links.

(U) For FY 1984 and subsequent years, the program is not funded due to budgetary constraints.

(U) Project W0647, Composite Structures for Advanced Aircraft: This project provides the critical design, fabrication, durability, damage tolerance, and systems compatibility information supporting wider and more efficient composites applications on primary structures of Advanced Naval Aircraft. Composite structures provide the most economical path to major reduction in aircraft weight while reducing maintenance and increasing structural service life. Program goals are to obtain a structural weight reduction of over 15% with composite usage. Structural components which obtain system gains of reduced weight, increased corrosion resistance and battle damage tolerance, while maintaining or reducing cost, include the composite wing, forward fuselage and horizontal stabilizer of the AV-8B and the composite outboard for the F-404 engine.

(U) In FY 1982, programs were initiated (under PE 63251N, Aircraft Systems (Advanced)) in high temperature composite fuselage structures and damage tolerant fuel-containing composite fuselage components. Programs were continued in damage tolerance and repair of AV-8B composite structures, and the composite duct for the F-404 engine was completed.

(U) The FY 1983 (under PE 63251, Aircraft Systems (Advanced)), program consists of:

- o Completing development of high temperature composite fuselage structure.
- o Completion of damage tolerant fuel-containing structures program.
- o Continuation of AV-8B Composite damage tolerance and repair effort.
- o Initiating a program on composite nozzles for AV-8B.
- o Initiating development of a composite forward Jam case for the F-404 engine (Joint Navy/NASA program).

(U) For FY 1984, it is planned to: (program transfers to PE 63217N from PE 63251N)

- o Complete AV-8B composite nozzle program.
- o Continue F-404 forward jam case effort.
- o Complete AV-8B composite damage tolerance and repair.

Program Element: 63217N

Title: Advanced Aircraft Subsystems

(U) Program to Completion: This is a continuing program.

(U) Project W0885, Modular Avionics Packaging: The program objectives are to establish lightweight thermally efficient avionics packaging approaches which are suitable for multi-platform applications (both new and retrofit) and to establish a Standard Avionics Modules concept for commonly used avionics hardware.

(U) In FY 1982, the module development for the 1/4 standard size module was completed (Standard Electronics Module Format B). A 1/2 standard size module form factor has been established and has been adopted by the Standard Electronics Module program as its format module. A development contract with Boeing was completed for the investigation of various concepts for standard enclosures and an effort was initiated again with Boeing for the design, development, evaluation and documentation of a family of forced-air-cooled standard enclosures. Thermal testing of the integrated rack was begun by Grumman Aircraft. Finally, a contract with Grumman Aircraft to develop a specification for an Analog/Digital converter which will be packaged in an integrated rack and used in the A-6E on the AM/ASQ-155.

(U) The FY 1983 program consists of:

- o Performing qualification testing of module hardware and connectors.
- o Developing ceramic compatible connectors of 150 and 250 pins.
- o Complete development of forced-air-cooled standard enclosures.
- o Complete environmental testing of Integrated Rack.
- o Continue support of Analog/Digital converter system demonstration.
- o Participate in the Very High Speed Integrated Circuits Packaging Subcommittee.

(U) For FY 1984 and subsequent years, the program is not funded due to budgetary constraints.

(U) Project W0892, Information Handling Systems: This project provides for: The development of solid state memory systems to replace obsolete memories in present avionic systems as well as to meet the requirements of advanced avionic systems; and the development of new architectural concepts (e.g., distributed, fault tolerant networks) and shared intelligence schemes to enhance the capabilities of existing and future advanced avionic systems.

(U) In FY 1982 the program initiated characterization of commercial bubble memory devices for military applications and the development of an Advanced Development Model secondary store memory for the S3-A/B aircraft as well as characterization of two types of commercial Electrically Alterable Read Only Memory devices for application to avionic systems and Radar Warning Receivers. The detailed definition of system requirements for an advanced P-3C system was begun. Implementation and test of a fault tolerant concept on an experimental local distributed microprocessor network was commenced.

(U) The FY 1983 program consists of:

- o Completing the characterization of the bubble memory and Electrically Alterable Read Only Memory devices.
- o Completing the design of an Advanced Development Model Main Memory Replacement for the AM/AYK-10 (S-3A Central Processor).
- o Completing the evaluation of the candidate fault tolerant concept of the experimental microprocessor subsystem.

Program Element: 63217N

Title: Advanced Aircraft Subsystems

- o Initiate the evaluation of alternate distributed architectures via simulation.
- o Identify the decision making processes/requirements for the P-3C mission.

(U) For FY 1984 and subsequent years, the program is not funded due to budgetary constraints.

I. (U) Projects over \$10 Million in FY 1984. Not Applicable

# FY 1984 ROT&E DESCRIPTIVE SUMMARY

Program Element: 63251N  
DoD Mission Area: 553 - Engineering Technology

Title: Aircraft Systems (Advanced)  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                      | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                  | 3,375          | 1,000            | 982              | 3,043            | Continuing               | Continuing           |
| W0585       | F-14/A-6 Follow On (VPMX)                  | 0              | 0                | 982              | 3,043            | Continuing               | Continuing           |
| W0647       | Composite Structures for Advanced Aircraft | 3,375          | 1,000            | *                | *                | Continuing               | Continuing           |

\*Funded in PE 63217N, Advanced Aircraft Subsystems, in FY 1984 and subsequent years.

As this is a continuing program, the funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced development of aircraft systems technologies for future Navy/Marine Corps aircraft. It also provides a means to define aircraft options for all future Navy/Marine Corps missions in preparation for Department of Defense/Navy decisions to establish line item aircraft development programs. The F-14/A-6 Follow On (VPMX) project provides system concept formulation, requisite advanced development and transition of engineering development of an F-14/A-6 Follow On Multi-Mission Fighter/Attack Aircraft Total System to meet future Anti-Air, Anti-Surface, and Strike Warfare needs. Composite Structures project discussed in P.E. 63217N.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are -369 in FY 1982, -2,430 in FY 1983, and -5,689 in FY 1984. The reduction from the Composite Structures for Advanced Aircraft Project in FY 1982 results from Navy distributions of overall budget reductions. The decrease of 2430 in FY 1983 results from Congressional reduction. In FY 1984 the Composite Structures program transfers to PE 63217N. The increase of 982 in FY 1984 for VPMX results from a Navy reprogramming to support VPMX assessment and concept development.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                 | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT             | 5,930          | 3,744            | 3,430            | 6,671            | Continuing               | Continuing           |
| W0585       | F-14/A-6 Follow On (VPMX)             | 923            | 0                | 0                | 0                | Continuing               | Continuing           |
| W0586       | Lightweight Hydraulic System          | 0              | 0                | 0                | 0                | Continuing               | Continuing           |
| W0647       | Composite Structures for Adv Aircraft | 5,005          | 3,744            | 3,430            | 6,671            | Continuing               | Continuing           |
| W1588       | VPMX                                  | 0              | 0                | 0                | 0                | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: Composite Structures for Advanced Aircraft - Continuous information exchange is being carried on with the Army, Air Force, NASA, private industry, and educational institutions in addition to utilizing technologies developed in applicable Exploratory Development program elements. Composite Materials/Structures research and development in Program Elements 62761N, Materials Technology and 62241N, Aircraft Technology, provide the technology base for the Composite Structure for Advanced Aircraft Program. F-14/A-6 Follow On (VPMX) - Advanced fighter/attack investigations in PE 62241N, Aircraft Technology, provide a mission and technology data base for the F-14/A-6 Follow On (VPMX) project. Coordination is maintained with the Air Force Advanced Tactical Fighter Program and the joint Navy/Air Force Propulsion Assessment for Tactical Systems Program.

Program Element: 63251N

Title: Aircraft Systems (Advanced)

G. (U) WORK PERFORMED BY: IN-HOUSE Naval Air Development Center, Warminster, PA. CONTRACTORS: McDonnell Douglas Corporation, St. Louis, MO; Northrop Corporation, Hawthorne, CA; Grumman Aerospace Corporation, Bethpage, NY; Vought Corporation, Dallas, TX; Lockheed California Company, Burbank, CA; and Boeing Military Airplane Company, Seattle, WA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0647, Composite Structures for Advanced Aircraft: This project provides the Navy's critical design, fabrication, durability and damage tolerance, and systems compatibility information supporting wider and more efficient composites applications on primary structures of Advanced Naval Aircraft. Composite structures provide the most economical path to major reductions in aircraft weight while reducing maintenance, and increasing structural service life. Program goals are to obtain a structural weight reduction of over 15% with composites usage in excess of 50%. The structural components developed in this program, to obtain system gains of reduced weight, increased corrosion resistance and battle damage tolerance, while maintaining or reducing cost, include the composite wing, forward fuselage and horizontal stabilizer of the AV-8B and the composite outer duct for the F-404 engine.

(U) In FY 1982 programs were initiated in high temperature composite fuselage structures and damage tolerant and repair of AV-8B composite structures, and the composite duct for the F-404 engine was completed.

(U) The FY 1983 program consists of:

- o Completing development of high temperature composite fuselage structure.
- o Completion of damage tolerant fuel-containing structures program.
- o Continuation of AV-8B composite damage tolerance and repair efforts.
- o Initiating a program on composite nozzles for AV-8B.
- o Initiating development of a composite forward fan case for the F-404 engine (Joint Navy/NASA program.)

(U) For FY 1984, it is planned to: (Program transfers to PR 63217N)

- o Complete AV-8B composite nozzle program.
- o Continue F-404 forward fan case effort.
- o Complete AV-8B composite damage tolerance and repair.

(U) Project W0585, F-14/A-6 Follow On (VFHX): (NEW START) This project provides for system concept formulation, requisite advanced development and transition to full scale engineering development of the F-14/A-6 Follow On Multi-Mission Fighter/Attack Aircraft Total System for first introduction circa 1996. The project will (1) delineate promising system candidates, alternatives and options for best fulfilling the mission needs and (2) narrow the selection at appropriate stages during the competitive concept formulation and advanced development/concept validation process.

(U) FY 1982 and FY 1983 are unfunded under this program element. Mission and technology data base are being developed under Program Element 62241N, Aircraft Technology.

(U) FY 1984, plans are to conduct preliminary aircraft concept/design investigations exploring the feasibility of the Multi-Mission Fighter/Attack Aircraft vice separate Fighter and Attack Aircraft approaches.

(U) Program to Completion: This is a continuing program.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not Applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63303N  
DoD Mission Area: 533 - Engineering Technology

Title: Electromagnetic Radiation Source Elimination System Technology  
Budget Activity: 2 - Advanced Technology Development

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                                   | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                        | 5,750          | 9,849            | 5,729            | 8,376            | Continuing               | Continuing           |
| W0447       | Electromagnetic Radiation Source Elimination Technology | 5,750          | 5,849            | 1,809            | 1,406            | Continuing               | Continuing           |
| W1720       | SIDEARM                                                 | 0              | 0                | 3,920            | 7,170            | 0                        | 11,090               |
|             |                                                         |                |                  | OT&E             |                  |                          | (30)                 |
| W1807       | Anti-Radiation Seeker Technology                        | 0              | 4,000            | 0                | 0                | 0                        | 4,000                |

As this (Project W0447) is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** The Electromagnetic Radiation Source Elimination program is the principal source of new defense suppression concepts and improved anti-radiation missile guidance systems. Electromagnetic Radiation Source Elimination keeps abreast of the expanding enemy surface-to-air missile threat by demonstrating the feasibility of new concepts and systems and preparing them for rapid transition to engineering development. Recent examples are the SIDEARM Weapon and the guidance technology in the High Speed Anti-Radiation Missile. Current high priority Electromagnetic Radiation Source Elimination objectives [

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are: A reduction of 213 in Project W0447 in FY 1982 which was the result of minor administrative adjustments. An increase of 4,000 in Project W1807 in FY 1983 due to a Congressional addition to fund work on the Anti-Radiation Projectile seeker. In FY 1984, SIDEARM becomes established as a separate project, W1720, and funding of 3920, which had been identified for this effort was transferred from Project W0447 to W1720. Additionally, Project W1720 was decreased by 906 due to budgetary constraints.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                                                   | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                        | 4,277          | 5,963            | 5,949            | 6,635            | Continuing               | Continuing           |
| W0447       | Electromagnetic Radiation Source Elimination Technology | 4,277          | 5,963            | 5,849            | 6,635            | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** Not applicable.

**F. (U) RELATED ACTIVITIES:** High Speed Anti-Radiation Missile (HARM), Program Element 64360N. Advanced seeker efforts in ERASE have potential cost-saving and product improvement application to HARM. In the joint Navy/Air Force SIDEARM project, Air Force funding is obtained from Program Element 27161F.

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Program Element: 63303M

Title: Electromagnetic Radiation Source Elimination System Technology

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA. laboratory for SIDEARM is the Naval Weapons Center. CONTRACTORS: Motorola, Inc., Scottsdale, AZ; Litcon Amercon, College Park MD; Airborne Instruments Lab, Buerpark, NY.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0447, Electromagnetic Radiation Source Elimination (ERASE): This is a continuing program for feasibility demonstration of new defense suppression concepts and hardware.

(U) In FY 1982, initial feasibility of the SIDEWINDER AIM-9C conversion was demonstrated (see Project 1720 below); [ ]

(U) The 1983 program consists of:

- o Fabricate a full-up [ ]
- o Complete [ ] [ ] brassboard detailed design. Initiate software development.
- o Implement design refinements identified during testing. [ ]
- o Incorporate NAWM requirements into Anti-Radiation Projectile Seeker engineering development unit.
- o Fabricate and test demonstration hardware for Anti-Radiation Projectile Seeker.
- o Captive flight test Anti-Radiation Projectile Seeker [ ] [ ]
- o Will be performed in Project W1807, Anti-Radiation Seeker Technology.

(U) The FY 1984 program consists of:

- o Fabricate a brassboard [ ]
- o Complete hardware and software [ ] and fabricate the first test item.
- o Transition [ ]
- o Free flight test Anti-Radiation Projectile Seeker [ ] [ ]
- o Integrate Anti-Radiation Projectile Seeker [ ] [ ]
- o Prototype Anti-Radiation Projectile Seeker design release.

(U) Program to Completion: This is a continuing program.

Program Element: 63303M

Title: Electromagnetic Radiation Source Elimination System Technology

(U) Project W1720, SIDEARM: This is a joint Navy/Air Force project to quickly convert existing but obsolete AIM-9C SIDEWINDER components and to integrate them with in-production SIDEWINDER components;  
] SIDEARM will provide a near term operational capability.

(U) In FY 1982, three feasibility demonstration weapons were fired. ]

(U) The FY 1983 program consists of:

- o Refining and finalizing the design of the modification which converts the SIDEWINDER AIM-9C guidance and control section to the SIDEARM configuration.
- o Test firing seven SIDEARM weapons.
- o Converting an additional 30 weapons to be used for Operational Test and Evaluation.

(U) The FY 1984 program consists of:

- o Conducting a 30 weapon Operational Test and Evaluation test program.
- o Initiating conversion of remaining SIDEWINDER components (over 1,000 AIM-9C guidance and control sections are currently in storage).

(U) Program to Completion: Initiate production in FY 1983 and complete in FY 1986. Capability in FY 1983.

1. (U) PROJECT OVER \$10 MILLION IN FY 1984. Not applicable.



FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63306N  
DoD Mission Area: 353 - Engineering Technology

Title: Advanced Air Launched Air-to-Surface Missile System  
Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                                              | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                                    | 5,497          | 0                | 2,439            | 3,912            | Continuing               | Continuing           |
| W0551                     | Air-to-Surface Missile Guidance Technology         | 4,201          | 0                | 2,439            | 3,912            | Continuing               | Continuing           |
| W0996                     | Air-to-Surface Missile Warhead and Fuse Technology | 1,496          | 0                | 0                | 0                | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the development of technical concepts which could improve the combat utility of air-to-surface missile systems. The Air-to-Surface Guidance Technology Project supports development of all-weather mid-course and terminal guidance concepts such as an Advanced Tactical Inertial Guidance System based on laser gyro concepts, passive millimeter wave mid-course navigation, terminal guidance and Synthetic Aperture Radar mid-course/terminal guidance. For future application as potential all-weather terminal guidance systems, and Synthetic Aperture Radar guidance systems are being developed jointly with the Air Force. The objective of the Air-to-Surface Missile Warhead and Fuse Technology project is increased weapon terminal effectiveness by demonstrating the feasibility of unitary ordnance systems for multi-target applications and by investigating cluster submunition technology for modular warhead application.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: FY 1983 - Projects W0551 and W0996, Air-to-Surface Missile Guidance Technology and Air-to-Surface Missile Warhead and Fuse Technology, were reduced to zero by Congressional action. FY 1984 - Project W0996 was reduced to zero and project W0551 was reduced by 114 due to budgetary constraints. The funds remaining in project W0551 will permit honoring a joint service commitment with the Air Force to complete the flight test and evaluation of Advanced Weather Guidance Systems previously developed under this project.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                                              | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                                    | 5,399          | 3,838            | 4,011            | 4,283            | Continuing               | Continuing           |
| W0551                     | Air-to-Surface Missile Guidance Technology         | 4,026          | 2,342            | 2,390            | 2,553            | Continuing               | Continuing           |
| W0996                     | Air-to-Surface Missile Warhead and Fuse Technology | 1,363          | 1,496            | 1,621            | 1,730            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: The guidance effort recently supported by this element is the Joint Service Advanced Weather Guidance System program under Joint Navy/Air Force support. Air Force funds were provided under Program Element 63601F. The millimeter wave terminal guidance work under this element was derived from earlier Air Force development efforts. This is currently the only advanced advanced weather missile guidance effort in either service.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Weapons Center, China Lake, CA; Air Force Armament Division, Eglin Air Force Base, FL; CONTRACTORS: Goodyear Aerospace Incorporated, Litchfield Park, AZ; Honeywell Incorporated, Hopkins, MN; The Martin Marietta Corporation, Orlando, FL.

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Program Element: 63306N

Title: Advanced Air Launched Air-to-Surface Missile Systems

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(S) Project W0551, Air-to-Surface Missile Guidance Technology: This project is directed toward the development of a critical subsystem technology base to support improvements in current and advanced air-to-surface missiles for joint service use. It concentrates on affordable, night/adverse weather guidance systems capable of precision delivery of lethal ordnance against sea/land targets. Advanced mid-course navigation and inertial guidance subsystems have been developed. The principal emphasis is currently on and passive only systems and squint mode, doppler processed synthetic aperture type guidance systems. A Navy/Air Force Memorandum of Agreement for development of these terminal guidance systems to joint service requirements is in effect.

(U) In FY 1982, completed development and captive flight test of Honeywell developed millimeter wave seeker, completed development and concluded effort on the Martin Marietta Corporation developed millimeter wave seeker, completed development effort on Goodyear developed synthetic aperture seeker, and completed synthetic aperture installation in aircraft in preparation for captive flight test.

(U) FY 1983 Program - Not funded.

(U) FY 1984 Program

- o Support the conduct of extensive flight testing of the promising Goodyear developed synthetic aperture guidance system.
- o Demonstrate in captive flight the detection, recognition, acquisition and tracking of high value targets and targets in background clutter.
- o Demonstrate in captive flight the detection, recognition, acquisition and tracking of combatant ship targets. Ship target recognition will be critically evaluated by the selection of a single combatant ship from a group of three.
- o Support the incorporation of critical test results into the computer software of the Honeywell developed millimeter wave seeker and conduct further test and evaluation of this system.
- o Initiate planning effort to evaluate the most promising of these jointly developed missile guidance systems and subsequent test and evaluation in a missile airframe free-flight regime.

(U) Program to completion: This is a continuing program which is expected to provide a critical missile technology data base to support the development of a new high performance stand-off missile system in the latter part of the 1980s.

(U) Project W0996, Air-to-Surface Missile Warhead and Fuse Technology: Deferred due to budgetary constraints.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63308N

Title: Air-to-Air Missile Technology Demonstration

DoD Mission Area: 553 - Engineering Technology

Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                 | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT             | 4,362          | 2,923            | 10,022           | 9,945            | Continuing               | Continuing           |
| W0440       | Air-to-Air Missile Technology         | 2,037          | 751              | 10,022           | 9,945            | Continuing               | Continuing           |
| W0453       | Advanced Air Technology Demonstration | 2,325          | 2,172            | 0                | 0                | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Refine and demonstrate state-of-the-art air-to-air missile subsystems directly applicable to solving current/projected fleet outer air battle deficiencies and test their integration potential in an AIM-7 (Sparrow sized) vehicle. This technology exploitation will demonstrate significantly enhanced air-to-air missile capability while minimizing program size, cost, complexity and development risk. Emergent guidance, airframe and propulsion technologies necessary in near future missile systems will be bench and flight tested. Maturing subsystem techniques and components require integrated captive and free flight testing/demonstration prior to any full system development commitment by the Navy.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile in the FY 1983 Descriptive Summary and the FY 1984 Descriptive Summary are as follows: In FY 1982 an increase of 100 due to revised cost estimates including inflation. In FY 1984 a net increase of 6,789 plus 9,178 in Project W0440 and -2,389 in Project W0453. Projects W0440 and W0453 were consolidated to exist as one project under PE 63308N. As recommended by the Assistant Secretary of the Navy (Research, Engineering and Systems) Blue Ribbon Committee (convened to review PHOENIX follow-on efforts) and as approved by the Chief of Naval Operations, the Advanced Common Intercept Technology Demonstration program has been restructured to provide for expanded technology investigation and fabrication of ramjet propulsion and multi-mode guidance equipment for a SPARROW (AIM-7) size airframe. Specific areas of interest include electronic countermeasures/electronic counter-countermeasures lethality and aircraft integration issues as related to small diameter air-to-air vehicles. The funding profile change is necessary to provide timely data needed for the Navy's "PHOENIX follow-on" decision in FY 1985.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                 | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT             | 2,871          | 4,262            | 2,923            | 3,233            | Continuing               | Continuing           |
| W0440       | RAMJET Missile Technology             | 0              | 2,037            | 751              | 844              | Continuing               | Continuing           |
| W0453       | Advanced Air Technology Demonstration | 2,871          | 2,225            | 2,172            | 2,389            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: Cooperative interface with PE 63318N (Multi-Mode Guidance Program) has been directed by Assistant Secretary of the Navy (Research, Engineering and Systems). Passive radar weather research under the Electromagnetic Radiating Source Elimination Program (PE 63307N) is directly supportive of guidance system development efforts demonstration for longer range air-to-air missiles. Direct support of the nation's ongoing ramjet industrial technology base has been encouraged by Office of the Secretary of Defense.

Program Element: 63308N

Title: Air-to-Air Missile Technology Demonstration

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Weapons Center, China Lake, CA. CONTRACTORS: Raytheon Co., MA; Hughes Aircraft Co., Canoga Park, CA; McDonnell Douglas Astronautics Co., St. Louis, MO; Marquardt Co., Van Nuys, CA; CSD Co., Sunnyvale, CA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984: Not applicable.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984:

(U) Project W0440, Air-to-Air Missile Technology

1. (U) DESCRIPTION PE 63308N is directed toward investigating and demonstrating technologies that promise to enhance air-to-air missile capabilities (i.e., electronic countermeasures/electronic counter-countermeasures survivability, faster/lighter weight vehicles providing added firepower and more lethal terminal guidance). The radar seeker technology of the Advanced Medium Range Air-to-Air Missile program in conjunction with techniques generated in exploratory development (under PE 62332N, Strike Warfare Weaponry Technology) indicate that seekers can be designed and adapted to small diameter airframes that will provide reliable long range air-to-air systems. Advances in airbreathing propulsion have demonstrated that a ramjet can be produced for a small diameter weapon. To exploit these technologies and assess potential applications to future missiles, individual component performance and total missile integration issues will be verified by ground tests, computer simulations and airborne field testing.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program: The FY 1982 funds were not released until September 1982. The areas supported were: (1) Advanced Common Intercept Missile Technology Demonstration booster propellant development program for the integral propulsion system; (2) aerodynamic/thermal/structural analyses to support the continuing vehicle design effort; (3) initial funding for the auxiliary power system contractual design development and fabrication of flight qualified systems; (4) preparation for initial hardware-in-the-loop testing to define the back-to-turn steering laws to be used for the Advanced Common Intercept Missile Technology Demonstration inertial navigation system design and to ultimately verify performance of various electronic countermeasures/electronic counter-countermeasures techniques.

b. (U) FY 1983 Program: The Advanced Common Intercept Missile Technology Demonstration seeker breadboard design will be tested and evaluated. Mid-course guidance handover to terminal phase guidance will be verified. An adaptive radome boresight error correction algorithm will be verified by computer simulation. Packaging of flight weight propulsion hardware will be verified. Design, fabricate and procure test hardware to resolve technical issues identified in advanced concept investigations. Continue to establish the requisite technology base for an outer air battle missile. Continue to test and evaluate electronic countermeasures/electronic counter-countermeasures concepts.

c. (U) FY 1984 Planned Program: Begin captive flight/laboratory and safe separation tests. Conclude evaluation of Advanced Common Intercept Missile Technology Demonstration guidance and control systems. Initial delivery of vehicle components will begin. Begin air launched flight demonstrations.

d. (U) Program to Completion: This is a continuing technology program. The captive and free flight testing of the Advanced Common Intercept Missile Technology Demonstration vehicle will be completed in FY 1985. Technology with promise to enhance our air-to-air missile capabilities will be refined and evaluated to provide mature, low risk technology for inclusion in program to upgrade present capabilities.

e. (U) Milestones: Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63508N

Title: Ship Propulsion System (Advanced)

DoD Mission Area: 553-Engineering Technology

Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                              | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                    | 20,084         | 20,457           | 41,542           | 65,665           | Continuing               | Continuing           |
| S0379                     | Gas Turbine Propulsion System      | 13,264         | 13,562           | 24,014           | 46,765           | Continuing               | Continuing           |
| S1649                     | DDG-51 Propulsion                  | 0              | 6,895            | 14,593           | 15,958           | 24,723                   | 62,169               |
| S1683                     | Gas Turbine Efficiency Improvement | 6,820          | 0                | 2,935            | 2,942            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only except for project S1649 which encompasses all work or development phases now planned or anticipated.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The primary objective of this program is to develop new, high efficiency, marine gas turbine engines and systems for surface combatants. This program develops advanced gas turbines and system components from 600 to 50,000 horsepower and in addition develops high efficiency improvements to existing engines such as, the LM2500 marine gas turbine combined Rankine Cycle Energy Recovery System. This program also provides component improvements for operational marine gas turbines to improve reliability and prototype propulsion machinery developmental upgrades for the DDG-51 class destroyer.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary result from the following: Project S0379 - An increase of 1,900 in FY 1982 and 3,279 in FY 1984 due to a Navy decision to enhance the Rankine Cycle Energy Recovery development. In addition, in FY 1982, 180 was transferred from S1683 to S0379 to enhance RACER support for the DDG-51 class destroyer. Other changes in FY 1984 included an increase of 1,185 to support the new TF40 engine component improvement program for the Landing Craft Air Cushion. Project S1649 - A decrease of 328 in FY 1984 is due to budget constraints. Project S1683 - An increase of 2,935 in FY 1984 continues the Fuel Efficiency Program begun by Congress in FY 1982.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                              | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                    | 15,798         | 18,184           | 20,457           | 34,471           | Continuing               | Continuing           |
| S0379                     | Gas Turbine Propulsion System      | 15,798         | 11,184           | 13,562           | 19,550           | Continuing               | Continuing           |
| S1649                     | DDGX Propulsion                    | 0              | 0                | 6,895            | 14,921           | Continuing               | Continuing           |
| S1683                     | Gas Turbine Efficiency Improvement | 0              | 7,000            | 0                | 0                | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                 | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OPN (PE 24228)                  |                |                  |                  |                  |                          |                      |
| LM2500 Gas Turbine MOD Program  | 3,322          | 4,750            | 11,212           | 8,890            | Continuing               | Continuing           |
| 501K-17 Gas Turbine MOD Program | 3,319          | 1,194            | 690              | 1,017            | Continuing               | Continuing           |

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Program Element: 63508N

Title: Ship Propulsion System (Advanced)

F. (U) RELATED ACTIVITIES: Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 64710N, Navy Energy Program (Engineering); Program Element 61153N, Defense Research Sciences; Program Element 63573N, Electric Drive; Program Element 64567, Ship Subsystems Development and Land Based Test Site.

G. (U) WORK PERFORMED BY: IN-HOUSE: David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Ship Engineering Center, Philadelphia, PA; Naval Research Laboratory, Washington, DC; Naval Air Propulsion Center, Trenton, NJ. CONTRACTORS: Detroit Diesel Allison, Indianapolis, IN; General Electric, Cincinnati, OH; Lynn, MA and Schenectady, NY; Garrett AirResearch, Phoenix, AZ and Torrance, CA; Mechanical Technology, Latham, NY; A. D. Little, Cambridge, MA; Philadelphia Gear Corporation, King of Prussia, PA; and Whitney Aircraft Corporation, East Hartford, CT; Westinghouse Electric Corporation, Pittsburgh, PA and Industry, CA; Curtiss-Wright Corporation, Wood-Ridge, NJ; Solar Turbines International, San Diego, CA; Western Gear Corporation, Lynwood, CA; Boeing Airplane Co., Seattle, WA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 61683, Gas Turbine Efficiency Improvement: This program develops LM2500 engine modifications that will result in a five percent overall improvement in fuel consumption.

(U) This program, started in mid FY 1982, initiated system optimization studies, preliminary design, and development of the integrated electric control system.

(U) For FY 1984, it is planned to:

- o Initiate first modified engine testing
- o Initiate second modified engine testing
- o Initiate planning for at-sea testing

(U) Program to completion will consist of complete fabrication and testing of two prototype LM2500 engines, one of which will be tested at-sea on the Military Sealift Command Adm Callaghan. This is a continuing program.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984.

(U) Project 80379, Gas Turbine Propulsion Systems

1. (U) DESCRIPTION (Requirement and Project): This project was established in 1970 to develop advanced propulsion systems and component improvements to reduce manning, maintenance and ship vulnerability, while increasing reliability, ship availability and performance for non-nuclear surface combatants. Required for development in this project are marine gas turbine engines of 600 to 50,000 horsepower and a Rankine Cycle Energy Recovery System which will reduce main propulsion fuel consumption by 25 percent. Also included are equipments necessary in the gas turbine propulsion system; e.g., clutches, reversing gears, controls, controllable pitch propellers, high performance mechanical transmissions as well as fuel and air system. In addition, an on-going component improvement program improves the reliability and maintainability of operational LM2500 and 501K-17 gas turbines in DD-963, FFG-7, BPC-993, CG-47 and Patrol Hydrofoil Class ships.

Program Element: 63508N

Title: Ship Propulsion System (Advanced)

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program: Continued full scale prototype development of the Rankine Cycle Energy Recovery System. Initiated Rankine Cycle Energy Recovery System support program to reduce development risk in concert with Guided Missile Destroyer (DDG-51) lead ship requirements. Continued high temperature materials development. Initiated control system micro-processor technology development. Continued engine and component development, and engine testing at manufacturer's plant and at-sea on Adm. Callaghan to resolve fleet-revealed deficiencies in LM2500 and 501K-17 operational engines. Completed at-sea evaluation of fuel pre-filter and initiated operational evaluation on the self-cleaning fuel purifier.

b. (U) FY 1983 Program: Continue Rankine Cycle Energy Recovery development and initiate land-based facility construction and at-sea test platform design on Military Sealift Command Adm. Callaghan. Continue high temperature materials development. Continue engine and component development resolution of LM2500 and 501K-17 engine deficiencies. Complete operational evaluation of self-cleaning fuel purifier on DDG-995. Request Approval for Production of purifier for initial operation on CG-47 Class and LSD-41.

c. (U) FY 1984 Planned Program: Deliver first Rankine Cycle Energy Recovery system for 1000-hour contractor development testing. Begin ship modifications to Adm. Callaghan to accept second Rankine Cycle Energy Recovery system for at-sea evaluation. Continue Rankine Cycle Energy Recovery System support program by initiating 1/4 scale system tests at manufacturer's plant. Continue high temperature materials development and initiate ceramic coating development. Continue engine and component development resolution of LM2500 and 501K-17 operational deficiencies and initiate component improvement program for TF40B engine selected for the Landing Craft Air Cushion.

d. (U) Program to Completion: Complete Rankine Cycle Energy Recovery system development and deliver third system to Guided Missile Destroyer (DDG-51) Land Based Test Site for integrated test and evaluation and lead ship crew training. Continue high temperature materials development. Expand marine gas turbine component improvement program to include uprated LM2500 main propulsion engine. Initiate development of a 600 horsepower surface combatant cruise propulsion engine, 1000 kilowatt and 3000 kilowatt auxiliary engines, a 50,000 horsepower large combatant and Surface Effect Ship propulsion engine, compact gears, heavy fuel combustor and a 50,000 - 70,000 horsepower controllable pitch propeller. This is a continuing program.

e. (U) Milestones: Not applicable.

(U) Project 81649, DDG-51 Propulsion

1. (U) DESCRIPTION (Requirement and Project): This project is a new start in FY 1983 to support propulsion and auxiliary power high efficiency upgrades for the Guided Missile Destroyer (DDG-51) class. The project develops pre-production prototype propulsion and auxiliary power systems by optimizing current developments to enhance their suitability for the Guided Missile Destroyer (DDG-51). This project includes operational evaluation at a land-based engineering facility and at-sea operational tests. Systems to be optimized include a 50,000 horsepower reversing reduction gear, Rankine Cycle Energy Recovery System and ship service generator power source. Development optimization of these equipments to meet Guided Missile Destroyer (DDG-51) requirements will result in as much as a 35 percent total fuel savings.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program: New start in FY 1983.

b. (U) FY 1983 Program: Initiate design and develop optimization of candidate main reversing reduction gear configurations for Guided Missile Destroyer (DDG-51). Initiate development of Rankine Cycle Energy Recovery System optimization requirements to insure DDG-51 compatibility. Initiate land-based test facility construction.

Program Element: 63506W

Title: Ship Propulsion System (Advanced)

c. (U) FY 1984 Planned Program: Development testing of reverse gear candidate configurations initiated. Rankine Cycle Energy Recovery System tests at the land-based engineering facility initiated. Begin construction of Guided Missile Destroyer (DDG-51) integrated test facility. Complete Technical Evaluation of ship service power system and initiate at-sea tests.

d. (U) Program to Completion: Complete reverse gear testing at manufacturer's plant. Complete at-sea evaluation of candidate reverse gear system. Complete auxiliary power system development. Complete Guided Missile Destroyer (DDG-51) land-based test facility construction and integrated testing of reverse reduction gear, Rankine Cycle Energy Recovery System and shipboard control system.

e. (U) Milestone: Not applicable.



# FY 1984 RDT&E DESCRIPTIVE SUMMARY

-Program Element: 63526N

DoD Mission Area: 351 - Electronic and Physical Sciences

Title: Advanced Computer Technology

Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                              | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT          | 4,534          | 3,272            | 9,900            | 10,559           | Continuing               | Continuing           |
| X0872       | Advanced Computer Technology       | 3,600          | 3,272            | 9,500            | 10,559           | Continuing               | Continuing           |
| X0911       | Automatic Data Processing Security | 934            | 0*               | 0                | 0                | Continuing               | Continuing           |

\* In FY 1983, Project X0911 was transferred to Program Element 64574N, Tactical Embedded Computer Program.

As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides basic resources required to improve capabilities, reliability, and maintainability of Navy embedded computer resources. DOD has designated Ada as the planned computer programming language for embedded computer applications. This program develops Navy standard support software for all Navy standard computers, and, in coordination with the DOD Ada Joint Project Office, develops a Navy standard software engineering environment based on Ada. Directly supports AN/UYK-43 and AN/UYK-44 Navy Embedded Computer Program (PE 64574N). Provides for preliminary studies of technology advances applicable to follow-on computers to the AN/UYK-43 and AN/UYK-44 computers.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: The 5,815 increase in FY 1984 is the result of an increase for Ada development applicable to the UYK-43 and UYK-44 computers.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                              | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT          | 5,514          | 4,534            | 3,272            | 4,085            | Continuing               | Continuing           |
| X0872       | Advanced Computer Technology       | 3,662          | 3,600            | 3,272            | 4,085            | Continuing               | Continuing           |
| X0911       | Automatic Data Processing Security | 1,852          | 934              | 0                | 0                | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: N/A

F. (U) RELATED ACTIVITIES: Command and Control Technology, PE 62721P; Avionics Development (AN/ATK-14), PE 64203N; Navy Tactical Embedded Computer Program, PE 64574N; Army Automatic Data Processing Equipment Development, PE 63703A; Air Force Advanced Computing Technology, PE 63728P; Defense Sciences, PE 62708X.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; Naval Underwater Systems Center, Newport, RI; Naval Surface Weapons Center, Dahlgren, VA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA; Naval Air Development Center, Warminster, PA; Naval Avionics Center, Indianapolis, IN; Fleet Combat Direction System Support Activities, Dan Neck, VA, and San Diego, CA. CONTRACTORS: Contractors will be selected competitively to support the planned activities.

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Program Element: 63526N

Title: Advanced Computer Technology

N. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984: Not applicable.

(U) Project 20872, Advanced Computer Technology: Provides support software for Navy standard embedded computers, including AN/UYK-43 and AN/UYK-44. Implement Ada in the Navy. In coordination with the DOD Ada Joint Project Office develop Ada based Navy Standard Software Engineering Environment.

(U) FY 1982 Program: Completed support software development for the AN/UYK-44. Continued support software development for the AN/UYK-43. In coordination with the DOD Ada Joint Project Office, and based on CMS-2 to Ada transition studies, completed Navy high level requirements for Ada implementation.

(U) FY 1983 Program: Continue support software development for the AN/UYK-43. Prepare Request for Proposals and Statement of Work for competitive procurement of Navy unique Ada standard support software. Initiate development of Navy Ada support environment and Ada run-time support software for AN/UYK-44.

(U) FY 1984 Planned Program: Continue support software development for AN/UYK-43. Continue development of Navy Ada support environment. Continue development of Ada run-time support for AN/UYK-44. Initiate development of Ada run-time support for AN/UYK-43.

(U) Program to Completion: Complete Navy Ada support environment and run-time support for AN/UYK-44 and AN/UYK-43. Initiate Ada implementation in new Navy tactical system development programs. Initiate development of programmer productivity enhancement tools for Navy software engineering environment to maximize efficiency and effectiveness of operational systems employing embedded computer resources. This is a continuing program.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not Applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63573N  
DOD Mission Area: 353 - Engineering Technology

Title: Electric Drive  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No | Title                       | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------|-----------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT   | 0              | 7,267            | 18,339           | 24,371           | Continuing               | Continuing           |
| S1314      | Electric Propulsion Systems | 0              | 7,267            | 13,353           | 18,256           | Continuing               | Continuing           |
| S1693      | Electric Drive (Advanced)   | 0              | 0                | 4,986            | 6,115            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops advanced electric drive systems and electric machinery for Navy ship propulsion. Electric propulsion for combatant ships was abandoned by the Navy after World War II because of excessive size and weight of available electrical machinery. The advantages of electric drive include ship machinery arrangement flexibility, ease of maneuvering control, low noise, and fuel economy. Advances in electric machinery technology promise to reduce the size and weight and improve efficiency of high-power electric drive systems. Application of these systems in a gas-turbine-powered general purpose destroyer, would provide substantial reductions in overall ship size and propulsion fuel consumption with resultant reductions in ship construction and operating costs as compared to identical range and mission-capability ships equipped with conventional mechanical drive systems. The program develops and operationally evaluates electric propulsion systems for Navy ships with propulsion power requirements in the range of 30,000 to 50,000 horsepower per shaft. Initial developments are directed toward electric propulsion systems for near-term operational evaluation and Approval for Production. These could support FY 1990 acquisition of LM-2500 gas turbine powered surface combatants such as DD/DDG-type ships. Development preference in the initial system demonstration is for those electric propulsion machinery designs which are considered low development risks for near-term at-sea evaluation and which are amenable to future upgrade with higher-performance, more advanced design components. Advanced design electric drive system component and technology developments will support upgrade of near-term electric propulsion systems and/or advanced ship acquisition in the post FY 1990 time frame. Emphasis is given to development of higher performance electric drives including advanced design combined propulsion and ship service power generation.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: S1314 Electric Propulsion Systems -2,301 in FY 1984 due to budget constraints. S1673 Electric Drive (ADV) a decrease of 2,500 in FY 1983 resulting from a Congressional reduction and, -114 in FY 1984 due to minor program adjustments including inflation.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No | Title                       | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|------------|-----------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT   | 0              | 0                | 9,767            | 20,754           | Continuing               | Continuing           |
| S1314      | Electric Propulsion Systems | 0              | 0                | 7,267            | 15,654           | Continuing               | Continuing           |
| S1673      | Electric Drive (Advanced)   | 0              | 0                | 2,500            | 5,100            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

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Program Element: 63573N

Title: Electric Drive

F. (U) RELATED ACTIVITIES: Program Element 63508N, Ship Propulsion Systems (Advanced); Program Element 63589N, DDG-51; Program Element 63513N, Shipboard Systems Component Development; Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 61153N, Defense Research Sciences.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ship Systems Engineering Station, Philadelphia, PA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Weapons Support Center, Crane, IN; Supervisor of Shipbuilding, Conversion and Repair, San Francisco, CA; CONTRACTORS: AirResearch Manufacturing Co., Torrance, CA; General Electric Co., Lynn, MA and Schenectady, NY; Westinghouse Electric Co., Pittsburgh, PA and Sunnyvale, CA; Gibbs & Cox, Inc., New York, NY.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 81693, Electric Drive (Advanced): (NEW START) This project develops advanced design electric drives for Navy ships. Principal technical thrust is toward higher-performance electric drives incorporating advanced-concept machinery and including advanced-design systems for combining propulsion and ship service power generation. These advanced-design electric drive developments will support upgrade of previously-constructed, near-term electric propulsion system applications and advanced ship acquisitions beyond FY 1992. Development and demonstration of advanced electric propulsion systems will permit the exploitation of the cost and performance benefits of electric drives in a broader range of future Naval ships than is feasible with near-term electric propulsion systems. Advanced-design component developments include generators, motors, switchgear, transmission lines, machinery shaft seals and current collectors, superconductive magnets, cryogenic refrigeration and other critical ancillary systems.

(U) The FY 1983 program consists of:

- o Preliminary design and tradeoff studies on advanced electric drive system concepts considered to be candidates for FY 1986 start on system construction.
- o Supporting technology and component development for advanced electric drive system concepts including 3000 HP feasibility-model machinery evaluation.
- o Supporting land-based test site planning for Navy system tests (jointly supported with Project 81314)

(U) For FY 1984, it is planned to continue:

- o System analyses and tradeoffs
- o Component development and supporting technology for advanced electric drive systems.
- o Supporting site planning and design for land-based system tests (jointly supported with Project 81314)

(U) Program to completion will consist of completion of component development and system manufacture for advanced electric drive systems of 30,000 horsepower and 50,000 horsepower per shaft. Complete jointly-supported effort with Project 81314 to construct land-based test site and install test equipment (FY 1988). Complete land-based tests leading to approval for limited production (1990) and start at-sea tests. Supporting technology and component improvement developments will continue.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984.

(U) Project 81314, Electric Propulsion Systems:

1. (U) DESCRIPTION (Requirement and Project): This project develops electric propulsion systems for Navy ships. The advantages of electric propulsion include ship machinery arrangement flexibility, ease of maneuvering control, low noise, and fuel

Program Element: 63573N

Title: Electric Drive

economy (especially for gas turbine drive ships) derived from the ease of electrical cross-connect between propeller shafts and variable prime mover/propeller speed reduction ratio. Advances in electric machinery technology such as liquid cooling of armature conductors, high performance current collectors (solid brushes and liquid metals), superconductive field windings, and solid-state power conditioning equipment will reduce the size and weight and improve the efficiency of high-power electric drive systems. For a typical gas turbine powered, general purpose destroyer application, these electric drive systems have the potential for major reductions in overall ship size and average propulsion fuel consumption with commensurate reductions in ship acquisition and operating costs as compared with an identical range and mission capability ship equipped with a conventional mechanical drive system. This program will develop and operationally evaluate full-scale electric propulsion systems and components. Operational evaluations are currently planned in nominal 30,000 and 50,000 horsepower per shaft systems at a land-based test site and at-sea tests and will include mechanical shock tests. Machinery design concepts selected for initial development in full-scale systems will be based on an optimization of improved performance and development risks to support the earliest feasible land-based test site installation (FY 1986) and at-sea test ship installation (FY 1988).

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o This work was accomplished in the DDGX Line in FY 1982 as directed by Congress. Results of prior conceptual design and trade-off studies together with results of prior technology developments were used to initiate competitive preliminary design of nominal 30,000 and 50,000 horsepower per shaft systems with three manufacturers of large electrical machinery.
- o Started development of critical components and supporting technology for full-scale systems.

b. (U) FY 1983 Program:

- o Complete preliminary design phase and award contracts to two or more contractors to proceed with detailed design, long-lead material procurement, and start construction of nominal 30,000 and 50,000 horsepower per shaft systems.
- o Continue development of critical components for full-scale systems.
- o Start site planning and design for land-based test site jointly with Project SI693.

c. (U) FY 1984 Planned Program:

- o Continue supporting technology and critical component development.
- o Complete detail design of major components and start construction of 30,000 and 50,000 horsepower per shaft, near-term electric propulsion systems including integrated ship service power generation.
- o Complete design of land-based test site and initiate procurement of long-lead test support equipment (joint effort with Project SI693).

d. (U) Program to Completion:

- o Complete construction and factory tests on near-term, integrated electric propulsion and ship service components on a test barge.
- o Install integrated systems at land-based test site, conduct operational evaluation and obtain Approval for Limited Production in 1988.

Program Element: 63573N

Title: Electric Drive

- o Conduct at-sea evaluation in selected test ship and obtain Approval for Production in 1990.
  - o Continue component improvements identified in operational evaluation and service application of integrated electric propulsion systems and opportunities for more effective improvements demonstrated in technology programs.
  - o This program is a continuing effort to provide development of electric propulsion systems for a number of future applications such as lower cost, monohull displacement ships, small-water-plane-twin-hull ships which will require electric drives to more effectively accomplish propulsion power transmission, and high-performance ships requiring very lightweight machinery.
- e. (U) Milestones: Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63609N  
DoD Mission Area: 553 - Engineering Technology

Title: Surface Launched Munitions  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                          | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT      | 4,220          | 4,331            | 4,254            | 4,918            | Continuing               | Continuing           |
| S0363       | Advanced Explosives Technology | 4,220          | 4,331            | 4,254            | 4,918            | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced development of insensitive high-performance explosives is to meet requirements given in the Insensitive High Explosives Operational Requirement for improved explosives safety, reduced weapons vulnerability, and improved explosives performance and producibility.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The change between the funding shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary is a decrease of 95 in FY 1984 due to adjustments during budget development.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                          | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT      | 3,927          | 4,220            | 4,331            | 4,349            | Continuing               | Continuing           |
| S0363       | Advanced Explosives Technology | 3,927          | 4,220            | 4,331            | 4,349            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: Undersea Warfare Weaponry Technology, PE 62633N; Shipboard Damage Control, PE 63514N; Strike Warfare, PE 62332N; Advanced Lightweight Torpedo, PE 63610N; Bomb Improvement Program, PE 64603N; Mine Development (Engineering), PE 64601N. Promising new, high-performance, insensitive explosives from the Undersea Warfare Technology program, PE 62633N, are transferred into the Advanced Development Project. Information on new explosives producibility and characteristics, including larger-scale safety/performance test data, is made available to weapon project offices such as the Gun Ammunition Improvement program, PE 64602N, the Shipboard Damage Control program, PE 63514N; Advanced Lightweight Torpedo, PE 63610N. Cooperative programs between the Explosives Advanced Development Project and the weapon project offices are in progress. The Explosives Advanced Development program provides information on the new explosives' producibility and characteristics and the weapon offices conduct tests to determine warhead effectiveness and behavior of in-service munitions.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Surface Weapons Center, Dahlgren, VA (Lead Laboratory); Naval Weapons Station, Yorktown, VA; Naval Weapons Center, China Lake, CA; Naval Ordnance Station, Indian Head, MD; Air Development Test Center, Eglin Air Force Base, FL; ARMY, Ballistic Research Laboratory, Aberdeen, MD; and S4 Rock Island, IL.

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Program Element: 63609N

Title: Surface Launched Munitions

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 80363, Explosives Advanced Development: Desirable insensitive explosives, primarily plastic bonded explosives, are available from the explosives exploratory development program. Although preliminary testing shows that these explosives exhibit marked improvement over conventional explosives, they cannot in general be economically loaded into munitions and are insufficiently characterized to be useful to weapons designers. This project provides for advanced development of insensitive, high-performance explosives that burn rather than detonate in a fire, that do not react violently to fragment impact, and that will not mass detonate in shipping (operational or storage) configurations. Work includes pilot plant scale-up of new explosives to enhance producibility, coordination of explosives testing and evaluation efforts, explosives characterization to establish a comprehensive data base, and large-scale safety/performance testing to provide explosives which meet the specific requirements identified in the Insensitive High Explosives Operational Requirement.

(U) In FY 1982, advanced development was completed on Composition A-3, Type II explosives, as a direct replacement for Composition A-3 (substitution of polyethylene for the no-longer-available Grade A Wax) for use in Navy gun projectiles. A specification problem was uncovered and corrective work begun on an ingredient in PBXN-106 used in HIFRAG and SM-2 warheads. PBXW-106 was recommended for use in single piece Navy 76mm and 5"/54 gun projectiles as a low vulnerability, equivalent performance explosive fill. Requalification was begun (in cooperation with Naval Air Systems Command) of MK 80 series bombs using PBXW-109(E) in place of the conventional R-6 fill. Recommendations were made to drop five new PBX's because better, similar materials are available (reducing proliferation of new explosives). Pilot plant scale-up was completed on the Advanced Lightweight Torpedo explosives (PBXW-113 and PBXW-114), modified to greatly improve processability. Necessary data was provided to select PBXW-113 for use in the Advanced Medium Range Air-to-Air Missile warhead. A number of cooperative efforts were initiated including Advanced Lightweight Torpedo and Bomb Improvement Program.

(U) The FY 1983 program consists of:

- o Modify specification for PBXN-106 ingredient and complete advanced development on PBXW-106 for use in gun projectiles and missile warheads.
- o Complete advanced development of PBXW-109(E) for use in Navy bombs and certain missile warheads (e.g., cruise missiles).
- o Issue first edition of the Navy Book of Explosives Data document on explosives in a cooperative program with Advanced Lightweight Torpedo.
- o Conduct large-scale safety tests on non-aluminized, insensitive explosives for use in projectiles and missile warheads.
- o Complete pilot plant scale-up of underwater explosives for mines and torpedoes.
- o Complete safety testing of a cook-off resistant booster and a safe primary explosives to replace lead azide.
- o Complete pilot plant scale-up of ASW, deformable explosives.

(U) For FY 1984 it is planned to continue:

- o Complete advanced development on a low vulnerability gun propellant and on a safer primary explosive.
- o Conduct large-scale performance tests on an insensitive, non-aluminized PBX for projectiles and missile warheads.
- o Complete advanced development on new torpedo explosives.



Program Element: 63609N

Title: Surface Launched Munitions

- o Conduct large-scale safety tests on underwater explosives, large-scale performance testing on cook-off resistant booster explosives, and performance tests on Selectively Aimable Warhead explosives.

(U) Project to completion: This is a continuing program which will continue efforts to provide safer, less vulnerable, high performance explosives for weapon development by exploiting promising new technology.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not Applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63654N

Title: Joint Service Explosive Ordnance Disposal Development (Advanced)

DoD Mission Area: 553 - Engineering Technology

Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT              | 3,330          | 4,954            | 5,011            | 8,065            | Continuing               | Continuing           |
| S0377       | Explosive Ordnance Disposal Procedures | 3,330          | 4,954            | 5,011            | 8,065            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the development of explosive ordnance disposal tools and equipment for use by all military services. The responsibility is assigned to the Navy as single service manager, by Department of Defense Directive 5160.62 of 24 November 1971, for management of the Joint Service Explosive Ordnance Disposal Research and Development Program. The mission of Explosive Ordnance Disposal teams is the detection, identification, rendering safe, recovery, field and laboratory evaluation and final disposal of unexploded nuclear, conventional (including improvised explosive devices) chemical and biological munitions. Increasing inventories of foreign and domestic weapons necessitate a continuing development program to provide explosive ordnance disposal personnel of all military services with the special equipment and tools required to support this mission.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in thousands) The change between the funding shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: A decrease of 3 in FY 1983 and a decrease of 103 in FY 1984 resulted from revision of cost estimates including escalation.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                  | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------|
|             | TOTAL FOR PROGRAM ELEMENT              | 3,063          | 3,330            | 4,957            | 5,114            | Continuing               | Continuing     |
| S0377       | Explosive Ordnance Disposal Procedures | 3,063          | 3,330            | 4,957            | 5,114            | Continuing               | Continuing     |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-----|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OPN | 2,035          | 1,554            | 8,931            | 11,325           | Continuing               | Continuing           |

F. (U) RELATED ACTIVITIES: All weapon related development, both domestic and foreign requires specialized tools and equipment to be developed to render safe those weapons which, after firing, fail to function as designed and create a hazard to personnel and facilities. Program Element 64654N, Joint Service Explosive Ordnance Disposal Development (Engineering), provides for the integration of specialized tools and equipment into specific procedures required for individual weapons and ordnance items.

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Program Element: 63654N

Title: Joint Service Explosive Ordnance Disposal  
Development (Advanced)

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Explosive Ordnance Disposal Technology Center (lead laboratory), Indian Head, MD.  
CONTRACTORS: Battelle, Inc., Columbus, OH; Varian Associates, Georgetown Toronto, Ontario; Southwest Research Institute; San Antonio, TX.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 70377, Explosive Ordnance Disposal Procedures: The mission of Explosive Ordnance Disposal teams is the detection, identification, rendering safe, recovery, field and laboratory evaluation and final disposal of unexploded nuclear, conventional (including improvised explosive devices) chemical and biological munitions. Increasing inventories of foreign and domestic weapons necessitate a continuing development program to provide explosive ordnance disposal personnel of all military services with the special equipment and tools required to support this mission.

(U) In FY 1982 a total of fourteen items were under design/development and two completed operational evaluation.

(U) The FY 1983 program consists of:

- o Obtaining approval for production for the items completing operational evaluation in FY 1982.
- o Continuing design/development of twelve items from FY 1982.
- o Completing development of two items.
- o Initiating the design/development of five items.

(U) For FY 1984, it is planned to:

- o Continue design/development of thirteen items.
- o Complete design/development of three items.
- o Initiate design/development of six items.

(U) The program is a continuing program under which development of new explosive ordnance disposal equipment will be initiated.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: **63701N**

Title: **Human Factors Engineering Development**

DoD Mission Area: **352 - Environmental and Life Sciences**

Budget Activity: **2 - Advanced Technology Development**

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No                       | Title                                                        | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|----------------------------------|--------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| <b>TOTAL FOR PROGRAM ELEMENT</b> |                                                              |                |                  |                  |                  |                          |                      |
| W0542                            | Air Human Factors Engineering Technology                     | 2,934          | 2,604            | 1,192            | 2,359            | Continuing               | Continuing           |
| W1188                            | Voice Interactive Systems Technology                         | 0              | 0                | 641              | 711              | Continuing               | Continuing           |
| W1190                            | Technology Integration and Applications                      | 230            | 0                | 0                | 0                | 0                        | 1,352                |
| W1191                            | Air-to-Air Visual Target Acquisition                         | 703            | 1,074            | 0                | 0                | 0                        | 2,422                |
| W1192                            | Improving Air Combat Performance                             | 150            | 0                | 0                | 0                | 0                        | 753                  |
| W1195                            | Models of System Cost Effectiveness                          | 342            | 498              | 0                | 0                | 0                        | 1,210                |
| W1196                            | Human Factors Engineering Technology for Ships               | 630            | 0                | 0                | 0                | 0                        | 1,227                |
| W1197                            | Human Factors Engineering Technology for Test and Evaluation | 347            | 385              | 0                | 0                | 0                        | 1,318                |
| Z1771                            | General Human Factors Engineering Development                | 532            | 647              | 0                | 0                | 0                        | 2,167                |
|                                  |                                                              | 0              | 0                | 551              | 1,648            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This program provides advancement and feasibility testing of human-machine-mission integration methods for application during the system development cycle. A separate program element was established to emphasize the Navy's need to insure that appropriate human factors considerations are incorporated in the engineering design of its systems. The primary objectives are: (1) improved crew and work station design and evaluation methods, (2) target acquisition and weapon system display interface criteria, (3) human performance assessment and prediction techniques for air combat maneuvering (4) human factors baseline support for emerging systems, and (5) improvements of crew/ship interface capability.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and this Descriptive Summary are as follows: In 1984 all projects shown in the 1983 Descriptive Summary will be merged into two new projects which are designated as W0542, Air Human Factors Engineering Technology, and Z1771, General Human Factors Engineering Development. This action is taken to reduce internal Navy administration. The former projects will be shown as subprojects in order to provide for congressional review of separate efforts. In 1982 the total decrease of 116 was due to inflation, economics and travel reductions. This decrease, combined with the requirement to initiate efforts to determine operator information requirements for the F-14 Advanced Instrumentation Program, resulted in the following reprogramming actions: (1) increase Subproject W1190, Human Factors Engineering Technology Integration and Applications, by 68 to initiate the F-14 effort; (2) decrease Subproject W1192, Improving Air Combat Performance, by 42; (3) decrease Subproject W1196-PN, Human Factors Engineering Technology for Ships, by 20; (4) decrease Subproject W1191, Air-to-Air Visual Target Acquisition, by 18; and (5) decrease Subproject W1195, Models of System Cost Effectiveness, by 104. In FY 1984 the total decrease of 2,375 was a result of budgetary constraints.

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Program Element: 63701N

Title: Human Factors Engineering Development

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                                                        | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                                    | 2,875          | 3,050            | 2,604            | 3,567            | Continuing               | Continuing           |
| W1188       | Voice Interactive Systems Technology                                         | 522            | 230              | 0                | 0                | 0                        | 1,352                |
| W1189       | Computer Assisted Methods of Human Factors Engineering Design And Evaluation | 542            | 0                | 0                | 0                | 0                        | 1,048                |
| W1190       | Technology Integration and Application                                       | 296            | 635              | 1,074            | 1,043            | Continuing               | Continuing           |
| W1191       | Air-to-Air Visual Target Acquisition                                         | 288            | 168              | 0                | 0                | 0                        | 771                  |
| W1192       | Improving Air Combat Performance                                             | 195            | 384              | 498              | 659              | 2,326                    | 4,237                |
| W1195       | Models of System Cost Effectiveness                                          | 292            | 734              | 0                | 0                | 0                        | 1,331                |
| W1196       | Human Factors Engineering Technology for Ships                               | 262            | 367              | 385              | 989              | Continuing               | Continuing           |
| W1197       | Human Factors Engineering Technology for Test and Evaluation                 | 478            | 532              | 647              | 876              | 3,093                    | 6,136                |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not Applicable.

F. (U) RELATED ACTIVITIES: Human Factors and Simulation Technology (Program Element 62757N), Human Factors in Military Systems (PE 62716A), Human Factors in Training and Operational Effectiveness (PE 63739A) and Aerospace Biotechnology (PE 62202F).

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory for W0542 is the Naval Air Development Center, Warminster, PA. Lead laboratory for Z1771 is the Navy Personnel Research and Development Center, San Diego, CA; OTHERS: Naval Aerospace Medical Research Laboratory, Pensacola, FL; Naval Air Test Center, Patuxent River, MD; Naval Ocean Systems Center, San Diego, CA; Naval Sea Systems Command, Washington, DC; Naval Training Equipment Center, Orlando, FL; Pacific Missile Test Center, Point Mugu, CA. CONTRACTORS: Analytica, Inc., Willow Grove, PA; Androlir, Inc., Washington, DC; Dunlap and Associates, Inc., La Jolla, CA; Hughes Aircraft Company, Fullerton, CA; Systems Technology, Inc., Hawthorne, CA; Eagle Technology, Inc., Arlington, VA; Tektronix, Inc., San Diego, CA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0542, Air Human Factors Engineering Technology: This project provides man-machine-mission integration methods to trade-off complexity, cost and manpower in a manner which ensures effective operational performance of airborne systems. This is a continuing project.

(U) Subproject 01, Human Factors Engineering Technology Integration and Applications (Formerly Project W1190-PN): This subproject provides technology support to specific systems to identify and resolve man-machine interface issues unique to the system involved.

(U) Expected Payoffs - Integration of human factors engineering techniques and procedures for system applications is estimated to reduce life cycle costs by from 10 to 30 percent by improving safety and reducing engineering change proposals.

(U) In FY 1982, joint Navy/Air Force effort determined feasibility of multi-colored, pictorially enhanced cockpit displays. Developed an experimental design to compare an advanced decision system to the ARL-67 electronic warfare display.

(U) The FY 1983 program consists of:

o Development of guidelines for application of human factors engineering technologies in advanced tactical electronic warfare decision systems.

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Program Element: 63701N

Title: Human Factors Engineering Development

- o Development of quantitative management matrices relating time, cost, and utility of human factors engineering to system development.
- o Verification of F-18 interactive voice functions.
- o Development of prototype computer-based debrief system evaluation for Tactical Aircrew Combat Training System.

(U) For FY 1984, this project will conduct voice stress analysis.

(U) Subproject 02, Improving Air Combat Performance (Formerly Project W1192): This subproject provides for development of quantitative air combat performance data related to identified requirements, development of procedures for enhancing air combat performance, and demonstration of the impact of developed procedures on mission effectiveness.

(U) Expected Payoff: Application of human factors engineering technology to tactical aircrew training system is estimated to improve tactical advantage by as much as 80 percent.

(U) The FY 1982, the functional specifications of a data retrieval system were developed for obtaining performance data on the Tactical Aircrew Combat Training System. An air combat engagement scoring system was developed for grading the outcomes of two-on-two air combat maneuvering engagements.

(U) The FY 1983 program consists of:

- o F-14 air combat maneuvering simulator training analysis to refine instructional strategies and support syllabi implementation.
- o Development of all-aspect maneuvering index, with performance measurement system refinements to include insertion of dynamic missile figure-of-merit performance characteristics.
- o Data retrieval system demonstration of extracting performance data for required analyses.
- o Data retrieval system installation in the mobile testing laboratory.

(U) For FY 1984, it is planned that this subproject will:

- o Determine functional requirements for a missile envelope recognition trainer.
- o Publish specifications for visual accommodation training device.

(U) Subproject 03, Human Factors Engineering Technology for Test and Evaluation (Formerly Project W1197): This subproject provides the techniques, methods and tools for application during test and evaluation of emerging and modified systems to assess man-machine capability as related to mission success.

(U) Expected Payoff: Feedbacks from application of operability assessment techniques during test and evaluation phases will reduce equipment down time and improve operational readiness by at least 20 percent.

(U) In FY 1982, the operability analysis of the F-18 will be completed.

(U) The FY 1983 program will consist of:

- o F-16 mission operability assessment technique validation studies.
- o User applications for integrated Army/Navy human factors engineering test and evaluation system (Title: INSPECT).

Program Element: 63701M

Title: Human Factors Engineering Development

- o System for monitoring in-flight activity.

(U) For FY 1984, this subproject will be limited to a technology watch due to an 82 percent reduction in funding level.

(U) Subproject 04, Human Factors Engineering Technology for Ships (Formerly Project W1196): This subproject provides validated and standardized methods for applying human factors engineering technology to ship systems design with initial emphasis on aircraft launch and recovery operations.

(U) Expected Payoff: Human errors during aircraft launch and recovery can be reduced by at least 50 percent.

(U) In FY 1982, evaluation of the MK 14 Arresting Gear Simulation Control station was evaluated. Human factors engineering technology was applied to evaluation of the Augmented Visual Carrier Aircraft Recovery System.

(U) The FY 1983 program consists of:

- o Complete evaluation of the MK 14 Arresting Gear Consoles.
- o Complete development of operational sequence diagrams for MK 13 Catapult Upgrade.
- o Develop human factors engineering plan for wind instrumentation measuring equipment.
- o Develop information and display requirements for CV navigation systems.

(U) Subproject 05, Voice Interactive Systems Technology (Formerly Project W1188): Voice interactive systems allow people to direct machines by talking to them, and allow the machines to report back. This subproject provides voice-controlled avionic systems to reduce present and projected crewstation workloads generated by the reliance on eyes and hands in complex airborne systems, e.g., workload problems in the P-3C, F-14 and F/A-18 aircraft. However, the technology will be applicable to all manned platforms.

(U) Expected Payoff: Voice control systems increase man-machine information transfer speed by 75 percent and accuracy by 30 percent.

(U) In FY 1982, development and validation of a payoff methodology for defining voice command functions was completed. Requirements for F-18 flight tests were defined.

(U) In FY 1983 this subproject becomes an integral part of subproject 01, Human Factors Engineering Technology Integration and Applications, for application of voice technology in the control of specific subsystems in the P-3C, F-14 and F/A-18.

(U) Subproject 06, Air-to-Air Visual Target Acquisition (Formerly Project W1191): This subproject provides a combination of visual test and training methods to improve target acquisition with unaided eyes and provide a quantitative evaluation of the improvement achieved.

(U) Expected Payoff: Target acquisition by sight improved by from 30 to 50 percent.

(U) In FY 1982, performance in the Vision Test Battery was correlated with performance in the Visual Detection Simulator, and the Mobile Testing Laboratory was completed for on-site assessment of visual abilities required in performance of air combat.

(U) The FY 1983 program calls for the Mobile Testing Laboratory to be relocated to a Tactical Aircrew Combat Training System site for the operational check-out as part of Subproject 02 above.

Program Element: 63701N

Title: Human Factors Engineering Development

(U) Subproject 07, Models of System Cost Effectiveness: (Formerly Project W1195): This subproject provides quantitative methods for determining the value of human factors engineering technology applications to naval airborne systems development.

(U) Expected Payoff: Increased appreciation for and application of human factors engineering technology during system design or modification.

(U) In FY 1982, the subproject was completed with approval of inputs to the "Program Manager's Guide for Determining the Contribution of Human Factors Engineering in Military Systems Development".

(U) Project Z1771, General Human Factors Engineering Development: (NEW START) This project develops human factors techniques for application in the weapon system acquisition process to help solve man-machine interface problems. This is a continuing project.

(U) In FY 1984, this project will:

- o Establish a man-system simulation facility.
- o Initiate assessment of tactical information overload and development of information management aids.
- o Develop interactive man-computer methods adaptive to user skill variations.
- o Assess candidate skill reduction design concepts in selected electronic system acquisitions.
- o Provide Human Factors Engineering guidance to gas turbine propulsion design for new ship program.
- o Develop methods to assess sources of difficulty in performing corrective maintenance.
- o Assess shipboard ADP systems applications effectiveness.

(U) Subproject 01, System Simulation for Man-Computer Interface Design: This subproject establishes a simulation capability for gathering empirical data on human performance in various computer interface options. These data will provide guidance to system designers for developing "user friendly" interface designs for optimizing human and computer performance in new system acquisitions.

(U) Expected Payoff: 30 percent savings in system design costs anticipated for systems simulated. Typically 20 percent savings of total system costs resulting from need for fewer hardware/software modifications once system is deployed.

(U) For FY 1984 it is planned for this subproject:

- o To provide for acquisition of a facility and development of the simulation capability.
- o Develop software for man-computer interface simulation and performance measurement.

(U) Subproject 02, Skill Requirement Reduction through System Design: This subproject seeks to develop design data that hardware system acquisition managers and system designers can use to select features for new systems that will make them easier to operate and maintain than current systems.

(U) Expected Payoff: Potential for 20-30 percent reduction in Petty Officer requirements from first class to second class.



Program Element: 63701N

Title: Human Factors Engineering Development

(U) For FY 1984, it is planned to:

- o Initiate development of specific techniques and data for selecting design alternatives that reduce operator and technical skill requirements for new system acquisitions.
- o Establish a comprehensive set of design concepts having manpower implications.
- o Initiate development of estimates of impacts the design concepts will have on operator and maintainer proficiency, maintenance man-hours, and acquisition and life cycle costs.

(U) Subproject 03, Integration of Shipboard Non-tactical ADP: This subproject seeks to integrate individual shipboard ADP systems with regard to functions performed, information stored and transferred, and operation requirements placed on the human users of these systems. This integration process will facilitate the transfer of information between and across the several shipboard departments and their respective ADP systems, providing for increased efficiencies in system operation and utilization.

(U) Expected Payoff: 40 percent savings in system development costs through elimination of duplication and redundancy.

(U) For FY 1984 it is planned to:

- o Review existing shipboard non-tactical ADP systems, applications, and strategies used to interface the systems.
- o Develop methods for assessing each system's contributions and deficiencies with respect to ship requirements.

(U) Subproject 04, Maintenance Simplification: This subproject seeks to reduce equipment downtime by developing a range of principles, procedures and job performance aids specifically directed at simplifying the corrective maintenance process.

(U) Expected Payoff: Troubleshooting job aids that will produce major increases in equipment availability (e.g., 15 percent) by reducing the time needed to correct equipment failures. Potential 30-50 percent reduction in fault isolation time.

(U) For FY 1984 it is planned to develop methods to assess the sources of difficulty encountered in performing corrective maintenance and establish a program to identify:

- o Equipment design features that facilitate maintenance diagnostics.
- o Effective decision-making strategies for technician use in resolving malfunctions.
- o Training principles specific to the corrective maintenance process.
- o Effects of logistics and management factors on corrective maintenance efficiency.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not Applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63704N  
DoD Mission Area: 552 - Environmental and Life Sciences

Title: Oceanographic Instrumentation Development  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                         | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                     | 2,902          | 2,999            | 6,168            | 9,217            | Continuing               | Continuing           |
| R0118       | Oceanographic Instrumentation Systems         | 1,507          | 1,324            | 2,424            | 3,827            | Continuing               | Continuing           |
| R1299       | Oceanographic Techniques                      | 1,395          | 997              | 2,439            | 3,827            | Continuing               | Continuing           |
| R1593       | Mapping, Charting and Geodesy Instrumentation | 0              | 0                | 373              | 461              | Continuing               | Continuing           |
| R1596       | Satellite Oceanographic Tactical Applications | 0              | 678              | 932              | 1,102            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides specialized, high resolution oceanographic instrumentation, measurement and analysis techniques in response to Navy fleet operational, survey, and mapping/charting/geodesy requirements. Provides tactically usable assessments of fleet operational problems ascribable to upper ocean variability.

to fleet operational improvement through development of oceanographic forecast/assessment models; and real time observational support by remote sensing and to Navy mapping/charting/geodesy through development of instrumentation/measurement optimization techniques.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The change between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary result from a net decrease of 132 in 1984 for escalation adjustments.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                         | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                     | 2,456          | 2,902            | 2,999            | 6,300            | Continuing               | Continuing           |
| R0118       | Oceanographic Instrumentation Systems         | 982            | 1,507            | 1,324            | 2,474            | Continuing               | Continuing           |
| R1299       | Oceanographic Techniques                      | 1,474          | 1,395            | 997              | 2,490            | Continuing               | Continuing           |
| R1593       | Mapping, Charting and Geodesy Instrumentation | 0              | 0                | 0                | 382              | Continuing               | Continuing           |
| R1596       | Satellite Oceanography Tactical Applications  | 0              | 0                | 678              | 954              | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES: This project provides direct oceanographic support for research and development pursued under the following program elements: 11224N, SSBN Security; 63371N, GEOSAT; 11221N, SSBN Unique Countermeasures Development; 63528N, Non-Acoustic ASW; and elements of 63701B and 64701B for Navy specific Mapping, Charting and Geodesy. Additionally, this project provides the primary research and development support to operations under the following program elements: 35112N, Oceanography (Survey Operations); and 35131N, Mapping, Charting and Geodesy.

Program Element: 63704N

Title: Oceanographic Instrumentation Development

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Ocean Systems Center, San Diego, CA; Naval Oceanographic Office, Bay St. Louis, MS; Naval Postgraduate School, Monterey, CA; Naval Research Laboratory, Washington, D.C. Contractors: Sippican Corporation, Marion, MA; Applied Physics Laboratory, University of Washington, Seattle, WA; University of British Columbia, Vancouver, BC, Canada; Science Applications, Inc., McLean, VA; Johns Hopkins University, Baltimore, MD; Applied Physics Laboratory, Johns Hopkins University, Baltimore, MD; Scripps Institute of Oceanography, San Diego, CA; Marine Environments, Inc., Washington, D.C.; Computer Science Corporation, Bay St. Louis, MS; Jet Propulsion Laboratory, Pasadena, CA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project R0118, Oceanographic Instrumentation Systems: This project responds to the Chief of Naval Operations stated requirements for developing oceanographic instruments suitable for general survey use to collect oceanographic data to meet fleet needs. These requirements for advanced oceanographic instrumentation and measurement techniques are illustrated by the stringent oceanographic data requirements of the present Fleet Ballistic Missile Defense Program and by the environmental information support requirements of various weapons systems.

(U) In FY 1982,

- o Completed expendable shear probe remote deployment technique.
- o Developed algorithms and software for automatic microstructure profiler.
- o Designed digital deck data collection unit and tested system.
- o Began development of horizontal towed current meter.
- o Tested new doppler acoustic current profiling system.
- o Designed a towed turbulence sensor.
- o Designed, constructed and delivered closed bathyphotometer system to the Naval Oceanographic Office.
- o Investigated means of adaptive data collection and compaction. Provided initial research and development support to the Naval Oceanographic Office.

(U) The FY 1983 program consists of:

- o Efforts to complete development of correlation acoustic current profiling techniques and test compare against doppler system.
- o Complete automatic yo-yo microstructure profiler and provide training to Naval Oceanographic Office personnel in its use.
- o Demonstrate feasibility of air-launched shear profilers.
- o Construct and test horizontal profiling current meter.
- o Demonstrate feasibility of adaptive data collection and compaction techniques.

Program Element: 63704N

Title: Oceanographic Instrumentation Development

- o Test new depth indication techniques in expendable sensors.
- o Construct and test towed turbulence sensor.
- o Design and construct new open profiling system for bioluminescent data collection.
- o Continue to provide the Naval Oceanographic Office aircraft with automated data collection and processing system.

(U) For FY 1984, it is planned to continue:

- o Development of the underway, shipboard acoustic profiling system.
- o Development of the oceanographic airborne multi-sensor data acquisition and processing system.
- o Transition the expendable current profiling system to engineering development.
- o Commence development of the airborne bioluminescence survey imager; remote ocean data acquisition system; and the towed temperature turbulence rake.

(U) Program to completion: This is a continuing program.

(U) Project R1299, Oceanographic Techniques: The objective of this program is to develop/document/validate experimental and analytical techniques to describe the background physical processes in the upper ocean and the variability of these processes. The program is designed to support high priority Navy efforts in areas such as Fleet Ballistic Missile Defense and Non-Acoustic Anti-Submarine Warfare.

(U) In FY 1982:

- o Provided data analysis for strategic areas of the North Atlantic and North Pacific Oceans.
- o Provided strategic areas [ ]
- o Continued development of algorithms and methods for analyzing Expendable Current Profiler results.
- o Completed a comparison of observed shear data with results from both a dynamic model and a statistical model for shear.
- o The role of turbulence in determining upper ocean background has been investigated.
- o The relationship between temperature and salinity in areas of strong temperature inversions was developed for strategic areas of the North Atlantic and North Pacific.
- o Techniques to determine levels of fine structure based on measurements of mesoscale features have been assessed.

(U) The FY 1983 program consists of:

- o Assessing strategic [ ] areas in the North Atlantic and North Pacific.

Program Element: 63704N

Title: Oceanographic Instrumentation Development

- o Analyzing of [ ] areas.
- o Measurement strategies for the expendable current profiling system.
- o Developing guidelines for interpreting oceanographic data from sensors having non-ideal motions.
- o Developing optimum survey strategies for measurements in vicinity of ocean fronts.

(U) For FY 1984, it is planned to continue:

- o Development of the data management/analysis software module for use with the expendable current profiler.
- o Development of sampling/analysis guidelines for the towed temperature turbulence rake.
- o Development of a sea/surf/heath currents forecast model for selected coastal sites in CINCLANTFLT's area of responsibility.
- o Development of consolidated oceanographic data base management system.
- o Development of consolidated quality and configuration management control system for oceanographic forecast models.

(U) Program to completion: This is a continuing program.

(U) Project R1593, Mapping, Charting and Geodesy: (NEW START) This project was established as a result of a Memorandum of Understanding between the Defense Mapping Agency, the Chief of Naval Operations (OP-952) and the Chief of Naval Research/Chief of Naval Development. This is a new start, which will address the special mapping, charting and geodesy requirements of the Naval Oceanographic Office.

(U) In FY 1982: Not applicable, FY 84 New Start.

(U) FY 1983: Not applicable.

(U) For FY 1984, it is planned to:

- o Develop and test a marine optical pumping magnetometer which will achieve continuous sampling of the magnetic field with 0.02 gamma sensitivity.
- o Investigate a feasibility of developing new Kevlar coaxial tow cable for use with this magnetometer.

(U) Program to completion: This is a continuing program.

(U) Project R1596, Satellite Oceanographic Tactical Applications: This was a new start in FY 1983 in response to the requirement for real time oceanographic data applicable to fleet tactical applications.

(U) In FY 1982: Not applicable.

(U) The FY 1983 program consists of:

- o Developing methods to assimilate satellite sea surface temperature and other tactically important ocean products into ocean prediction models and tactical ocean products at Fleet Numerical Oceanography Center.

Program Element: 63704N

Title: Oceanographic Instrumentation Development

- o Developing methods to assimilate Defense Meteorological Satellite Program-Spatial Sensor Microwave Imager stress data into ocean prediction models. Developing data processing and communication systems to support use of GEOSAT data in detecting ocean fronts and eddies for fleet use in near-real time.
- o Developing and transitioning software modules to Naval Eastern Oceanographic Center, Norfolk, Virginia for exploitation of satellite data for fleet ASW and ship routing support.
- o Developing North Atlantic and Mediterranean volume of Naval Tactical Application guides for interpretation of satellite imagery in oceanography applications.

(U) For FY 1984, it is planned to continue: developing GEOSAT ocean application methods and software modules for operational use at Fleet Numerical Oceanography Center. Developing techniques for tactical use of satellite data and install these at Fleet Numerical Oceanography Center, Naval Oceanography Command Regional Centers and aboard ships. Conducting at sea verification of ocean products derived from advanced satellites. This is a continuing program.

(U) Program to completion: This is a continuing program.

1. (U) PROJECT OVER \$10 MILLION IN FY 1984. Not Applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63706N  
DoD Mission Area: 552 - Environmental and Life Sciences

Title: Medical Development (Advanced)  
Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                             | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT         | 12,015         | 8,384            | 10,275           | 11,070           | Continuing               | Continuing           |
| M0095       | Fleet Health Technology           | 7,179          | 4,382            | 4,979            | 5,804            | Continuing               | Continuing           |
| M0096       | Fleet Health Standards            | 1,996          | 1,142            | 2,233            | 2,596            | Continuing               | Continuing           |
| M0097       | Air Crew Impact Injury Prevention | 2,840          | 2,860            | 3,063            | 2,670            | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The wide variety of possible combat scenarios in which Navy and Marine Corps personnel may be called upon to function necessitates the development of medical and dental health care maintenance and delivery systems for use in diverse operational settings. This program element focuses on the development of advanced systems and techniques to enhance unit/individual performance effectiveness and combat readiness, to prevent injury, and to optimize combat casualty care in order to increase return-to-duty rates and to minimize mission abortion frequency.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: In FY 1982, a net decrease of 219 (-632 in M0095, +451 in M0096 and +38 in M0097) was due to reprogrammings to other Navy medical RDT&E projects; for partial support of a Congressionally-directed study of relationships between birth defects and exposure to Agent Orange; and evaluation of chronic exposure of primates to extremely low frequency electric and magnetic fields (540 was transferred from Project M0095 to Project M0096 since the work provides a basis for establishing fleet health standards). In FY 1983, funds were decreased by 474 as a result of Congressional reduction. In addition, funds were transferred among projects to more accurately reflect where they will be expended. In FY 1984, funding for Project M0096 is increased by 349 to support development of age-free biomedical standards for naval aviators. Other adjustments in FY 1984 are due to budget constraints.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                             | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT         | 9,428          | 12,234           | 8,858            | 9,890            | Continuing               | Continuing           |
| M0095       | Fleet Health Technology           | 6,022          | 7,811            | 4,532            | 5,099            | Continuing               | Continuing           |
| M0096       | Fleet Health Standards            | 1,202          | 1,545            | 1,466            | 1,684            | Continuing               | Continuing           |
| M0097       | Air Crew Impact Injury Prevention | 2,204          | 2,878            | 2,860            | 3,107            | Continuing               | Continuing           |

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Program Element: 63706N

Title: Medical Development (Advanced)

E. (U) OTHER FY 1984 APPROPRIATION FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: Army and Air Force R&D efforts in medical support of military operations; Department of Transportation efforts on impact injury; National Institutes of Health efforts in the development and evaluation of blood products, and tissue transplantation techniques. Beginning with FY 1983 the Army is the lead service for infectious disease and combat dental research; the Navy participates in these areas and develops a technical program jointly with the Army which has overall management responsibility. The Service's programs are coordinated by the Armed Services Biomedical Research Evaluation and Management Committee. Additional coordination is provided by various reviews sponsored by the Under Secretary of Defense for Research and Engineering to ensure that work is complementary to, rather than duplicative of, the programs of the other Military Departments and non-DoD research organizations.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Medical Research Institute, Bethesda, MD, and five other Naval Medical Research and Development Command laboratories; Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA; National Naval Dental Center, Bethesda, MD. CONTRACTORS: University of North Carolina, Chapel Hill, NC; University of California, San Diego, CA; Michael Reese Hospital and Medical Center, Chicago, IL; Boston University, Boston, MA; Georgetown University, Washington, DC; University of Miami, Miami, FL; Pacific Northwest Research Foundation, Seattle, WA; Cyometrics, Washington, DC; Dynatech R&D Co., Boston, MA; Yale University, New Haven CT; University of Tulsa, Tulsa, OK; Institute of Human Performance, Fairfax, VA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project M0095, Fleet Health Technology: This project provides for the advanced development of new techniques for the prevention, diagnosis, treatment, and management of medical and dental casualties in different operational and climatic environments.

(U) In FY 1982, perfected field-suitable, coagulation test for rapid diagnosis of typhoid fever in blood and stool cultures, developed ELISA-monoclonal antibody test for Rift Valley Fever, proved metrifonate to be an excellent non-toxic drug for treatment of light Schistosoma haematobium infections, developed an animal model to assess resuscitation procedures for cold weather casualties with traumatic injuries, completed construction of a laser-assisted microsurgical anastomosis device for repair of vessels and nerves, produced and patented a synthetic wound covering, commenced Fleet Phase I test and evaluation of the Modular Laboratory, determined that cryopreserved platelets are therapeutically safe and effective in humans, field tested prototype frozen blood system at Navy Pacific Fleet Command, Okinawa, Japan.

(U) The FY 1983 program consists of:

- Testing and evaluating a shipboard frozen blood system
- Completing Phase I test and commencing Phase II test of the Modular Laboratory



Program Element: 63706N

Title: Medical Development (Advanced)

(U) The FY 1983 program consists of: (cont)

- Completing feasibility study of a field medical information system for amphibious operations
- Continuing development of improved techniques to manage combat trauma casualties in cold weather operations
- Developing a dental emergency kit for use by independent duty corpsmen
- Continuing development of a new wound covering which provides for the slow release of antibiotics and other biologically active agents
- Determining the efficacy of hypertonic lactate solutions for resuscitation of trauma patients
- Testing the feasibility of producing pyrogen-free water aboard ships for use in resuscitation fluids

(U) For FY 1984 it is planned to:

- Continue development of improved medical equipment to enhance field and shipboard casualty support
- Continue development and evaluation of new procedures for early diagnosis and treatment of shock and trauma casualties with emphasis on trauma casualties in cold weather environments
- Continue evaluation of blood component preservation system for improved therapeutic effectiveness
- Complete development of system for computer assisted diagnosis of dental emergencies

(U) This is a continuing program.

(U) Project M0096, Fleet Health Standards: This project is directed toward the development and validation of (1) biomedical screening guidelines for establishing service entry, assignment and retention standards for specific Navy and Marine Corps operational duties; (2) medical procedures for minimizing the biomedical effects of occupational stressors such as fatigue, workload and vibration; and (3) medical guidelines for equipment design, work procedures and safety.

(U) In FY 1982, developed software to validate the newly developed performance-based test used to select Student Naval Aviators for initial pilot training, determined that stress occurring during Marine Corps basic training has a positive effect on overall performance, analysis of hospital admission data indicated that less than 16 percent of personnel admitted for personality disorders were effective when returned to duty, developed specifications for sonar headphones that significantly improve target detection, specifications developed for automated Navy Mental Health Information System, continued evaluation of the effects of chronic exposure to extremely low frequency electric and magnetic fields on primates.

Program Element: 61706M

Title: Medical Development (Advanced)

(U) FY 1983 program consists of:

- Continuing work on task analysis of Marine Corps performance under operational environments
- Continuing development of the Airsickness Desensitization Program
- Continuing validation of recently developed performance-based screening tests to predict naval aviator success in training
- Continue development of screening and selection techniques for Explosive Ordnance Disposal Training

(U) In FY 1984 it is planned to:

- Complete development of interia hearing conservation standards for Navy personnel using underwater tools
  - Evaluate effectiveness of the Airsickness Desensitization Program
  - Commence development of age-free biomedical standards for naval aviators
  - Complete development of techniques for screening and selecting Explosive Ordnance and Disposal training candidates
- Continue task analysis of the performance of Marine Corps personnel in operational environments

(U) This is a continuing program.

(U) Project M0097, Aircrew Impact Injury Prevention: This project determines the human physical, performance and neurophysiological response to impact acceleration. The information is required for (1) the design and construction of anthropomorphic manikins that are required for the test and evaluation of Navy weapons system and (2) the development of models that will predict the injurious effects of impact and for use in the design and evaluation of safety features in Navy and Marine Corps and other vehicles.

(U) In FY 1982, completed an extensive set of experiments on the impact sled including accelerations and decelerations along the frontal and lateral planes, developed an impact measurement system for evaluating the physiological hazards associated with aircraft ejection, and, developed mathematical models of head-neck responses to impact acceleration.

Program Element: 63706M

Title: Medical Development (Advanced)

(U) The FY 1983 program consists of:

- Completing human data set for head, neck and pelvic response to acceleration and deceleration applied perpendicularly to gravity
- Comparing neurophysiological response data of human volunteers in the frontal and horizontal impact acceleration planes with similar data obtained from subhuman primates to provide information of mathematical modelling
- Continuing development of methods to assess the biomedical effects of parachute-opening shock

(U) For FY 1984 it is planned to:

- Define impact injury thresholds based on cardiovascular, neurophysiological, neuropathological, general pathologic and/or biochemical measures
- Extend the impact injury model for subhuman primates to lateral plane of accelerations

(U) This is a continuing program.

1. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63707M  
DoD Mission Area: 352-Environmental and Life Sciences

Title: Manpower Control Systems Development  
Budget Activity: 2-Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No                | Title                                                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|-----------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                                           | 4,370          | 1,805            | 2,915            | 4,388            | Continuing               | Continuing           |
| Z1167                     | Procedures for Officer and Enlisted Acquisition           | 180            | 0                | 0                | 0                | 0                        | 703                  |
| Z1169                     | Productivity Improvement Systems                          | 241            | 212              | 0                | 0                | 0                        | 1,051                |
| Z1178                     | Attrition Analysis and Management                         | 270            | 40               | 0                | 0                | 0                        | 887                  |
| Z1182                     | Military Personnel Cost Projections                       | 270            | 0                | 0                | 0                | 0                        | 1,017                |
| Z1186                     | Fleet Support Manpower                                    | 550            | 696              | 0                | 0                | 0                        | 2,831                |
| Z1187                     | Computer Based Manpower Planning and Programming          | 510            | 498              | 0                | 0                | 0                        | 2,190                |
| Z1342                     | Family Support Program                                    | 0              | 299              | 0                | 0                | 0                        | 514                  |
| Z1383                     | Civilian Personnel Issues                                 | 90             | 0                | 0                | 0                | 0                        | 155                  |
| Z1385                     | Computer Adaptive Testing*                                | 1139           | 60               | 0                | 0                | 0                        | 1199                 |
| Z1583                     | Geographic Stability                                      | 400            | 0                | 0                | 0                | 0                        | 400                  |
| Z1584                     | Improved Personnel Records System**                       | 600            | 0                | 0                | 0                | 0                        | TRD                  |
| Z1610                     | Improved Personnel Administrative Support System Office** | 70             | 0                | 0                | 0                | 0                        | 70                   |
| Z1678                     | Manpower, Personnel and Training R&D Program Analysis     | 50             | 0                | 0                | 0                | 0                        | 50                   |
| Z1770                     | Manpower and Personnel Development                        | 0              | 0                | 2,915            | 4,388            | Continuing               | Continuing           |

\* Will be transferred to P.E. 64703M in FY 1984

\*\* Transferred to P.E. 63710N for FY 1983 only

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The increased cost of military personnel, plus anticipated shortages in their supply, have brought a new urgency to the search for solutions to major Navy problems with personnel and manpower. Compounding this urgency is the critical need for effective manpower management that is responsive to problems caused by below-standard fleet performance of marginal personnel, premature enlisted attrition, and inadequate retention of high-quality personnel in the operating forces. The central objective of this program, therefore, is the development of improved techniques for the management of Navy manpower and personnel systems. Specific problem areas being addressed include people/assignment mismatches, manpower shortages in critical ratings, high service attrition, inadequate compensation planning policies, inaccurate predictions of support manpower requirements, family-related retention problems and inadequate civilian management policies in the face of budget and workforce reductions.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) To reduce internal Navy administration, all projects have been merged into the single project, Z1770 - Manpower Personnel Development. To provide for Congressional review of separate efforts, the former projects will be shown as subprojects in later paragraphs. The FY 1982 total in the FY 1984 Descriptive Summary reflects a net increase of 1,597 to attain a viable manpower and personnel advanced development program through reprogramming from lower priority work in other program elements and from two projects in this program. These decremented projects are Z1186, Fleet Support Manpower (-461) and Z1187, Computer Based Manpower Planning

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Title: Manpower Control Systems Development

and Programming (-143). FY 1982 work augmented or reinstated through this reprogramming includes projects 21167, Procedures for Officer and Enlisted Acquisition (+160); 21169, Productivity Improvement Systems (+30); 21178, Attrition Analysis and Management (+270); 21182, Military Personnel Cost Projections (+270); 21383, Impact of New Technologies on Civilian and Military Occupations (+90); 21385, Computer Adaptive Testing (+241); and 21583, Geographic Stability (+400). Three projects were transferred to the program: 21610, Improved Personnel Administrative Support System Office (+70); W1584, Improved Personnel Records System (+600); and, Manpower, Personnel and Training R&D Program Analysis (+30). The first two of these additions were continuing efforts transferred to P.E. 63707N when budget constraints resulted in cancellation of P.E. 63710N. The FY 1983 total program was reduced (1706) by Congress. As a result, the following specific reductions were made: 21182, Military Personnel Cost Projections (-329); 21186, Fleet Support Manpower (-100); 21211, Total Force Personnel Supply (-398); 21383, Civilian Personnel Issues (-301); 21582, Second Generation Human Resources Management (-289) and 21583, Geographic Stability (-389). Two projects had small increases to complete necessary work in FY 1983. They are 21178, Attrition Analysis and Management (+40) and 21385, Computer Adaptive Testing (+60). The FY 1984 program is 122 greater in this Descriptive Summary primarily due to new requirements and efforts.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No.               | Title                                              | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                                    | 3,129          | 2,773            | 3,511            | 2,793            | Continuing               | Continuing           |
| 21167                     | Procedures for Officer and Enlisted Acquisition    | 204            | 0                | 0                | 0                | 0                        | 523                  |
| 21169                     | Productivity Improvement Systems                   | 248            | 211              | 212              | 0                | 0                        | 1,021                |
| 21170*                    | Human Processing of Large Automated Data Bases     | 361            | 0                | 0                | 0                | 0                        | 1,010                |
| 21178                     | Attrition Analysis and Management                  | 215            | 0                | 0                | 0                | 0                        | 577                  |
| 21182                     | Military Personnel Cost Projections                | 372            | 0                | 329              | 349              | 893                      | 2,318                |
| 21186                     | Fleet Support Manpower                             | 845            | 1,011            | 796              | 506              | 2,999                    | 6,897                |
| 21187                     | Computer Based Manpower Planning and Programming   | 602            | 653              | 498              | 395              | 897                      | 3,625                |
| 21211                     | Recruiting System Management                       | 0              | 0                | 398              | 386              | 1,455                    | 2,239                |
| 21326                     | Integrated Crews                                   | 60             | 0                | 0                | 0                | 0                        | 142                  |
| 21342                     | Family Support Program                             | 65             | 0                | 299              | 276              | 1,710                    | 2,477                |
| 21383                     | Civilian Personnel Issues                          | 65             | 0                | 301              | 297              | 996                      | 1,859                |
| 21385**                   | Computer Adaptive Test                             | 0              | 898              | 0                | 0                | 0                        | 898                  |
| 21392*                    | Performance Enhancement                            | 94             | 0                | 0                | 0                | 0                        | 185                  |
| 21582                     | Second Generation Human Resources Management (HRM) | 0              | 0                | 289              | 287              | 855                      | 1,431                |
| 21583                     | Geographic Stability                               | 0              | 0                | 389              | 297              | 296                      | 982                  |

\* Transferred to P.E. 63710N in FY 1982 budget. Project subsequently cancelled by FY 1982 Budget Amendment.

\*\* Transferred to P.E. 64709N after FY 1982.

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES: Related DoD work in manpower and personnel R&D is being conducted under the following program elements: 61102A (74), Training, Personnel and Human Engineering; 61102F (2313), Human Resources; 61153N (42), Behavioral and Social Sciences; 62722A, Manpower, Personnel and Training; 62703F, Personnel Utilization Technology; 62763N, Personnel and Training Technology; 63731A, Manpower and Personnel; 63732N, Marine Corps Advanced Manpower/Training System; and 64709N, Prototype Manpower/Personnel System. The work in P.E. 63707N, while often related in objective and approach to the above R&D of the other services, is unique in that it is tailored to the organizational and population characteristics of the Navy. Nevertheless, to ensure that unnecessary duplications of efforts do not arise, extensive preliminary literature reviews are conducted and liaison is maintained with the Office of the Under Secretary of Defense for Research and Engineering and with the Army and Air Force through program reviews, information exchanges, visits, and special briefings.

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Title: Manpower Control Systems Development

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is the Navy Personnel Research and Development Center, San Diego, CA. OTHERS: Naval Air Systems Command. CONTRACTORS: REMAS Group, Inc., Falls Church, VA; Mathtec, Inc., Princeton, NJ; Market Facts, Inc., Washington, DC; SDC Integrated Services, San Diego, CA; Belt, Baranek, & Newman, Inc., Cambridge, MA; McDonnell Douglas Corp., St. Louis, MO; WICAT Systems, Inc., Orem, UT; Human Resources Research Organization, Alexandria, VA; Systems Exploration, Inc., San Diego, CA; Westinghouse Electric Corp., Columbia, MD; International Business Services, Inc., Washington, DC. OTHERS: None.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 21770, Manpower Personnel Development: This continuing project is divided into subprojects as described below.

(U) Subproject 01, Military Personnel Cost Projections (Formerly Project 21182): This project will enable managers to determine the cost of alternative compensation policies and their impact on retention. Quantitative techniques will be developed to provide more accurate estimates of the contribution that various compensation elements (as well as factors such as unemployment) have on the decision to stay in or leave the military. These techniques will be used to determine the cost and retention effects of alternative compensation packages, which in turn will enable Navy managers to identify the most cost-effective policies in managing the force.

(U) Expected Payoff: Typical of the payoff from this project was the identification of an alternative military pay adjustment index that increases military occupational representation from a current 10% to roughly 70%. Use of this new, more comparable index could lead to more stable retention and eliminate the need for costly "catch-up" raises--a legacy of non-comparable indexes.

(U) In FY 1982 development of a comprehensive occupational reenlistment forecasting model was continued and an assessment of alternative military pay adjustment indexes was completed.

(U) The FY 1983 program continues the development and enhancement of a computer-based model to determine the effects of various methods of allocating military pay.

(U) For FY 1984 it is planned to:

- o Complete the reenlistment forecasting model.

- o Undertake development of model to effectively allocate pay dollars among basic pay, allowances, selective reenlistment bonuses, and special pays will be undertaken.

(U) In future years the Navy retirement program will be evaluated including the role and mix of cash and nonrecurring compensation elements.

(U) Subproject 02, Fleet Support Manpower (Formerly Project 21186): This project will develop techniques to forecast Navy support manpower requirements and estimate total civilian and military requirements based on size and mix of fleet. The computerized manpower forecasting system developed under this project will be used by manpower managers to determine budgets and manpower resources necessary to support programmed force levels (ships and aircraft inventories). As forecasting models for each area of support are developed, specific Navy resource sponsors will test and evaluate the models for improved manpower forecasting and allocation.

(U) Expected Payoff: Since a 10% increase in platforms implied only a 3.54% increase in support manpower, savings of about 4.5% can be made relative to the assumption of equal percentage increases.

(U) In FY 1982 a computer model to forecast aggregate civilian and military manpower requirements for the total support establishment was developed for use in the Extended Planning Annex. In addition, data bases and models were developed for

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estimating manpower at naval stations and air stations. These models indicated that the manpower requirements of the support component are disproportionate to increases in operating forces: that is, a 10% increase in force levels (platforms) implied a 5.54% increase in support.

(U) The FY 1983 program develops data bases and models to:

- o Forecast civilian and military support manpower requirements by Defense Planning and Programming Category.
- o Estimate Base Operating Support manpower at training activities.

(U) In FY 1984 it is planned to develop techniques to forecast requirements at indirect support activities (e.g., medical personnel).

(U) In future years analytical models to forecast military and civilian manpower requirements by major skill groupings will be developed and implemented for operational use.

(U) Subproject 03, Computer-Based Manpower, Planning and Programming (Formerly Project Z1187): The results of this project will improve Navy officer and enlisted personnel inventory management by determining the accession, promotion and retention levels necessary to achieve requirements, and the cost/feasibility of attaining those levels. Officer and enlisted force planners will be able to increase the accuracy with which they predict personnel flows, develop personnel policies designed to meet manpower requirements, thus reducing skill excesses and shortages.

(U) Expected Payoff: Substantial improvements in the accuracy of planned personnel levels and costs, typified by the already improved accuracy of officer personnel loss forecasts. A new technique developed under this project, has reduced the forecast error of previous methods by an average of 65%.

(U) In FY 1982 an initial version of a system that permits simultaneous consideration of officer accession and promotion plans, manpower requirement specifications and officer supply projections was completed.

(U) The FY 1983 program will continue development of the total officer system that integrates accession and promotion with loss forecasting and supply constraints.

(U) For FY 1984 it is planned to:

- o Enhance the basic enlisted manpower management models including those for generating optimal accession requirements, forecasting losses and other personnel flows, and generating force strength data.
- o Develop, enhance, test and evaluate officer and enlisted systems.

(U) In the outyears methods will be implemented as they are completed.

(U) Subproject 04, Total Force Personnel Supply (Formerly Project Z1211): (FY 1983 new start) This project will develop techniques for defining the total supply of personnel available for Navy service and will develop policy-oriented computer planning models for determining optimally cost-efficient accession policies. This work will lead to a significant reduction in manpower procurement costs brought about by the requirement for the Navy to rapidly expand in both technological complexity and size while its supply of available manpower will decline by more than 20 percent.

(U) Expected Payoff: Specific benefits will include reduced manpower procurement costs of up to \$8,000,000 per year for the current decade, an accession strategy that will assure adequate manning levels for all components of the Naval Reserve; an overall accession strategy that will assure on-time manning of the 600 ship Navy; and up to \$3,000,000 per year in avoidance of training costs realized by not recruiting attrition-prone personnel.

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(U) The FY 1983 program:

- o Develops estimates of the qualified military available, both present and projected.
- o Assesses existing enlisted, officer, and reserve computer models and supply sources.

(U) For FY 1984 it is planned to assess enlisted recruitment strategies.

(U) In the outyears, comprehensive planning computer models emphasizing efficient techniques for procuring sufficient personnel in all classes (enlisted, officer, reserve) in a cost-efficient manner will be developed.

(U) Subproject 05, Family Support Program (Formerly Project Z1342): This project will develop effective Navy family programs and policies for implementation. Knowledge of the basic structure, needs, and environment of the Navy family as well as its role in morale, performance and retention will be obtained. Family-related programs will be designed and evaluated.

(U) Expected Payoff: Improvements in retention, operational readiness, satisfaction and quality of life. Other benefits will include lowered incidence of family violence in Navy homes, reduction of health claims arising from family stress, and increased commitment to the Navy on the part of service members and their families.

(U) In FY 1982 funding was reprogrammed to higher priority projects.

(U) The FY 1983 program includes:

- o Evaluation of the effectiveness of Navy Family Service Centers.
- o Determining the impact of spouse job employment assistance in relation to retention, career decision-making, and quality of life.

(U) For FY 1984 it is planned to:

- o Select additional family-related programs for test and evaluation.
- o Investigate role played by family-related factors at different points in a naval career.

(U) In future fiscal years, evaluation of family-centered programs will be completed and policy changes recommended to improve the quality of Navy family life with resulting increases in reenlistments and productivity.

(U) Subproject 06, Impact of New Technologies on Civilian and Military Occupations (Formerly Project Z1383): The Navy has approximately 300,000 civilian employees. Their productivity and effectiveness impact fleet readiness because they develop, procure and maintain weapon systems, and provide supplies and facilities. They are managed in accordance with the Federal Government's civilian personnel administration system. There has been very little research on ways the Navy can improve the management of civilian personnel. Yet, there is strong reason to believe that significant improvements in their performance can be attained through improved management and administration.

(U) Expected Payoff: Reduced civilian personnel costs through improved management.

(U) In FY 1982, new technology areas being applied to logistic support activities were identified and their implications for personnel management compiled.



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(U) The FY 1983 plan calls for:

- o Development of a civilian personnel R&D "roadmap", identifying major issues and prioritizing the needed work.
- o Development of techniques to forecast civilian manpower skill requirements for the Fleet support activities.

(U) For 1984, it is planned to:

- o Begin work on the high priority areas previously identified.
- o Improve the performance of military managers of civilians and relations between line management and civilian personnel staff.

(U) Subproject 07, Computer Adaptive Testing (Formerly Project Z1335): This project, which is a joint service effort, will develop and evaluate an automated adaptive test administration system to replace the current paper-and-pencil Armed Services Vocational Aptitude Battery tests used for enlisted personnel selection and classification.

(U) Expected Payoff: The use of computer-administered, adaptive tests will eliminate a number of costly shortcomings of the printed Armed Services Vocational Aptitude Battery. Testing time will be cut by 50 percent, with a savings of over one million examinee manhours and 90,000 test administrator manhours annually. Compromise of test security will be eliminated. Erroneous enlistments/assignments resulting from clerical errors in test scoring and record-keeping will be eliminated. Aptitude measurement accuracy will be improved, with potential for reduction of enlisted training attrition. Finally, the automated system will eliminate a number of costs associated with test printing, distribution, and manual operations. A preliminary estimate is that the automated system will save five million dollars annually in operating costs.

(U) In FY 1982 preliminary design and development analyses were conducted, and three alternative designs were selected for evaluation.

(U) The FY 1983 program develops and evaluates prototypes of the three design alternatives.

(U) For FY 1984, it is planned to move the project to Program Element 64709N, Training and Personnel System Development.

(U) Subproject 08, Second Generation Human Resources Management (Formerly Project Z1582): The Navy Human Resources Management Program has resulted in significant improvements in fleet readiness and command effectiveness. However, its scientific base is about twenty years old. This subproject will apply and develop new findings and techniques related to organizational functioning to increase the effectiveness of the Human Resources Management Program. These will be implemented after evaluation.

(U) Expected Payoff: A significant increase in operational readiness and a concomitant increase of 5-10% in military unit productivity.

(U) In FY 1983 the program will identify the organizational, technological, structural and environmental problem areas that have an impact on readiness.

(U) For FY 1984 it is planned to continue the above activities.

(U) In future fiscal years strategies for improving readiness and productivity through human resource management will be developed, tested, and implemented in the fleet.

(U) Subproject 09, Improved Personnel Records System (Formerly Project W1584): The Navy Personnel Records System contains all records of present and past naval personnel. These microfilm records are used for many personnel actions, so that about

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30,000 records are processed looked at, or duplicated each day. The record system is labor intensive, incurring high personnel costs, and resulting in an unacceptably high error rate. This program will initially emphasize evaluation of the state-of-the-art and replacement of existing equipment and manual procedures with automated devices. Later phases will develop a complete new Navy Personnel Records System.

(U) Expected Payoff: Reduction of accumulated errors in the master file by 70%, prevent errors at image entry by automating routine and boring tasks, and reduce operating personnel by 20% during the next five years.

(U) In FY 1982 an evaluation of current military records system was undertaken and an assessment made of the technology used.

(U) In FY 1983 funding was reprogrammed to higher priority projects.

(U) For FY 1984 it is planned to begin analysis of the military personnel records system in the field.

(U) In future fiscal years the technology assessment and system design necessary to modernize the entire system will be completed.

(U) Subproject 10, Improved Personnel Administrative Support System Office (Formerly Project 21610): Personnel using the new automated Source Data System, currently under development for the more than 300 Personnel Administrative Support System offices, have a high error rate when entering personnel data. These errors cost the government millions of dollars per year in the form of (1) erroneous personnel actions and (2) man-years (currently 150).

(U) Expected Payoff: Elimination of most of the errors now plaguing the system. Increased work output through good man-machine design. Task completion time can be reduced by as much as 75% on some tasks. While more modest overall gains are realistic the availability of built-in aids to system use is expected to reduce the need for extensive formal training in system operation.

(U) In FY 1982 a user demonstration of the Source Data System was developed and conducted.

(U) The FY 1983 funding was reprogrammed to higher priority projects.

(U) For FY 1984 the project will be completed resulting in a training system developed and a system for direct user access to Personnel Administrative Support System Offices.

(U) Subproject 11, Personnel Assignment System: This project will develop techniques to improve the effectiveness of the Navy's personnel assignment system. These techniques will enable assignment policy makers to make more effective tradeoffs among rotation and promotion resources, tour lengths, and loss rates to achieve desired manning goals for fleet and shore units, and make better and more equitable matches of people to jobs.

(U) Expected Payoff: The Navy will benefit from reduced manning imbalance at sea and shore, potential reductions in Permanent Change of Station costs, and reductions in manhours for screening job candidates and documenting assignments. A 75 percent reduction in the resources spent on routine assignments is expected, coupled with very large improvements in matching personnel and jobs for the critical skills.

(U) The FY 1983 program develops and implements a personnel turbulence data base.

(U) For FY 1984, it is planned to develop:

- o Assignment policy computer models that consider tradeoffs among billet structure, personnel levels, and promotion and loss patterns.

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- o A computer model to improve assignment effectiveness by screening job candidates, matching job demands to available individual skills and preferences, and minimizing Permanent Change of Station costs.

(U) Subproject 12, Prediction of Officer Tenure: Failure to identify, select and train those officer candidates who will subsequently choose a naval career represents a significant waste of individual and institutional resources. The extensive loss of competent technically trained officers imposes a severe financial and logistic burden to the personnel training budget as well as a decrement in fleet readiness. Past research has provided improvements in selection procedures to assure successful completion of training. This project will identify factors leading to losses following training and seek to develop selection instruments that can provide early assessment of these factors.

(U) Expected Payoff: Increases in officer retention would directly translate into reductions in current recruiting and training costs.

(U) For FY 1984 it is planned to:

- o Develop reliable methods for assessing the reasons underlying officer separation decisions.
- o Construct a data base.

(U) In future fiscal years the extent to which officers leaving the Navy can be identified will be determined and valid factors which forecast retention of officers will be identified.

(U) Subproject 13, Performance Based Personnel Classification: This effort was initiated in response to the dissatisfaction expressed by the House Committee on Armed Services (Report 97-71, Part I, which accompanied the Fiscal Year 1982 Defense Authorization Act) concerning the relationship between factors such as Armed Services Vocational Aptitude Battery scores, level of education, etc., and potential for effective service. This project will seek to address this issue by developing a new approach for personnel screening and classification based on identified relationships between individual aptitudes and abilities and the significant task components of job performance.

(U) Expected Payoffs: Products from this effort will be incorporated into the Navy's optimal recruit classification system resulting in a significant reduction in people incorrectly assigned to jobs, and an overall increase in job performance and fleet readiness.

(U) For FY 1984 it is planned to design job performance tests for selected enlisted ratings.

(U) In future fiscal years, attempts will be made to link the Armed Services Vocational Aptitude Battery to job performance. Experimental predictor tests will be devised and attempts will also be made to link them to job performance.

(U) Subproject 14, Officer Performance Appraisal System: The current Navy Officer Fitness Report is not providing adequate information to enable selection boards to identify officers for critical assignments, promotions, schools, etc. This project will evaluate systems for officer performance appraisal, recommend revisions in the Navy's officer appraisal system, and evaluate the resulting prototype system in one or more pilot studies.

(U) Expected Payoff: the prototype will result in a significant increase in retention of high quality officers and a related reduction in the retention of marginal officers. This will result in significant gains in Navy combat leadership and commitment of the Naval Services.

(U) For FY 1984 it is planned to design and introduce prototype officer performance appraisal systems.

(U) In future fiscal years they will be tested and evaluated and a final system proposed.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable

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# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63709N  
DoD Mission Area: 552 - Environmental & Life Sciences

Title: Advanced Marine Biological Systems  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                              | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT          | 3,789          | 3,980            | 4,242            | 6,439            | Continuing               | Continuing           |
| S0214       | Advanced Marine Biological Systems | 3,789          | 3,980            | 4,242            | 6,439            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element concerns training marine mammals and developing associated hardware in response to Advanced Development Objective 38-12X, Advanced Marine Biological Systems. The objective of Advanced Development Objective 38-12X is "to identify those naval operations wherein the utilization of marine mammals is possible and to test the feasibility, determine the military worth and establish the optimum characteristics of such utilization." At present, two marine mammal systems, QUICK FIND, an unclassified system used to recover torpedoes with California Sea Lions and SHORT TIME, are approved for service use and are operationally deployed. A third marine mammal system, the MK 18 Mine Detection and Neutralization System (formerly LINEAR SWEEP), has received provisional approval for service use.

C. (U) COMPARISON WITH 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: The decrease of 1097 in FY 1984 is due to a Navy decision to reduce the scope of the program.

## D. (U) FUNDING AS REFLECTED IN FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                              | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT          | 3,415          | 3,789            | 3,980            | 5,339            | Continuing               | Continuing           |
| S0214       | Advanced Marine Biological Systems | 3,415          | 3,789            | 3,980            | 5,339            | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: Efforts are underway in a basic study of marine mammals by the Office of Naval Research under PE 62759N, Ocean and Atmospheric Support Technology.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; (Lead laboratory); Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD. CONTRACTORS: Integrated Science Corporation, Santa Monica, CA; Systems Engineering Analysis Company, Kailua, HI; Applied Research Laboratory, University of Texas, Austin, TX.

Program Element: 63709N

Title: Advanced Marine Biological Systems

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 80214, Advanced Marine Biological System: This project is directed towards determining acquisition, training, and maintenance specifications of potential marine mammal mission systems.

(U) In FY 1982, performance of the (Dolphin) [ ] system was demonstrated [ ] acoustically in water depths to [ ] The (Beluga Whale) cold/deep water object recovery system was deployed to Nanoose Range, B.C., Canada for testing and successfully recovered. [ ] The (Dolphin) [ ] minehunting system was trained to detect [ ] The (Sea Lion) [ ] system was trained to transit in an inflatable boat, conduct a visual search, report target present or absent [ ] The LINEAR CHEK countermeasure project sponsored a workshop [ ] The minimum training requirement evaluation was completed.

(U) The FY 1983 program consists of:

- o The LINEAR CHEK countermeasures project office conducting a workshop on [ ] systems development.
- o The [ ] system undergoing operational testing [ ] and establish system specifications documentation prior to the start of full scale engineering development.
- o The (Beluga Whales) [ ] minehunting system being transported to Kaneohe Bay for training and evaluation in the CLOSE scenario.
- o The (Sea Lion) [ ] mine neutralization system being trained [ ]
- o The [ ]
- o The (Dolphin) location of generalized objects demonstrating the feasibility of the concept of providing an animal with an acoustic description of the target we wish located.

(U) For FY 1984, it is planned to:

- o Continue the LINEAR CHEK countermeasure project.
- o The [ ] transitioning into engineering development.
- o The (Beluga Whale) [ ] minehunting system undergoing open ocean test and evaluation in the minehunting and neutralization task.
- o The (Sea Lion) [ ] mine neutralization system transitioning into engineering development.
- o The [ ]
- o The (Dolphin) location of generalized objects demonstrating match-to-sample concepts through acoustic modeling of the target in the open bay.

Program Element: 63709N

Title: Advanced Marine Biological Systems

(U) Program to completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984. Not Applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63712N

DoD Mission Area: 551 - Electronic and Physical Sciences

Title: Advanced Modular Component Demonstration

Budget Activity: 2 - Advanced Technology Development

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No | Title                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT | 0              | 0                | 488              | 782              | Continuing               | Continuing           |
| X1816      | Calibration Reduction     | 0              | 0                | 488              | 782              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This program involves the development of a test bed to demonstrate and transition available testing technology from exploratory development to weapon systems and test system applications. The program will initially focus on Metrology and Calibration technology to develop calibration techniques for prime systems, and automatic and manual test equipment. The intent of the program is to improve maintenance support and testing of prime and automatic testing systems through the use of available technology, such as microprocessor based monitoring, design for testability, fault tolerance, etc. The program will improve the productivity and quality of work of fleet technicians maintaining prime systems. Prime system availability will be improved and technical risk minimized through implementation of demonstrated support approaches.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) This is a new start in FY 1984 and was not funded in FY 1983.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:** Not Applicable.

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** Not Applicable.

**F. (U) RELATED ACTIVITIES:** Electronic Device Technology, PE 62762N; Logistics Technology, PE 62760N; and Support Equipment, PE 64215N. Exploratory development work in design for testability, fault tolerance, diagnostics (fault detection and isolation), performance/fault monitoring, automated calibration, advanced calibration techniques will be evaluated. Those techniques, that are applicable to off-line automatic testing will be transitioned for potential implementation into the Consolidated Support System (PE 64215N).

**G. (U) WORK PERFORMED BY:** IN-HOUSE: Lead laboratory is tentatively Naval Ocean Systems Center, San Diego, CA. OTHERS: Metrology Engineering Center, Pomona Annex, Pomona, CA, and National Bureau of Standards, Department of Commerce, Washington, D.C.. CONTRACTORS: To be determined.

**H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:**

(U) Project X1816-Calibration Reduction: New start. This project provides for the development of calibration techniques and standards for prime weapon systems and test systems. This is done by evaluating technology developed during exploratory development in a test bed environment and demonstrating/optimizing those techniques that prove most suitable for incorporation in prime and test systems.

Program Element: 63712N

Title: Advanced Modular Component Demonstration

(U) For FY 1984, it is planned to:

- o Complete Navy metrology and calibration technical requirements definition.
- o Develop and test calibration support for laser weapons, fiber optical and infrared devices. Included is the development of metrology standards and measurement equipment for the radiant power, attenuation and pulse spreading parameters.
- o Develop standards for power attenuation, reflection coefficient and phase at millimeter wave frequencies from 94 to 320 GHz.
- o Develop operationally adequate and scientifically valid standards and calibration techniques for automatic test equipment.

(U) This is a continuing program.

I. (U) Project over \$10 Million in FY 1984. Not Applicable.



FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63713N  
DoD Mission Area: 553 - Engineering Technology

Title: Ocean Engineering Technology Development  
Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                   | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT               | 11,759         | 13,184           | 21,704           | 24,859           | Continuing               | Continuing           |
| M0099       | Deep Submergence Biomedical Development | 3,892          | 4,028            | 7,917            | 11,670           | Continuing               | Continuing           |
| S0396       | Deep Depth Diving                       | 1,525          | 2,602            | 2,719            | 2,868            | Continuing               | Continuing           |
| S0397       | Deep Ocean Technology                   | 6,342          | 6,554            | 11,068           | 10,321           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Program is composed of three projects (1) Deep Submergence Biomedical Development develops medical technology to minimize risks and enhance the performance of personnel participating in manned undersea operations; (2) Deep Depth Diving develops diver life support equipment and tools to permit: (a) construction, maintenance, and repair of underwater facilities; (b) conducting salvage; (c) searching for and recovering objects of military importance; and (d) carrying out other Navy projects requiring saturated diving to depths of 1,000 feet and one-man, one-atmosphere diving to depths of 2,000 feet. (3) Deep Ocean Technology, provides a deep ocean technology base to support Navy needs. This project develops components and subsystems which have general application to manned and unmanned deep ocean operations to depths of 20,000 feet.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary result from minor program adjustments and are as follows: A net increase of 135 in FY 1982 and decreases of 10 in FY 1983 and 467 in FY 1984.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                   | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT               | 14,819         | 11,624           | 13,194           | 22,171           | Continuing               | Continuing           |
| M0099       | Deep Submergence Biomedical Development | 6,297          | 3,757            | 4,028            | 8,074            | Continuing               | Continuing           |
| S0396       | Man-in-the-Sea Continental Shelf        | 2,697          | 1,549            | 2,608            | 2,781            | Continuing               | Continuing           |
| S0397       | Deep Ocean Technology                   | 5,825          | 6,318            | 6,558            | 11,316           | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not Applicable

F. (U) RELATED ACTIVITIES: Program Elements 63702N, Ocean Engineering Systems Development; 63706N, Medical Development (Advanced); 63722N, Naval Special Warfare; 62758N, Biomedical Technology; 63794N, Anti-Submarine Warfare Surveillance.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Medical Research Institute, Bethesda, MD (lead); Naval Coastal Systems Laboratory, Panama City, FL; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Underwater Systems Center, Newport, RI; Naval Submarine Medical Research Laboratory, Groton, CT; Naval Ocean Systems Center, San Diego, CA. CONTRACTORS: Westinghouse Electric Corp., Philadelphia, PA; General Dynamics, Groton, CT; Southwest Research Institute, San Antonio, TX; Bendix Corp., Los Angeles, CA; Dupont Corp., Wilmington, DE; University of Pennsylvania, Philadelphia, PA; Duke University, Durham, NC; State University of New York, Buffalo, NY; Webb Associates, Yellow Springs, OH; University of Southern California, Los Angeles, CA; and others.

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Program Element: 63713N

Title: Ocean Engineering Technology Development

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project M0099, Deep Submergence Biomedical Development: The objectives of this project are to provide biomedical technology to support all Navy manned diving operations, to increase the safety and effectiveness of divers at current operational depths, and to provide physiological information which will allow useful work to be performed at deeper depths for longer periods of time.

(U) The increase of \$4 million projected for FY 1984 is required to restore the project to minimal productive capacity in line with the FY 1981 budget of \$6.3 million. The significant cuts suffered in FY 1982 and FY 1983 have reduced the research capacity of the newly completed Hyperbaric Research Facility at the Naval Medical Research Institute to a minimum level and forced termination of 10 out of 12 contract efforts. The FY 1984 and FY 1985 budgets are designed to restore the capability of in-house laboratories and contractors to provide critical information needed to advance deep submergence diving operations.

(U) In FY 1982, major accomplishments were:

- o Developed initial decompression limits for rescue of personnel from a disabled, pressurized submarine.
- o Demonstrated effectiveness of new drug therapy in treating air embolism and other diving accidents.
- o Developed methods to quantify regional and total heat loss of submerged divers.
- o Defined optimum oxygen pressures for recompression therapy of severe decompression sickness.
- o Determined that diving during early pregnancy is deleterious to fetal development.

(U) The FY 1983 program consists of:

- o Complete development of decompression tables for saturation air exposure and recommend procedures for rescue of personnel from pressurized submarines.
- o Complete studies to evaluate the risk of diving to the fetus and to Navy women divers.
- o Begin development of new indicators to acute and chronic oxygen poisoning.
- o Begin validation of new decompression tables for air diving.

(U) In FY 1984, it is planned to continue development of:

- o Safe and efficient decompression procedures for air, mixed gas and saturation diving.
- o Biomedical criteria for underwater breathing apparatus and for thermal protection of divers.
- o Improved drugs and procedures to treat diving accidents.

Program to Completion: This is a continuing program.

(U) Project S0396, Deep Depth Diving (formerly Man-in-the-Sea-Continental Shelf): This project provides for the development of deep depth diving life support equipment and diver tools to safely support Navy divers performing work such as salvage, recovery, inspection, emplacement, repair and rescue to depths of 2,000 feet. This project includes the necessary development, test and evaluation to provide modern integrated equipment for deep diving operations - both saturation diving, a condition

Program Element: 63713N

Title: Ocean Engineering Technology Development

reached by the diver's body when the tissues have fully assimilated the ambient breathing gas (saturated) and becomes equilibrated at a given depth, and one-atmosphere deep diving, where the diver is contained in a pressure housing which protects him from the high hydrostatic pressures experienced at depth.

(U) In FY 1982, development continued on:

- o The MK14 Closed Circuit Saturation Diving System and the saturation diver's tool package.
- o Development was initiated on improvements to operational deep diving systems utilizing latest available technology.
- o Contract was awarded to Oceanseering International, Inc. for the development of a one-man, one-atmosphere diving system.

(U) The FY 1983 program consists of:

- o Completing Technical Evaluation and operational evaluation of the MK14 Closed Circuit Saturation Diving System.
- o Continuing development of the one-man, one-atmosphere diving system, and the saturation diver's tool package.
- o Continue development of subsystems for retrofit on Deep Diving Systems.

(U) For FY 1984, it is planned to:

- o Complete development (Approval for Service Use) of MK14 Closed Circuit Saturation Diving System.
- o Conduct testing of saturation diver's tool package.
- o Continue development of one-man, one-atmosphere diving system.

Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984.

(U) Project 80397 Deep Ocean Technology

1. (U) DESCRIPTION (Requirement and Project): The U.S. Navy, to fulfill its mission is required to be able to operate in any ocean at any depth. The operations the Navy is required to perform at deep depths include: search, surveillance, emplacement, salvage/recovery, explosive ordnance disposal and military oceanography. The systems that are necessary to support these deep ocean operations include: manned and unmanned submersible vehicles, underwater work systems and surface support. To develop reliable and safe operational systems for deep depths (to 20,000 feet and greater) requires the exploitation of the most advanced technology. The objective of this project is to identify and advance critical technologies the lack of which prohibit the Navy from functioning effectively in the deep ocean environment. Inherent within the objective is development of operational systems to validate advances in technology. Systems developed primarily for testing and validating technological advancements will become fleet hardware, as appropriate, after test completion. The significant systems being developed under the project for the purpose of advanced technology validation include:

- o 20,000 feet depth manned submersible vehicle (Deep Submergence Vehicle SEA CLIFF).
- o Advanced unmanned, untethered, underwater, search system.
- o Integrated surface support and handling system.

Program Element: 63713N

Title: Ocean Engineering Technology Development

The increase of \$5 million projected for FY 1984 is required to support the timely completion and introduction to the fleet of the significant one-of-a-kind, first-of-a-kind systems being developed under this project.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program: The following was accomplished during FY 1982:

- o Completed hydrostatic pressure (10,000 psi) tests on electric (dc), pressure compensated (oil filled), propulsion motor.
- o Completed development of 34 lb/ft<sup>3</sup> syntactic foam buoyancy material.
- o Completed fabrication of a high-head, seawater variable ballast system and initiated hydrostatic pressure tests.
- o Conducted at-sea tests of acoustic data link for unmanned, untethered submersibles. Tests conducted to 15,000 ft. depth.
- o Conducted at-sea tests of the Advanced Unmanned Search System handling system.
- o Awarded contract for advanced electromechanical cable (25,000 ft long) with fiber optics. To be used on unmanned tethered submersible.
- o Published engineering handbook on Deep Submergence Hydraulic Systems.
- o Completed fleet evaluation and at-sea testings of commercial Remotely Operated Vehicle.

b. (U) FY 1983 Program: The following major milestones are to be accomplished in FY 1983:

- o Complete fabrication and hydrostatic testing of titanium personnel pressure hull (spherical).
- o Initiate modification of Deep Submergence Vehicle SEA CLIFF for 20,000 ft. operating depth. First-of-a-kind components developed under this project include: titanium pressure hull, syntactic foam buoyancy material, pressure compensated electric motors, and direct sea water pumped variable ballast system.
- o Complete assembly and launch prototype Advanced Unmanned Untethered Search Vehicle capable of underwater search to 20,000 ft depth.
- o Publish Deep Submergence Geotechnics Handbook.
- o Initiate technology assessment (power system, propulsion, pressure hull, etc.) and begin concept design of advanced manned submersible vehicle.
- o Complete assembly of prototype Advanced Unmanned Tethered Work Vehicle. Conduct test on advanced underwater tool systems.

c. (U) FY 1984 Planned Program: Continue the development, test and evaluation of the Advanced Unmanned Search System. Continue development test and evaluation of the Advanced Unmanned Tethered Work Vehicle. The electromechanical cable (tether) with fiber optics under development (initiated FY 1982) will be incorporated into the Advanced Unmanned Tethered Work Vehicle. Complete modification of Deep Submergence Vehicle SEA CLIFF for 20,000 ft. depth operation. Continue development of critical component technology for application to manned and unmanned deep diving submersibles and work systems with emphasis on advanced power systems, electric and mechanical systems and low weight to displacement ratio pressure hulls.

Program Element: 637154

Title: Ocean Engineering Technology Development

d. (U) Program to Completion: This is a continuing development effort to identify and advance critical technologies, the lack of which prohibit the Navy from functioning effectively in the deep ocean environment. Systems such as the Advanced Unmanned Search system and the Advanced Unmanned Tethered work Vehicle developed primarily for testing and validating technological advancements will become fleet hardware, as appropriate after test completion.

e. (U) Milestones Not Applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63720N

Title: Education and Training

DoD Mission Area: 552 - Environmental and Life Sciences

Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No | Title                                           | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT                       | 3,642          | 2,898            | 2,799            | 4,802            | Continuing               | Continuing           |
| Z0828      | Enlisted Personnel Individualized Career System | 1,077          | 1,135            | 0                | 0                | 0                        | 6,221                |
| Z0992      | Authoring Instructional Materials               | 425            | 0                | 0                | 0                | 0                        | 425                  |
| Z1176      | Individual Technical Training                   | 200            | 249              | 0                | 0                | 0                        | 1,942                |
| Z1177      | Advanced Computer-Aided Instruction             | 953            | 806              | 0                | 0                | 0                        | 4,015                |
| Z1180      | Techniques for Shipboard Training               | 527            | 0                | 0                | 0                | 0                        | 1,727                |
| Z1382      | Functional Context Training                     | 211            | 150              | 0                | 0                | 0                        | 361                  |
| Z1388      | Low Cost Microcomputer Training System          | 249            | 558              | 0                | 0                | 0                        | 807                  |
| Z1772      | Education and Training Development              | 0              | 0                | 2,799            | 4,802            | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Navy training establishment must maintain personnel readiness to meet operational demands in the face of economic restrictions, manpower competition, and the increasing sophistication of weapons. It has become necessary to redefine performance and training standards, to reduce high training costs, to provide the fleet with proficient personnel who are trained in their operational environments, and to improve the planning of training programs to meet mid- and long-range readiness requirements. Projects are directed toward improving the efficiency and effectiveness of training activities ashore and afloat, avoiding the high costs of technical training, and increasing the proficiency of graduates.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The differences between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this descriptive summary follows: To reduce internal Navy administration all projects have been merged into a single project - Z1772, Education and Training Development. To provide for Congressional review of separate efforts, the former projects will be shown as subprojects. FY 1982 shows a decrease of 49 as the result of a minor restructuring of the program to advance the start date of project Z0992, Authoring Instructional Materials, to FY 1982 (+425). Other reprogramming was accomplished to adjust for cost growth in specific subprojects including Z0828, Enlisted Personnel Individualized Career System (+87); Z1177, Advanced Computer-Aided Instruction (+139); and Z1388, Low Cost Microcomputer Training System (+51). The funds for this reprogramming came from Z1176, Individual Technical Training (-701); and Z1180, Techniques for Shipboard Training (-160). Z1382, Functional Context Training was increased (+110). In 1983 Congressional reductions caused the delay of Z0992, Authoring Instructional Materials (-299) and Z1218, Tactical Decision Training (-299). The net difference (-1,639) in the FY 1984 program results from DoD reductions reflecting the FY 1983 Congressional action. For FY 1984 all separate projects have been combined into Project Z1772 as subprojects. These will be described in Section H.

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Program Element: 63720N

Title: Education and Training

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                           | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                       | 4,742          | 3,691            | 3,496            | 4,438            | Continuing               | Continuing           |
| RO126       | Operational Decision Aids                       | 4              | 0                | 0                | 0                | 0                        | 4,617                |
| 20828       | Enlisted Personnel Individualized Career System | 1,033          | 990              | 1,135            | 1,264            | 2,321                    | 9,670                |
| Z0992       | Authoring Instructional Materials               | 0              | 0                | 299              | 300              | 1,408                    | 2,101                |
| Z1168       | Relating Training Output and Job Performance    | 268            | 0                | 0                | 0                | 0                        | 676                  |
| Z1175       | Training System Design and Management           | 511            | 0                | 0                | 0                | 0                        | 1,099                |
| Z1176       | Individual Technical Training                   | 660            | 901              | 249              | 229              | 75                       | 2,947                |
| Z1177       | Advanced Computer-Aided Instruction             | 1,164          | 814              | 806              | 597              | 2,203                    | 6,676                |
| Z1180       | Techniques for Shipboard Training               | 583            | 687              | 0                | 0                | 0                        | 1,887                |
| Z1181       | Design of Combat Team Training                  | 60             | 0                | 0                | 0                | 0                        | 85                   |
| Z1218       | Tactical Decision Training                      | 0              | 0                | 299              | 772              | 3,231                    | 4,302                |
| Z1251       | Training Approaches to Counter Attrition        | 459            | 0                | 0                | 0                | 0                        | 1,191                |
| Z1382       | Functional Context Training                     | 0              | 101              | 150              | 494              | 1,697                    | 2,442                |
| Z1388       | Low Cost Microcomputer System                   | 0              | 198              | 558              | 782              | 1,960                    | 3,498                |

E. OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES: Related DoD work in education and training R&D is being conducted under the following program elements: 61102A (74), Training, Personnel and Human Engineering; 61102F (2313), Human Resources; 61153N (42), Behavioral and Social Sciences; 62722A, Manpower, Personnel and Training; 62205F, Training and Simulation Technology; 62763N, Personnel and Training Technology; 63743A, Education and Training; 63715F, Innovations in Education and Training; 63732M, Marine Corps Advanced Manpower/Training Systems; and 64722A, Education and Training Systems. The work in program element 63720N, while often similar in objective and approach to the above R&D of the other services, is unique in that it is tailored to the Navy's organizational structure, population characteristics and training requirements. Nevertheless, to ensure that unnecessary duplications of effort do not arise, extensive preliminary literature reviews are conducted and liaison is maintained with the Office of the Under Secretary of Defense for Research and Engineering and with the Army and Air Force through program reviews, information exchanges, visits, and special briefings.

G. (U) WORK PERFORMED BY: IN-HOUSE: Navy Personnel Research and Development Center, San Diego, CA; Training Analysis and Evaluation Group, Orlando, FL; Office of Naval Research, Arlington, VA. CONTRACTORS: Biotechnology, Inc., Falls Church, VA; Bolt, Beranek & Newman, Inc., Cambridge, MA; Kinton, Inc., Alexandria, VA; MAR Consultants, San Diego, CA; Syracuse University, Syracuse, NY; Systems Exploration, Inc., San Diego, CA; University of Illinois, Urbana, IL; University of Southern California, Los Angeles, CA; McDonnell-Douglas, Inc., Denver, CO; and Unified Industries, Inc., San Diego, CA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project Z1772, Education and Training Development: This continuing project is divided into subprojects as described below.

(U) Subproject 01, Enlisted Personnel Individualized Career System (Formerly Project 20828): This project will develop an integrated personnel system based upon job performance aid technology in order to counter increasing personnel and maintenance costs and decreasing skill levels among entry level personnel.

(U) Expected Payoff: Job performance aiding can reduce initial training on the order of 50 to 80 percent and increase productivity as much as 60 percent.

Program Element: 6372CN

Title: Education and Training

(U) In FY 1982 job performance aids were developed for system technicians at the lowest skill levels and tested aboard ship. The installation of job performance aids and of shipboard instructional modules was completed. Job designs were developed and the system technician training course (shorebased) was completed and installed.

(U) The FY 1983 program will:

- o Develop job performance aids for higher skill levels.
- o Develop instructional packages.
- o Collect data in the fleet on the value of the system.

(U) For FY 1984 is is planned to complete data collection for the evaluation phase of the project.

(U) In the out-years the usefulness, feasibility, cost benefits, and productivity obtained from Enlisted Personnel Individualized Career System will be determined and the project completed in FY 1986.

(U) Subproject 02, Authoring Instructional Materials (Formerly Project 20992): Currently, about 200 man-hours of effort by experienced personnel are required to develop an hour of instruction. These personnel are in short supply. To meet its requirements for curriculum development and revision of over 4,000 courses, the Navy needs better tools for the preparation and production of instructional materials. This effort will develop automated systems for the design, development and production of instructional materials for both conventional and computer delivered courses.

(U) Expected Payoff: The goal of this work is a 25 percent reduction in the costs of preparing instructional materials.

(U) In FY 1982 author aids were collected and demonstration hardware was selected.

(U) The FY1983program includes:

- o Definition of authoring requirements.
- o Development of hardware specifications for the operational authoring systems.
- o Programming of author tools.

(U) For FY 1984,

- o Hardware specifications will be completed.
- o Software specifications will be initiated.

(U) In following fiscal years, the authoring system will be tested, enhanced and made operational.

(U) Subproject 03, Individual Technical Training (Formerly Project 21176): This project developed a job-oriented basic skills curriculum to teach low-aptitude enlisted personnel the skills needed to prepare them for technical training. The training system will expand the use of lower mental quality personnel. Thus, it will allow broader recruiting to increase the pool of those eligible to enlist in historically short-supply ratings. Also, the effort will maintain racial/ethnic representation across Navy occupational specialties.



Program Element: 63720N

Title: Education and Training

(U) Expected Payoff: Initial results show that this broadened recruiting base has lowered recruiting costs for these trainees by up to 30 percent. In addition trainees have a first term attrition rate at least 50 percent lower than that of other personnel.

(U) In FY 1982 methods for enhancing the job-oriented basic skills training curricula were developed. An interim program evaluation has been completed.

(U) The FY 1983 program includes:

- o Development of training for Acoustic Sensor Operation ratings.
- o Conduct second interim program evaluation.

(U) For FY 1984 it is planned to:

- o Continue evaluation.
- o Modify the curriculum in accordance with findings.

(U) The subproject will be completed in FY 1986.

(U) Subproject 04, Advanced Computer Aided Instruction (Formerly Project Z11770): This work consists of two parts investigating the use of computer-based training within schools and at remote sites (including aboard ship). Both parts are focused on areas of critical training needs (propulsion engineering, electronic warfare and electronic countermeasures training). One area (STEAMER) involves the first major use and evaluation of advanced artificial intelligence hardware and software in the construction of a training system. The system will provide automated tutorial and explanation facilities to reduce instructor requirements and makes possible practice of important exercises that are either impossible under existing conditions or very instructor- or personnel-intensive. It both provides an alternative to and complements the type of training that is now provided on expensive simulators. The other area (Remote Sites) is concerned with providing increased readiness through on-site microprocessor-based training in electronic warfare and electronic countermeasures. This work will evaluate refresher training intervals for maintaining these combat skills and the requirements for remote site implementation and support of microcomputer-based training systems.

(U) Expected Payoff: Work in these areas will increase fleet readiness by providing more practice of critical skills at substantially less cost than existing methods.

(U) In FY 1982 an initial version of the STEAMER training system was installed at Surface Warfare Officers School (Newport). Electronic warfare and electronic countermeasures training was developed and experimentally implemented at Fleet Combat Training Center, Pacific.

(U) The FY 1983 program includes:

- o Continuing the in-situ evaluation and refinement of the STEAMER system at Surface Warfare Officers School.
- o Implementing the ability to automatically execute engineering operational sequencing system standards and providing explanations of the procedures, in terms of generic components and principles.
- o Implementing and evaluating remote site electronic warfare and electronic countermeasures training.

Program Element: 63720N

Title: Education and Training

(U) For FY 1984 it is planned to:

- o Add advanced tutorial and explanation facilities to STEAMER.
- o Continue assistance in transition of the training system into operational use.
- o Develop Electronic Warfare threat analysis training using microcomputers.

(U) In the outyears these training systems will be evaluated.

(U) Subproject 05, Lateral Entry (Formerly Project Z1216): This project will provide and evaluate a prototype program to enlist skilled, non-prior service civilians as petty officers (i.e., lateral entry) for the middle and upper enlisted paygrades. The program will provide a supplemental source of military manpower to alleviate the shortage of skilled personnel now and in the future, with additional promise for reduced training costs.

(U) Expected Payoff: This work should result in a decrease of 50 percent in the time needed to correct the Navy's petty officer shortfall and in multi-million dollar savings in training costs.

(U) For FY 1984 it is planned to complete the design, development and coordination of the lateral entry program as the research progresses from Program Element 62763N, Manpower and Personnel Technology.

(U) In future fiscal years, the program will be implemented and evaluated. A cost benefits analysis will be conducted and the program will then be made operational.

(U) Subproject 06, Tactical Decision Training (Formerly Project Z1218): This project will design and test a prototype, inexpensive, stand-alone training system for practicing tactical decision-making skills. The system will be usable aboard ship, dockside or wherever naval officers are stationed. Naval officers have very little opportunity to practice tactical decision-making. The system will provide a unique training capability because it will be a small, portable trainer that can be used by individual officers to practice a wide range of decision-making skills such as identification of enemy platforms, selection of weapons, use of countermeasures, and quick responses to changes in battle situations. The system will greatly improve tactical proficiency by providing ample opportunities to respond to realistic battle problems.

(U) Expected Payoff: Because of limited access to large simulators and a lack of training facilities aboard ship, it is estimated that there will be at least ten times more opportunity for practicing these skills than currently exists. The system will provide cost-saving pre-practice to other forms of training so that time on expensive simulators and costly naval exercises can be reduced.

(U) The FY 1983 program includes:

- o Selecting battle problems for an initial system.
- o Determining hardware and software requirements.

(U) For FY 1984 it is planned to:

- o Implement the initial tactical training system on development machines.
- o Establish a site for development.

(U) In future fiscal years, the initial system will be evaluated and a final system developed, tested and refined.

Program Element: 63720N

Title: Education and Training

(U) Subproject 07, Functional Context Training (Formerly Project Z1382): This project will develop and test a training system which integrates Functional Context Training, Personalized System of Instruction and microcomputer-based graphic simulation. This is an approach to training that restructures curriculum to be highly job-task oriented, with fundamentals and theory presented only when necessary for a student to proceed with job-skill acquisition. If Functional Context Training proves to be effective in Navy training, it could significantly decrease training time while increasing job competence.

(U) Expected Payoff: Objectives are: 10 percent reduction in training time; lowering of aptitude requirements by 10 percentile ranks; improved student motivation and interest; and increase ability to perform tasks related to specialized training.

(U) In FY 1982 a candidate course was chosen for a feasibility test of Functional Context Training, and functional specifications for the microcomputer system to support experimental training were developed.

(U) The FY 1983 program will develop a prototype Functional Context Training system.

(U) For FY 1984 it is planned to evaluate the prototype system.

(U) In future fiscal years, training materials will be designed and the final Functional Context Training system developed, evaluated and implemented.

(U) Subproject 08, Low Cost Microcomputer System (Formerly Project Z1388): This project will examine, design, construct, and test low-cost portable, microcomputer-based training systems in order to improve Navy training productivity at acceptable costs. If microcomputer training systems prove applicable, the time, effort and cost of training operator and maintenance personnel will be greatly reduced.

(U) Expected Payoff: Previous research on computer-based training have shown student and instruction time savings of about 25 percent. The time, effort, and cost of these applications are expected to be similarly reduced.

(U) In FY 1982 training courses were analyzed to identify training needs. Basic skills training programs in technical vocabulary and literal comprehension were adapted for low-cost microcomputers.

(U) The FY 1983 program:

- o Completes analysis of training needs and requirements.
- o Matches them to microcomputer capabilities.

(U) For FY1984 it is planned to:

- o Begin development of software and course.
- o Develop prototype applications.

(U) In future fiscal years, microcomputer-based systems will be developed, tested and evaluated.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not Applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63721N Title: Environmental Protection  
DoD Mission Area: 552 - Environmental and Life Sciences Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>          | <b>6,674</b>   | <b>8,150</b>     | <b>10,412</b>    | <b>10,933</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| S0400       | Ordnance Reclamation                      | 1,849          | 2,023            | 2,073            | 2,169            | Continuing               | Continuing           |
| S0401       | Shipboard Waste Management                | 1,683          | 1,861            | 2,915            | 3,025            | Continuing               | Continuing           |
| S0402       | Oil Pollution Abatement                   | 1,107          | 1,446            | 1,088            | 1,112            | Continuing               | Continuing           |
| Y0817       | Pollution Abatement Ashore                | 2,035          | 2,820            | 3,355            | 5,647            | Continuing               | Continuing           |
| S1741       | Environmental Protection/Salvage Open Sea | 0              | 0                | 981              | 980              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The goal is to develop processes, prototype hardware,, systems and operational procedures that will allow the U.S. Navy to operate in U.S., foreign and international waters, air spaces and land areas while complying with US statutes and international agreements enacted for the protection of the environment. The projects support the Navy requirement to meet environmental standards outlined by the Environmental Protection Agency and the provisions of Executive Order 12088 of October 1978. The technology developed will permit the Navy to comply with present and future regulations in a cost effective manner without impairing military readiness of operational units.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in FY 1983 Descriptive Summary and that shown in this Descriptive Summary are the result of refined cost estimates including inflation except for a net reduction of 2,202 in FY 1984 resulting from budget constraints and an increase of 981 to start new project S1741.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>2,913</b>   | <b>6,693</b>     | <b>8,151</b>     | <b>12,614</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| S0400       | Ordnance Reclamation             | 0              | 1,868            | 2,023            | 2,117            | Continuing               | Continuing           |
| S0401       | Shipboard Waste Management       | 990            | 1,696            | 1,861            | 2,982            | Continuing               | Continuing           |
| S0402       | Oil Pollution Abatement          | 992            | 1,094            | 1,447            | 1,115            | Continuing               | Continuing           |
| Y0817       | Pollution Abatement Ashore       | 931            | 2,035            | 2,820            | 6,400            | Continuing               | Continuing           |

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable.

F. (U) RELATED ACTIVITIES: 63508N, Ship Propulsion Systems (Advanced); 63513N, Shipboard Systems Component Development; 63609N, Surface Launched Munitions. In addition close liaison is maintained with the Environmental Protection Agency; Departments of Commerce, Transportation, Army, Air Force, Interior; the U.S. Coast Guard; Maritime administration; and National Interagency Committee on Oil and Hazardous Materials. International cooperation and information exchange is achieved with allied nations through direct liaison with NATO and Chief of Naval Material sponsored international symposia.

G. (U) WORK PERFORMED BY: IN-HOUSE: David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Ship Systems Engineering Station, Philadelphia, PA; Naval Shipyard, Mare Island, CA; Naval Weapons Support Center, Crane, IN; Naval Surface Weapons Center, Silver Spring, MD, and Dahlgren, VA; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Ocean

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Systems Center, San Diego, CA; Pearl Harbor Naval Shipyard, HI; Norfolk Naval Shipyard, VA; Readiness Support Group, Charleston, SC. CONTRACTORS: Fram, Tulsa, OK; Bio Merics, Inc., Rockville MD; General Electric Co., King of Prussia PA; Baird, Bedford, MA; Fluidyne Engineering Corp., Minneapolis, MN; International Dynamics Corps., South Norwalk, CT; Daedalean Associates, Inc., Columbia, MD; ManTech International Corp., Livingston, NJ; Garrett, Inc., Los Angeles, CA; Combustion Engineering, Inc., Windsor, CT; SCS, Longbeach, CA; and Aluf Industries Inc., Corona, NY.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 80400, Ordnance Reclamation: This project provides economically and environmentally acceptable reclamation and disposal techniques. The goals are: (1) reclamation of ordnance materials; (2) ecologically safe disposal procedures for those items for which reclamation is not economic; (3) purification of waste water from ordnance operations and (4) minimization of adverse environmental effects of essential test explosions. This program is formally coordinated with other Department of Defense agencies through the Under Secretary of Defense (Research and Engineering) prepared Area Coordinating Paper No. 42.

(U) In FY 1982, design of pilot plant equipment to recover infrared flare ingredients. Design pilot plant equipment for colored smoke disposal and for plastic-bonded explosive removal by hydraulic jet. Upgrade several plastic-bonded explosives by solvolysis.

(U) In FY 1983 program consists of:

- o Complete work on infrared flare ingredient reclamation pilot plant.
- o Complete design and procurement for colored smoke incineration pilot plant.
- o Solvolyse Submarine Rocket, High Speed Anti-Radiation Missile, and Anti-Submarine Rocket propellants at one-pound level and plastics bonded explosive-107 at the five-pound level.
- o Prepare reconstituted plastic bonded explosive-109.
- o Install and operate high-pressure water jet washout facility for plastic bonded explosive removal.
- o Test fish dispersal technique at underwater explosion field test site in a river.

(U) For FY 1984, it is planned to continue:

- o Initial operation of colored smoke incineration pilot plant.
- o Solvolyse propellants recovered from hydraulic jet operation.
- o Prepare reconstituted POLARIS A3 propellant.
- o Establish safe operating conditions for high-pressure jet washout of plastic bonded explosives.
- o Test fish dispersal technique at oceanic test site.

(U) Program to completion: This is a continuing program. Planned efforts include: Document colored smoke disposal and plastic bonded explosives results. Design/install/operate pilot plants to recover colored flare and dye marker ingredients and for plastic bonded explosives solvent breakdown/ingredient recovery. Analyze economics for plastics bonded explosives removal and ingredient recovery by solvents. Complete solvolysis of TOMAHAWK and other propellants; reconstitute propellant with recovered ingredients. Provide impact assessment, technology, and other environmental support needed to permit required explosion tests.

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(U) Project 30401, Shipboard Waste Management: This project evaluates alternate solutions to the total shipboard waste problem; addresses solid and liquid waste streams, and air emissions generated on shipboard. Emphasis is placed on the development of systems for environmentally acceptable disposal of sewage, wet garbage, and solid waste; and removal, disposal, and detoxification processes for organotin anti-fouling paints. Short range developments include a small ship compactor, sewage treatment systems, waste food disposers, low-flow showers, a classified-document destructor and hazardous waste management.

(U) In FY 1982, completed evaluation of effect of organotin waste water on sewage plants, completed assessment of effect of organotin dry dock wastewater on receiving waters, completed laboratory evaluation of infra-red organotin detoxification. Completed evaluation of multi-function waste incinerator.

(U) The FY 1983 program consists of:

- o Complete laboratory evaluation of an off-the-shelf solid waste marine incinerator, a cavitating water jet for organotin paint removal from ship hulls and a small ship compactor.
- o Initiate development of improved submarine solid waste handling capability.
- o Complete pilot evaluation to detoxify organotin-contaminated water and test a screw feeder for rotary kilns.
- o Initiate laboratory evaluation of a quiet, water powered food waste disposer.

(U) For FY 1984, it is planned to continue:

- o Initiate ship evaluation of a small ship compactor.
- o Complete ship evaluation of solid waste marine incinerator.
- o Complete shipyard evaluation of cavitating water jet to remove organotin hull coatings.
- o Initiate laboratory evaluation of shipboard trash pulpers.

(U) Program to completion: This is a continuing program. Planned efforts include: Incorporate integrated waste system prototypes on combatant and tender and evaluate components. Obtain Approval for Production for marine waste incinerator and small ship compactor.

(U) Project 30402, Oil Pollution Abatement: This project is aimed at reducing the generation of oily wastes and development of oil/water separator systems and oil/water separator effluent stream and ballast discharge monitoring equipment to permit ships and small craft to meet national and international discharge standards.

(U) In FY 1982, initiated Operational Test and Evaluation of one 10-gallon per minute parallel plate oil water separator and completed Operational Test and Evaluation of one 30-gallon per minute centrifugal oil water separator. Completed shipboard Technical Evaluation and initiated Operational Evaluation of a visible light scattering/transmission oil content monitor for use with oil water separator to ensure compliance with environmental regulations.

(U) FY 1983 program consists of:

- o Completed Fleet Operation Test & Evaluation for one 10 gallon per minute parallel plate oil water separator.
- o Initiate shipboard Technical Evaluation of an in-tank parallel plate oil water separator on board a destroyer
- o Initiate shipboard Technical Evaluation of an ultra-violet fluorescence oil content monitor and complete Operational Evaluation of a visible light scattering/transmission oil content monitor.

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- o Complete shore-side evaluations of small boat/craft oil water separator candidate systems.

(U) For FY 1984, it is planned to:

- o Obtain Approval for Production for the 10-gallon per minute parallel plate oil water separator. Complete Operational Evaluation of in-tank parallel plate oil water separator and ultra-violet fluorescence oil content monitor.
- o Obtain Approval for Production for visible light scattering/transmission oil content monitor.
- o Initiate shipboard evaluation of CG-47 fuel/ballast tank modification for prevention of oil pollution during refueling.
- o Initiate small craft oil water separator shipboard evaluations.

(U) Program to completion: This is a continuing program. Planned efforts include: Obtain Approval for Production for small oily waste processing systems, and for bilge oily waste transfer pumping systems. Verify adequacy of ship/shore interfaces for oily wastes.

(U) Project Y0817, Pollution Abatement Ashore: This project develops cost effective systems/equipment for solid waste resource recovery, hazardous waste disposal and control, oily waste water treatment and reclamation, jet engine test facilities, and heavy metal analysis in waste streams and in the marine environment.

(U) In FY 1982, evaluated Heat Recovery Incinerator at Naval Station Mayport and Naval Air Station Jacksonville. Completed specification for oil water separator unit. Installed a prototype Aqueous Film Forming Foam wastewater treatment process at San Diego Fire Fighting School. Determined air pollution control correction factors appropriate to Jet Engine Test Cells. Assembled an instrumental survey craft to conduct marine environmental quality assessments.

(U) The FY 1983 program consists of:

- o Continue development of instrumentation for real-time analysis of metals in navy harbors and effects of Navy pollutants on marine life.
- o Continue to evaluate Heat Recovery Incinerators for utilization of refuse, focusing on the economics of future shore installations
- o Prepare an industrial wastewater reuse/recycling handbook.
- o Conduct evaluation of alternative techniques for treating oily sludge.
- o Continue field evaluation of Aqueous Film Forming Foam treatment.
- o Initiate investigation and field evaluation of plating waste pretreatment alternatives.

(U) For FY 1984, it is planned to continue:

- o Continue development of analytical methods for marine environmental surveys.
- o Complete oily sludge treatment study.
- o Complete solid waste Heat Recovery Incinerator specification.

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- o Continue Aqueous Film Forming Foam prototype field evaluation of San Diego Fire Fighting school.
- o Continue plating wastes evaluations.
- o Complete emission prediction models for jet engine test cells.

(U) Program to completion: This is a continuing program.

(U) Project S1741, Environmental Protection/Salvage Open Sea: Develop new and improved systems for open sea oil and hazardous substances pollution abatement in the following functional categories: (1) Containment; (2) Collection; (3) Cargo Offloading, Transfer, and Handling; (4) Detection, Sampling, and Surveillance; (5) Disposal; (6) Offship Firefighting.

(U) This program will be a new start in FY 1984 consisting of: Develop system definition and requirements for oil and hazardous substances pollution abatement for containment, collection, cargo offloading, detection, disposal and offship firefighting.

(U) Program to completion: This is a continuing program. Planned efforts include: Continue development efforts in the six areas of technological deficiencies.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not Applicable.



FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63722N  
DoD Mission Area: 553 - Engineering Technology

Title: Naval Special Warfare  
Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                      | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                  | 7,660          | 8,284            | 8,084            | 10,042           | Continuing               | Continuing           |
| SO416       | Swimmer Weapon System                      | 1,462          | 3,113            | 3,974            | 4,449            | Continuing               | Continuing           |
| SO417       | Swimmer Support System                     | 3,135          | 2,126            | 3,039            | 2,842            | Continuing               | Continuing           |
| SI317       | Explosive Ordnance Disposal Support System | 1,053          | 795              | 1,071            | 875              | Continuing               | Continuing           |
| SI684       | Special Warfare Combatant Craft            | 2,000          | 2,250            | 0                | 1,876            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops weapons, life-support and delivery systems for Naval Special Warfare Forces (Underwater Demolition and Sea/Air/Land Teams) and Explosive Ordnance Disposal divers in support of their missions which include unconventional warfare (amphibious reconnaissance and beach clearance, ship attack, interdiction) and ordnance disposal. It provides for development of the Swimmer Weapons System, a family of specialized swimmer weapons, the Swimmer Support System Swimmer Delivery Vehicles, a submarine Dry Deck Shelter for clandestine swimmer/swimmer delivery vehicle operations, swimmer communications, navigation and reconnaissance mission support systems, exposure suits, underwater breathing apparatus and an underwater decompression computer; and the Explosive Ordnance Support system, a family of diver mission support equipment with low acoustic and magnetic signatures enable Explosive Ordnance Disposal divers to locate and "render safe" underwater ordnance; and a special warfare combatant craft which will support a wide variety of Naval Special Warfare missions and will replace the 65-foot patrol boat MK III.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a net increase of 2,623 in FY 1982 (reduced project SO416, Swimmer Weapon System, by 250 which was reprogrammed into higher priority project; increased Project SO417, Swimmer Support system, by 2,873 for cost increases in the project; a net increase of 2,247 in FY 1983 resulting from a Congressional increase of 2,250 in SI684 in order to accelerate the program) and compensation reductions of 253 resulting from revised cost estimates; a net increase of 795 in FY 1984 (reduced SO416 by 290, a Department of the Navy reduction; increased SO417 by 234 to support increased testing; increased SI317 by 851 to support development of a remotely operated vehicle, an increase in scope of the project.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                      | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                  | 4,969          | 5,037            | 6,037            | 7,289            | Continuing               | Continuing           |
| SO416       | Swimmer Weapon System                      | 1,035          | 1,712            | 3,116            | 4,264            | Continuing               | Continuing           |
| SO417       | Swimmer Support System                     | 3,135          | 262              | 2,126            | 2,805            | Continuing               | Continuing           |
| SI317       | Explosive Ordnance Disposal Support System | 779            | 1,063            | 795              | 220              | Continuing               | Continuing           |
| SI684       | Special Warfare Combatant Craft            | 0              | 2,000            | TBD              | TBD              | Continuing               | Continuing           |

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Program Element: 63722N

Title: Naval Special Warfare

D. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                                         | FY 1982<br>Actual | FY 1983<br>Estimate | FY 1984<br>Estimate | FY 1985<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|---------------------------------------------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
| S0416 Swimmer Weapon System<br>OPN                      | 1,679             | 2,645               | 260                 | 1,200               | Continuing                  | Continuing                 |
| S0417 Swimmer Support System<br>OPN                     | 3,955             | 6,923               | 8,642               | 8,642               | Continuing                  | Continuing                 |
| S1317 Explosive Ordnance Disposal Support System<br>OPN | 2,035             | 1,554               | 8,931               | 11,325              | Continuing                  | Continuing                 |

F. (U) RELATED ACTIVITIES: Exploratory development in swimmer weapons under Program Element 62734N, Project SF34-373. Program Element 63654N, Joint Explosive Ordnance Disposal: advanced development fusing systems developed under Program Element 63601N, Mine Development; Project S0267, Mine Improvements, are providing technology base necessary for development of swimmer weapons, support systems and Explosive Ordnance Disposal mission support equipment.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Coastal Systems Center, Panama City, FL (Project S0417 lead laboratory); Naval Surface Weapons Center, White Oak, MD (Project S0416 lead laboratory); Naval Weapons Support Center, Crane, IN; Naval Surface Weapons Center, Dahlgren, VA; Naval Oceans Systems Center, San Diego, CA; Naval Sea Systems Command, Washington, DC; Explosive Ordnance Disposal Facility, Indian Head, MD (Project S1317 lead laboratory). CONTRACTORS: General Dynamics, Electric Boat Division, Groton, CT; Biomarine Systems; Raytheon; Ametec-Straza, San Diego, CA; EDO Western, Salt Lake City, UT.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project S0416, Swimmer Weapon System: This project provides for development of unique weapons and ordnance equipment required for Underwater Demolition Teams and SEAL Teams to conduct reconnaissance/beach clearance, underwater ship attack, and direct action missions. Project includes [ ] explosive weapons, firing systems, and accessory devices.

(U) In FY 1982, obtained approval for full production for one system [ ] for this project. Successfully completed operational evaluation of Standoff Weapon Assembly.

(U) The FY 1983 program will consist of:

- o Obtaining Approval for Full Production [ ]
- o Revise target response criteria [ ] and conduct operational evaluation
- o Begin six new systems

(U) For FY 1984, it is planned to:

- o Obtain Approval for Full Production [ ]
- o Conduct technical evaluation on three other systems and Operational Evaluation on one
- o Continue design/development/testing on four systems

(U) This is a continuing program.

Program Element: 63722N

Title: Naval Special Warfare

(U) Project 80417, Swimmer Support System: This project provides for the unique development of Swimmer Delivery Vehicle, Swimmer Life Support System, Mission Support Package and Submarine Transport System for Dry Deck Shelter. This equipment utilized by Navy combat swimmers Underwater Demolition Team/SEAL Teams to conduct the missions as listed in the Swimmer Wea System.

(U) In FY 1982 completed construction of prototype Swimmer Delivery Vehicle Dry Deck Shelter, approval for production achieved for Vehicle Communication System and Swimmer Area Navigation system portion of the mission support package. Approval Navy Use was granted for the Passive Diver Thermal Protection system Approval for Service Use obtained for the Draeger L Closed /circuit Scuba.

(U) The FY 1983 Program will consist of:

- o Complete certification and operational demonstration ☐
- o Continued development of ☐ Mission Support Package
- o Continued evaluations of Dry Diving Suits for Combat Swimmers
- o Investigation of Helo Transport of Swimmer Delivery Vehicles
- o Investigation of improvements to Swimmer Delivery Vehicle and MK 15 Underwater Support Package, Breath Apparatus.

(U) In FY 1984 it is planned:

- o Investigate improvements to Swimmer Delivery Vehicle Shelter
- o Investigate approval for Production ☐
- o Continue Helo Transport for Swimmer Delivery Vehicle
- o Continue improvement to Swimmer Delivery Vehicles and MK 15 Underwater Breathing Apparatus

(U) This is a continuing program.

(U) Project 81317, Explosive Ordnance Disposal Support System: This project provides for the development of equipment which will allow the Explosive Ordnance Disposal diver to locate and render safe underwater ordnance. This system is a family of diver mission support equipment which has ☐ to accomplish the above stated task.

(U) In FY 1982, obtained Approval for Service Use for the MK 16 Low Influence Self Contained Underwater Breathing Apparatus (SCUBA). Completed development of new helium oxygen tables ☐ to be used with the Low Influence Scuba. Began initial work on low influence timer/depth gauge and underwater decompression computer.

(U) The FY 1983 program will consist of:

- o Commence advanced development of remotely operable vehicle
- o Continuing work on timer/depth gauge and underwater decompression computer

Program Element: 63722N

Title: Naval Special Warfare

(U) In FY 1984 it is planned to:

- o Complete Advanced Development phase of Remote Operable Vehicle
- o Begin engineering development phase of Remote Operable Vehicle
- o Obtain approval for production on timer/depth gauge and underwater decompression computer.

(U) This is a continuing program.

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63727N

DoD Mission Area: 352 - Environmental and Life Sciences

Title: Navy Technical Information Presentation System

Budget Activity: 2 - Advanced Technology Development

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                          | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>               | 1,243          | 1,253            | 3,257            | 5,748            | TBD                      | TBD                  |
| W1032       | Navy Technical Information Presentation System | 1,243          | 1,253            | 1,697            | 3,508            | TBD                      | TBD                  |
| T1806       | Logistics Systems Information Network          | 0              | 0                | 1,560            | 2,240            | TBD                      | TBD                  |

As this program will be completed during the out-years, the above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** Project W1032, the Navy Technical Information Presentation System, when tested and implemented, will be a Navy-wide system to consolidate and supervise the acquisition, generation, distribution, and control of all weapons systems Technical Information for use in weapon system operation, maintenance, training, and logistics support. Advancing weapon-system technology, rising costs, and changes in enlisted technician capability have produced severe system maintenance and training problems in the Navy. Acquisition, dissemination, and update of the large volume of weapon systems Technical Information involved require use of advanced technology to keep abreast of the rising requirements and expense. More usable forms of weapon systems Technical Information are needed to achieve major reductions and significant cost savings in parts replaced in maintenance, in maintenance time, and in training time. Project T1806, Logistics Systems Information Network, will provide the ability to rapidly assess important logistical data that is virtually impossible with the techniques, equipments and procedures currently available today. Lack of an integrated logistic information communication network for all weapons systems continues to hamper logistic support and investment decisions.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in FY 1983 Descriptive Summary and this Descriptive Summary are as follows: Project W1032. A minor decrease of 73 in FY 1982 results from adjustments during budget development. A decrease of 200 in FY 1983 is due to Congressional reduction. An increase of 264 in FY 1984 is to provide for hardware and software to initiate the Navy Technical Information Presentation System into the Navy as a prototype operation (increase in scope of program), in accordance with approved Navy Decision Coordinating Paper, DoD and Joint Congressional Committee on Printing direction. Project T1803 is a new project under this Program Element, and increases the FY 1984 funds by 1,560.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                                          | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>               | 1,812          | 1,316            | 1,453            | 1,433            | 3,605                    | 11,179               |
| W1032       | Navy Technical Information Presentation System | 1,414          | 1,316            | 1,453            | 1,433            | 3,605                    | 10,781               |
| Z1393       | Microfilm Technology for Personnel Records     | 398            | 0                | 0                | 0                | 0                        | 398                  |

NOTE: Project Z1393 was terminated.

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Program Element: 63727N

Title: Navy Technical Information Presentation System

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|     | FY 1982<br>Actual | FY 1983<br>Estimate | FY 1984<br>Estimate | FY 1985<br>Estimate | Additional<br>to<br>Completion | Total<br>Estimated<br>Cost |
|-----|-------------------|---------------------|---------------------|---------------------|--------------------------------|----------------------------|
| OPN | 0                 | 0                   | 500                 | 445                 | TBD                            | TBD                        |

F. (U) RELATED ACTIVITIES: Continuous information exchange is being carried on with the Army, Air Force, other Navy activities, private industry, and educational institutions, in addition to utilizing technologies developed in applicable exploratory development program elements. The Navy Technical Information Presentation Program Office has been assigned the role of providing leadership for all DoD Technical Manual research and development, as directed by DoD and the Joint Congressional Committee on Printing.

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is the David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. OTHERS: Training Analysis and Evaluation Group, Orlando, FL; Naval Air Technical Services Facility, Philadelphia, PA; Naval Sea Data Support Activity, Port Hueneme, CA. CONTRACTORS: Hughes Aircraft Company, Long Beach, CA, is the prime contractor. OTHERS: Grumman Aerospace Corporation, Bethpage, NY; Clifton-Precision Products, Inc., Drexel Hill, PA. Project T1803. To be determined.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W1032, Navy Technical Information Presentation System: The purpose of this effort is to design and test an improved Navy-wide standard system for acquiring, generating, mastering, replicating, distributing, and controlling Technical Information to be used by those who operate and maintain Navy weapon systems. Present problems include: (1) Increasing complexity and volume of such documentation (currently in the form of Technical Manuals) to keep pace with weapon system complexity; (2) decreasing reading capability of Navy recruits; (3) operationally costly delays in providing initial documentation; (4) duplication of effort in providing technical information to both the training and logistic communities; (5) escalating costs of developing, distributing, and storing technical documentation. The Navy Technical Information Presentation System (W1032) will exploit new technologies such as logistic support analysis, computerized authoring, computer graphics, advanced data base design, videodisc, holography, digital storage, satellite communications, and human factors engineering. The system will develop ways of providing Technical Information for all users from the same data base, in such a way as to be of optimal use of individual enlisted technicians.

(U) In FY 1982, the program initiated Phase III (System Test) of the Navy Technical Information Presentation System on the F-14A Flight Control System and AN/SPA-25D radar hardware system. Experimental Technical Information for each hardware system is being defined and generated using the entire data-stream process of the Navy Technical Information Presentation System. Work is being performed under contracts with Grumman Aircraft Company and Clifton-Precision Products, Inc.; cost type contracts. Hughes Aircraft Company is providing technical support for the experimental hardware and software being used in the Phase III test.

(U) Phased implementation of the 47 proposed technology improvements developed by the program commenced with the introduction of the quality assurance specification at the Naval Air Systems Command, Modular Technical Information Specifications at the Naval Sea Systems Command, and computer-assisted authoring at the Naval Education and Training Command.

(U) The FY 1983 program will:

- o Complete the generation of experimental Technical Information for the test hardware systems.
- o Initiate user tests with target user population.
- o Evaluate test results.

Program Element: 63727N

Title: Navy Technical Information Presentation System

(U) For FY 1984, it is planned to:

- o Complete user tests and evaluation.
- o Provide recommendations to the Chief of Naval Operations on the prototype operation of the System.
- o Initiate Phase IV, the prototype operation of the Navy Technical Information Presentation System.

(U) The program to completion will include: Complete prototype operation of the System. Make design changes as required. Develop full system capability. The final output of this development will consist of: A complete description of the system design, instructions, and standards providing a detailed description of all required policies and procedures for operating the system, reflecting significant improvement over existing procedures; a proposed Navy organization for handling weapon system Technical Information; the required data base and control information system; a proposed automated production system; and proposed electronic delivery devices. Research and development support will be provided during the implementation of the system.

(U) Project T1803, Logistics Information Network: (NEW START) This project will provide the ability to rapidly assess important logistics data that is virtually impossible with the techniques, equipments and procedures currently available.

(U) For FY 1984 and program to completion it is planned to: Initiate project effort to determine applicability of data base, machines, and communicative technology development required in logistics applications in 1990-2000 time frame. Investigate the application of optical disk for mass data for network concepts for multi-media users. Develop distributed processing concepts to decrease response time and transmission costs and to increase reliability of data. Develop advanced concepts for logistics data entry to improve the validity of systems data to meet fleet and ashore support requirements. Investigate new architectural concepts for improving the processing throughput for large volumes of data required for logistics network circa 2000. Design and evaluate the system for ease of use and accuracy of input. Examine data base management systems and natural language applications.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63728N  
DoD Mission Area: 553 - Engineering Technology

Title: Manufacturing Technology  
Budget Activity: 2 - Advanced Technology Development

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 3,657          | 3,339            | 7,827            | 15,299           | Continuing               | Continuing           |
| 21050       | Manufacturing Technology  | 3,657          | 3,339            | 7,827            | 15,299           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This RDT&E program is conducted in conjunction with the procurement funded Manufacturing Technology Program, PE 78011N. Together they comprise a concerted effort to reduce the acquisition and support costs of weapon systems by developing and applying advanced methods of manufacturing. The Manufacturing Technology program objectives are to reduce costs and increase productivity, reduce dependence on import of strategic and critical materials, reduce dependence on labor intensive operations, enhance flexibility of facilities and equipment, strengthen defense industrial base, stimulate industry to invest in Manufacturing, and transfer technology. Specifically this element provides for the exploration of manufacturing alternatives and concepts prior to the fabrication of fully operational production equipment. New developments are pursued when they are generically applicable to a variety of weapon systems and when they show cost reduction potential. This effort includes identification of cost drivers, feasibility demonstrations of innovative concepts and emphasizes hardware development suitable for the exploration of equipment alternatives, process variables, and operating characteristics. Particular attention is paid to the demonstration of feasibility and to design data in order to assure the timely transfer of technology to the production line. Major thrust areas are: fabrication processes, e.g., improved welding, strategic materials substitution, e.g., composites manufacturing, and flexible manufacturing systems, e.g., manufacturing processing technologies and robotics applications.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary result from the following change: A net decrease of 4,258 in FY 1984 due to budgetary constraints during FY 1984 budget development.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 4,754          | 3,657            | 3,339            | 12,085           | Continuing               | Continuing           |
| 21050       | Manufacturing Technology  | 4,754          | 3,657            | 3,339            | 12,085           | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:**

|       | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OP,N  | 23,104         | 25,420           | 55,490           | 79,634           | Continuing               | Continuing           |
| OGN,N | 2,466          | 2,870            | 3,128            | 3,796            | Continuing               | Continuing           |

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Program Element: 63728N

Title: Manufacturing Technology

F. (U) RELATED ACTIVITIES: All Navy RDT&E Manufacturing Technology funds are in this element. The Army and Air Force also utilize RDT&E Manufacturing Technology funds. The Tri-Service Manufacturing Technology Advisory Group screens all Manufacturing Technology activities to preclude duplication among the Services. Where applicable, developed Manufacturing Technology is utilized by other program elements as necessary/required.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Research Laboratory, Washington, D.C.; Naval Surface Weapon Center, Silver Spring, MD; Naval Weapons Support Center, Crane, IN; Naval Weapons Center, China Lake, CA; National Bureau of Standards, Washington, D.C. Contractors: SRI International, Palo Alto, CA; Massachusetts Institute of Technology, Cambridge, MA; Battelle Laboratories, Columbus, OH; Fibre Materials Inc., Biddleford, ME; Materials Concepts, Inc., Columbus, OH; DWA Composite Specialities, Los Angeles, CA; Vought Corporation, Dallas, TX; McDonnell Douglas Aircraft Corporation, St. Louis, MO.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project Z1050, Manufacturing Technology: This is the only project under element 63728N and is described in paragraph B.

(U) In FY 1982, development continued on materials manufacturing and fabrication techniques, computer aided design/computer aided manufacturing, robotics and requirements definition.

(U) The FY 1983 program consists of:

- o Removing technical limitations and extending range of application of computer aided design/computer aided manufacturing in manufacturing. In particular, neutral language development, definition of manufacturing data base architecture and interfaces, flexible work center unit operations prototyping, and large batch automation techniques.
- o Development of manufacturing processes to make viable the introduction of metal matrix composite materials into Navy systems.
- o Feasibility determination of artificially intelligent "expert system" utilization in the welding operation.

(U) For FY 1984, it is planned to:

- o Continue development of robotics applications.
- o Continue computer aided design/computer aided manufacturing development: implement manufacturing processes on pilot bases.
- o Demonstrate metal matrix composite materials production techniques and procedures for ship, aircraft and aerospace development systems.
- o Continuing development of automated, expert welding system.

(U) Program to Completion: This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not Applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63732H

DoD Mission Area: 552-Environmental and Life Sciences

Title: Marine Corps Advanced Manpower Training Systems

Budget Activity: 2 - Advanced Technology Development

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                                    | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                         | 1,762          | 1,464            | 2,136            | 1,410            | Continuing               | Continuing           |
| C0073       | Human Resources Management and Forecasting               | 1,292          | 1,098            | 1,724            | 968              | Continuing               | Continuing           |
| C0074       | Training Devices and Simulators                          | 234            | 235              | 118              | 147              | Continuing               | Continuing           |
| C0867       | Marine Corps Training Resources Development and Analysis | 236            | 131              | 196              | 196              | Continuing               | Continuing           |
| C1732       | USMC Professional Military Education                     | 0              | 0                | 98               | 99               | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This Program Element provides RDT&E funds for the advanced development of systems and equipment to improve the manpower and training readiness of the Fleet Marine Forces.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: Human Resources Management and Forecasting: The increase of 111 in FY 1982 was for development of software modules for the Automated Recruit Management System and the FY 1983 decrease of 28 is due to a reduction in management support contracts, and the FY 1984 decrease of 49 is due to an inflation adjustment. Training Devices and Simulators: The FY 1982 increase of 95 is due to increased costs associated with the Simulated Tank/Anti-tank Gunnery System, and for testing and evaluating a blank firing device for the .50 cal machine gun and the FY 1984 decrease of 6 is due to refined cost estimates, including escalation. Marine Corps Training Resources Development and Analysis: The FY 1982 increase of 67 is due to additional costs for evaluation of computer based educational systems in support of Marine Corps formal schools and other service schools, the FY 1983 decrease of 17 is due to a reduction in management support contracts, and the FY 1984 decrease of 2 is due to refined cost estimates, including escalation.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                                                   | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                        | 1,292          | 1,489            | 1,509            | 2,095            | Continuing               | Continuing           |
| C0073       | Human Resources Management and Forecasting              | 887            | 1,181            | 1,126            | 1,773            | Continuing               | Continuing           |
| C0074       | Training Devices and Simulators                         | 305            | 139              | 235              | 124              | Continuing               | Continuing           |
| C0867       | Marine Corps Training Resources Management and Analysis | 100            | 169              | 148              | 198              | Continuing               | Continuing           |

Program Element: 63732M

Title: Marine Corps Advanced Manpower Training Systems

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                  | <u>FY 1982<br/>Actual</u> | <u>FY 1983<br/>Estimate</u> | <u>FY 1984<br/>Estimate</u> | <u>FY 1985<br/>Estimate</u> | <u>Total<br/>Additional<br/>to Completion</u> | <u>Total<br/>Estimated<br/>Cost</u> |
|----------------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------------------------|-------------------------------------|
| PWC                              |                           |                             |                             |                             |                                               |                                     |
| Training Devices and Simulators: |                           |                             |                             |                             |                                               |                                     |
| Manual Wargames                  | -                         | 479                         | 101                         | -                           | 6,610                                         | 7,100                               |
| Quantity                         |                           | (299)                       | (40)                        |                             |                                               |                                     |

F. (U) RELATED ACTIVITIES: U. S. Army: Simulated Tank/Anti-tank Gunnery System, Multiple Integrated Laser Engagement System (MILES), Individual Remote Target System, Armor Remote Target System (ARETS), Army Instructional Management System. U. S. Navy: Electronic Warfare Simulation developments, SMOKEY SAM, Versatile Training Systems. All services' activities are supporting the joint-service Computerized Adaptive Testing project.

G. (U) WORK PERFORMED BY: In-House: Navy Personnel Research and Development Center, San Diego, CA; Contractors: Bolt, Beranek, and Newman, Cambridge, MA; McDonnell Douglas, St. Louis, MO; WICAT Systems, Orem, UT; Rehab Group, Inc., San Diego, CA; Decision Systems Associates, Inc, Rockville, MD.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project C0073, Human Resources Management and Forecasting: This is a continuing project. The purpose of this project is to develop techniques and methods that advance the use and control of human resources in the Marine Corps.

(U) In FY 1982, the following was accomplished:

- o Integration of previously developed assignment models as they pertain to first term enlisted Marines was completed. These models will assist personnel managers in optimizing the assignment functions.
- o Development of computerized adaptive accession testing and analysis of technological methods to facilitate the Precise Personnel Assignment System (PREPAS) integration in the overall manpower management system was continued.
- o A three vendor, multi-stage contract was let for Computerized Adaptive Testing (CAT).
- o Preliminary Design Reviews (PDR) by the three Computerized Adaptive Testing vendors was accomplished and prototype production for test and evaluation (Stage 1B) was initiated.
- o The development of the Automated Recruit Management System to automate the full spectrum of enlisted and officer personnel procurement was continued.

(U) FY 1983, it is planned to continue:

- o The development of the Precise Personnel Assignment System and the Automated Recruit Management System.
- o An Objective Force Model will be developed to assist planners in shaping future personnel targets.
- o Production of prototype for test and evaluation (CAT STAGE 1B) will be completed.

Program Element: 63732M

Title: Marine Corps Advanced Manpower Training Systems

(U) The FY 1984 program consists of:

- o Continued development of manpower methods and procedures in support of Precise Personnel Assignment System.
- o Transition of the following Exploratory Development projects: special assignment battery for Drill Instructors and recruiters; systematic procedures for granting enlistment waivers; initiatives for reducing attrition of Women Marines; separation and retention survey program; urban area close-air-support training program; and professional military education courses.
- o Development of Computerized Adaptive Testing - Stage 2 will be completed and production and installation (Stage 3) will be initiated.
- o Continued development of the Automated Recruit Management System and the leadership program.

(U) Project C0074, Training Devices and Simulators: Continuing project for development of training devices and simulators which are not or cannot be developed in conjunction with a major end item. Simulated Tank Anti-Armor Gunnery System (STAGS) - device for training infantrymen in field firing anti-tank weapons without need for ranges, ammunition or weapons. Manual Wargame Based Tactical Training System (MWC) - a series of training systems to give unit commanders and their staffs an opportunity to practice the tactical decisions they would have to make on a real battlefield.

(U) In FY 1982, the following was accomplished:

- o Testing of the advanced development model for the M16 Rifle of the Universal Infantry Weapons Trainer was completed.
- o Advanced Development of the Anti-Tank Weapons System Module for the Simulated Tank/Anti-Tank Gunnery System was initiated.
- o Development of a family of manual wargames continued.

(U) In FY 1983, it is planned to continue:

- o Advanced Development of the Anti-Tank Weapons Modules for Simulated Tank/Anti-Tank Gunnery System.
- o Advanced Development of the battalion and Marine Amphibious Force (MAF) wargames.
- o Field the prototype for company wargame.

(U) The FY 1984 program consists of Engineering Development of the Simulated/Tank Anti-tank Gunnery System. Advanced Development of other Infantry Weapon System modules will continue. Development of manual wargames will continue.

(U) Project C0867, Marine Corps Training Resources Development and Analysis: This is a continuing project that identifies methods and techniques to improve the effectiveness of training conducted throughout the Marine Corps.

(U) In FY 1982, the following was accomplished:

- o The requirements statement was completed. An analysis of feasible alternative methods of meeting those requirements through automation was completed.
- o Identification of possible computer applications in Marine Corps formal schools continued.

Program Element: 63732M

Title: Marine Corps Advanced Manpower Training Systems

(U) In FY 1983, it is planned to:

- o Continue development of conceptual methods for the employment of automation in support of all tasks identified in the Instructional System Design (ISD) process and in the management of Marine Corps training resources.
- o Initiate selection of a prototype system.
- o Commence installation and evaluation of the prototype system at a Marine Corps formal school.

(U) The FY 1984 program consists of:

- o Continue evaluation of prototype system.
- o Continue development of techniques for automated instructional system design.
- o An analysis of Computer Assisted Instruction requirements will be conducted in order to determine the feasibility of automated instruction in support of the fixed mastery variable time concept.

(U) Project C1732, USMC Professional Military Education: The purpose of this program is to design, test, and evaluate new instructional delivery systems such as teleconferencing and interactive video, which may be identified as effective alternatives for improving the Marine Corps professional military education program.

(U) In FY 1982 and FY 1983 this effort is in Exploratory Development (6.2). Subsequent to transition to Advanced Development (6.3) in FY 1982 it is planned to design, implement and evaluate a method for teaching fire support coordination, which will incorporate interaction among instructors and students enrolled in the Amphibious Warfare School Extension Course.

(U) The FY 1984 program consists of:

- o Continued analysis of alternative methods which, based upon the results of previous Exploratory Development, show potential for improving instruction in resident and nonresident courses.

I. PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63733M  
DoD Mission Area: 552 - Environmental and Life Sciences

Title: Training Devices Technology  
Budget Activity: 2 - Advanced Technology Development

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No | Title                                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT                        | 6,979          | 6,200            | 6,555            | 10,424           | Continuing               | Continuing           |
| W1199      | VTOL Visual Technology Research Simulator        | 603            | 0                | 0                | 0                | 0                        | 5,281                |
| W1200      | Visual Technology Research Simulator Utilization | 2,298          | 2,446            | 0                | 0                | 0                        | 7,409                |
| W1202      | Integrated Maintenance Training System           | 304            | 880              | 0                | 0                | 0                        | 1,912                |
| W1203      | Individual Adaptive Training System              | 561            | 0                | 0                | 0                | 0                        | 941                  |
| W1204      | Microcomputer Architecture for Trainer Systems   | 323            | 73               | 0                | 0                | 0                        | 597                  |
| W1206      | Automation of Part Task Trainers                 | 769            | 0                | 0                | 0                | 0                        | 1,091                |
| W1209      | Dynamic Scene Visual Display                     | 0              | 150              | 0                | 0                | 0                        | 150                  |
| W1390      | Multi-Spectral Image Simulation                  | 124            | 779              | 0                | 0                | 0                        | 903                  |
| W1391      | Helmet Mounted Display                           | 1,793          | 1,870            | 0                | 0                | 0                        | 3,665                |
| W1773      | Training Devices Technology                      | 0              | 0                | 6,555            | 10,424           | Continuing               | Continuing           |

As this is a continuing program, the above funding includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program deals with development and demonstration of new capabilities in training equipment. Principal focus is on proof-of-concept, reduction of risk, and cost effectiveness in device acquisition (approximately \$800 million in FY 1984). Current technical areas include advanced simulation of visual and sensor systems, part-task/low cost training alternatives and intelligent systems/wargaming. Projects in this program provide the principal development links between PE 62757N, Human Factors and Simulation Technology and first-article procurement in aviation, surface and subsurface systems.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) To reduce internal Navy administration, all projects have been merged into a single project - W1773, Training Devices Technology. To provide for Congressional review of separate efforts, the former projects will be shown as subprojects. All current projects and approved outyear efforts were mapped into six Product Areas, then consolidated into a single project. The intent of this restructure is to enhance the Navy's ability to take advantage of major breakthroughs from PE62757N and within PE63733M and advance to proof-of-concept testing as rapidly as possible. Mapping of these projects into the FY 1984 Product Areas is as follows: Subproject 01: Product Area Training Technology Demonstration & Utilization was restructured from the continuing project W1200 (VTRS Utilization); Subproject 02: Visual Systems Simulation Development was restructured from W1391 (Helmet Mounted Display), W1209 (Dynamic Scene Visual Display), W1206 (Computer Generated Imagery for Simulation), and W1389 (VTOL Laser Display); Subproject 03: Computer Architectures for Training Systems was restructured from W1204 (Microcomputer Architecture); Subproject 04: Part Task Training Alternatives was restructured from W1202 (Integrated Maintenance Training System), W1663 (Part Task Training for Missile Envelope Recognition), and W1665 (2nd Generation Maintenance Training); Subproject 05: Intelligent Training Systems Development was restructured from W1206 (Automation of Part Task Trainers), W1675 (Decision Training for Tactical Teams), and W1674 (Expert Systems for Instructor Support); Subproject 06: Sensor Simulation Development was restructured from W1390 (Multi-Spectral Image Simulation) and W1676 (Acoustic Signal Generator for Sonar Training). In FY 1982, Navy budgetary adjustments resulted in a net reduction of 971 which resulted in the following decreases in project funding: Project 1199, Visual Technology Research Simulator -15; Project 1200, Visual Technology Research Simulator Utilization -325; Project 1202, Integrated Maintenance Training System -6; Project 1206, Automation of Part Task Trainers -315 and Project 1391, Helmet Mounted Display -310. In FY 1983, Congressional reductions amounted to 1,199 which resulted in the following changes in project funding: Project 1200, Visual Technology Research

Program Element: 63733N

Title: Training Devices Technology

Simulator Utilization -340; Project 1202, Integrated Maintenance Training System +277; Project 1204, Microcomputer Architecture for Trainer Systems -224; Project 1209, Dynamic Scene Visual Display -447; Project 1390, Multi-Spectral Image Simulation +341; and Project 1391, Helmet Mounted Display -804.

In FY 1984, all projects have been consolidated into Project W1773 which was reduced by 1,500 due to budgeting constraints.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                                                  | Additional | Total | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | to Completion | Estimated Cost |
|-------------|------------------------------------------------------------------------|------------|-------|----------------|------------------|------------------|------------------|---------------|----------------|
|             | TOTAL FOR PROGRAM ELEMENT                                              |            |       | 5,975          | 7,950            | 7,399            | 8,055            | Continuing    | Continuing     |
| W1198       | Conventional Take-off and Landing Visual Technology Research Simulator |            |       | 404            | 0                | 0                | 0                | 0             | 1,034          |
| W1199       | Vertical Take-off and Landing Visual Technology Research Simulator     |            |       | 2,687          | 618              | 0                | 0                | 0             | 5,296          |
| W1200       | Visual Technology Research Simulator Utilization                       |            |       | 1,293          | 2,623            | 2,786            | 3,111            | Continuing    | Continuing     |
| W1201       | Intermediate Hands-On Maintenance Simulators                           |            |       | 289            | 0                | 0                | 0                | 0             | 610            |
| W1202       | Integrated Maintenance Training System                                 |            |       | 333            | 510              | 603              | 0                | 0             | 1,641          |
| W1203       | Individual Adaptive Training System                                    |            |       | 141            | 561              | 0                | 0                | 0             | 941            |
| W1204       | Microcomputer Architecture for Trainer Systems                         |            |       | 197            | 325              | 299              | 961              | 0             | 1,782          |
| W1205       | Simulation for Selecting Aviation Trainees                             |            |       | 237            | 0                | 0                | 0                | 0             | 237            |
| W1206       | Automation of Part Task Trainers                                       |            |       | 322            | 1,084            | 0                | 0                | 0             | 1,406          |
| W1207       | Simulation/Training Requirements for Automatic Test Equipment          |            |       | 72             | 0                | 0                | 0                | 0             | 72             |
| W1208       | Computer Generated Imagery for Simulation                              |            |       | 0              | 0                | 0                | 244              | 2,883         | 4,128          |
| W1209       | Dynamic Scene Visual Display                                           |            |       | 0              | 0                | 597              | 1,315            | 3,627         | 5,539          |
| W1390       | Multi-Spectral Image Simulation                                        |            |       | 0              | 124              | 438              | 783              | 592           | 1,937          |
| W1391       | Helmet Mounted Display                                                 |            |       | 0              | 2,105            | 2,676            | 1,363            | 4,337         | 10,481         |
| W1663       | Part Task Training For Missile Envelope Recognition                    |            |       | 0              | 0                | 0                | 198              | 2,776         | 2,974          |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not Applicable.

F. (U) RELATED ACTIVITIES: 62757N, Subproject W57-526, Training Devices and Simulation provides the principal technology base. Work is coordinated through a series of working groups with 62727A, Non-systems Training Devices Technology, 62203P, Training and Simulator Technology, 63216A, Synthetic Flight simulator Development, 63227F, Advanced Simulator Technology and Marine Corps Elements 63733N and 64657N; work directly supports 64703N, Training Devices Prototype Development, 64714N, Air Warfare Training Devices, 64715N, Surface Warfare Training Devices, and 64716N, Submarine Warfare Training Devices. The successes achieved from advanced development applications lead to prototype implementation or to first article procurement.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Training Equipment Center, Orlando, FL CONTRACTORS: Singer/Link, Binghamton, NY and Silver Spring, MD; General Electric Corp., Syracuse, NY; Texas Instruments, Dallas, TX; Honeywell, Minneapolis, MN; American Airlines, Dallas/Fort Worth, TX; Canyon Research Group, Inc., Westlake Village, CA; University of Central Florida, Orlando, FL; Computer Sciences Corp., Orlando, FL. OTHERS: N/A

Program Element: 63733N

Title: Training Devices Technology

M. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) For FY 1984, work under this Program Element is consolidated into a single project (W1773), divided into six product line areas with one or more subtasks under each project area. Current product areas and proposed work are identified below.

(U) Subproject 01: Product Area, Training Technology Demonstration & Utilization: Included within this project area is the FY83 Project W1200, Visual Technology Research Simulator Utilization. Advances in simulation technology have made possible new applications to military flight training tasks. However, the application of visual simulation technology to advanced flight training, beyond takeoff and landing, continues to experience significant development difficulties. Computer image generation problems can in many instances be lessened through trade-offs or compromises in capability and performance. However, trade-offs between subsystem performance and cost effectiveness as measured by total system performance and cost effectiveness continues to be a very expensive issue over the course of trainer development and delivery. The focus of this subproject program is to provide: (a) a test bed for hardware performance research to improve state-of-the-art flight simulator visual technology and (b) human performance research to evaluate the effect of visual technology in pilot performance and transfer of training effectiveness in a simulator environment. The experience gained to date in the Visual Technology Research Simulator continues to point to the need for design criteria guidelines and the ability to assemble tested subsystems into cost effective trainers prior to delivery to the Fleet.

(U) Expected Payoff: Subproject will provide test facilities for evaluation and demonstration of new technical capabilities developed under exploratory and advanced development.

(U) In FY 1982 the Visual Technology Research Simulator was used to complete Conventional Takeoff and Landing design criteria development for carrier landing training; initiate terrain research program, including air-to-surface weapons delivery and low level flight. The system was also used by fleet project teams for evaluation of visual systems for: F/A-18 and AV-8B.

(U) The FY 1983 program consists of:

- o Determining visual simulation detail required for tasks such as aircraft aspect recognition and formation flying.
- o Defining of Vertical Takeoff and Landing simulation requirements.
- o Maintenance and Instructor/Operator Station demonstrations.
- o Anti-Submarine Warfare demonstration.

(U) For FY 1984 it is planned to:

- o Continue VTOL trainer design criteria investigations.
- o Evaluate CTOL design criteria.
- o Exercise ASW system to assess comparative performance of ocean/target models in providing displays for training.
- o Interface advanced development model multiple microcomputer demonstration system.
- o Prepare for implementation of multi-sensor simulation.

(U) The planned FY 1985 - FY 1988 program will continue Conventional, Vertical and Short Takeoff and Landing research emphasizing evaluation of advanced display technology; complete Eye-Slaved Display Integration and Test evaluation in 1985



Program Element: 63733N

Title: Training Devices Technology

followed by Helmet Mounted Display in 1986/7; evaluate multi-microcomputer system in simulator operation; install multi-simulation system in Visual Technology Research Simulator; determine optimum simulation requirements, and provide specific for acquisition; continue use of ASW system for fidelity requirements studies.

(U) Subproject 02: Production Area, Visual Systems Simulation Development: Included within this project area are projects: (1) W1208, Computer Generated Imagery for Simulation; (2) W1209, Dynamic Scene Visual Display; (3) W1389, VT Display; and (4) W1391, Helmet Mounted Display. Available visual simulation technology is not adequate to provide high imagery over a wide field of view for low level flying and navigation, air-to-ground target acquisition and weapons training. In addition to high detail, simulation of low level flying requires dynamic, rapidly changing visual displays is an immediate need for improved visual display technology to allow these tasks to be adequately trained at an affordable cost. This subproject has two major thrusts: One focuses on dynamic scene content and the hardware and software requirements for detail image generation system design; the other focuses on the development and evaluation of a pilot helmet mounted projector to display the high detail across a wide field of view at costs much lower than current wide field of view systems.

(U) Expected Payoff: Subproject is expected to provide a reduction of from \$15 to \$20 million dollars per copy visual system.

(U) In FY 1982 procurement of the pilot Helmet Mounted Laser Projection System (Helmet Mounted Display) was initiated

(U) The FY 1983 program will address the display part of the visual simulation problem:

- o High detail imagery for any direction in which the pilot turns his head/eyes will be provided at greatly reduced cost utilizing results from successful 6.2 efforts.
- o Procurement specifications will be developed for programmable multiprocessor advanced Computer Image Generation (CIG) system to test previously developed architectures in real time. The CIG system will support normal, window computer displays as well as the Helmet Mounted Display.
- o Development of alternative display technology including advanced light valves and off-the-head, head tracked.

(U) For FY 1984 it is planned to:

- o Continue procurement of the Helmet Mounted Display.
- o Initiate procurement/development of the computer image generation system.

(U) The planned FY 1985 - FY 1988 program will install the Helmet Mounted Display on the Visual Technology Research Simulator for parameter studies leading to design criteria and specifications for acquisition of trainers; install the computer image generation system in the Simulator as the image source for tradeoff studies between conventional displays and Helmet Mounted Display.

(U) Subproject 03: Product Area, Computer Architecture for Training System: Included within this project area is the Project W1204, Microcomputer Architecture for Trainer Systems. The use of a large variety of embedded computers and assembly programming languages in training systems has created a large inventory in which there is little commonality of hardware language, software programs or documentation. Use of standard military general purpose computers to reduce this proliferation and associated costs have not been successful due to their performance limitations in meeting the very high performance requirements imposed by real-time simulation for training, other technical constraints and high acquisition costs. Atrac standardize the programming and documentation of trainers through the use of available and approved Higher Order Language

Program Element: 63733N

Title: Training Devices Technology

programming such as FORTRAN have had limited success due to inefficiency in code generation for real-time execution in modern trainers and the inherent problems associated with attempts to transfer programs for one trainer hardware configuration to a different hardware configuration. In addition, the current cost of training by simulation continues to increase. A significant part of this increased cost is directly attributable to computer hardware, computer software, and their field support. This subproject is focusing upon an effort to develop an advanced development model of a multiple microcomputer architecture and control concept which will be used to derive application and technical data. These data will be used to evaluate multiple microcomputer designs and control concepts and to prepare detailed trainer computer specifications in order to control the introduction and application of advanced microcomputer technology in future trainers. In addition, standardization of trainer computer system components, languages and software modules is essential to significantly reduce total life cycle costs. The proposed development will result in standardization of trainer computer system architecture and application techniques through the use of commercially available microprogrammable microcomputers and eventually a complementary Higher Order Language.

(U) Expected Payoff: Approaches to hardware and software expected to reduce computer costs by 60 percent.

(U) For FY 1984 it is planned to:

- o Initiate advanced development of demonstration system.
- o Select math model for demonstration, partitioning and programming.
- o Design the computer system architecture.
- o Identify hardware for procurement and software constraints.
- o Procure required development hardware/firmware/software.
- o Fabricate demonstration system.
- o Partition software and perform module programming.
- o Integrate hardware/software with the Government facilities.
- o Initiate evaluations and demonstrations.

(U) Subproject 04: Product Area, Part Task Training Alternatives: Included within this subproject were former projects: (1) W1202, Integrated Maintenance Training System; (2) W1563, Part Task Trainer for Missile Envelope Recognition; and (3) W1663, Second Generation Maintenance Training. This product area focuses on cost-effectiveness in training devices via development of alternative technology for certain segments of high-cost training. Adaptive training, automated performance assessment, voice technology, expert systems and micro-processor technology demonstrated in exploratory development programs will be implemented for tests and evaluation in Automated Performance Assessment Recursion Training System, air combat maneuvering Missile Envelope Recognition, portable maintenance Job Performance Aiding and Personal Electronic Aid to Maintenance, and sensor/vehicle-control operator training such as for Remotely Controlled Vehicles. For the SH-3H helicopter cockpit procedures trainer, a cost reduction from \$1.8 million to \$335 thousand was realized by the substitution of alternative technology including fabricating and documenting to best commercial practices vice some Military Standards; providing fidelity only to the extent necessary to accomplish required training; and eliminating redundancies. The same technology was applied to the EA-3B part task trainer with a corresponding savings of \$3.2M. Plans are in progress for implementation of this technology in LAMPB MK III, KA-3B, CB-53, LVT-7A1, TH-57 and EA-6B low cost training system developments.

(U) Expected Payoff: Cost reductions estimated to be between \$1 to \$2 million per device.

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Title: Training Devices Technology

(U) In FY 1982 completed a model for a portable, programmable maintenance job performance aid, including development of data bases.

(U) The FY 1983 program will initiate demonstration and field evaluation of Automated Performance Assessment Remedial Training System.

(U) For FY 1984 it is planned to:

- o Select high payoff Missile Envelope Recognition variables from 6.2 program for incorporation into a proof of concept device.
- o Complete Automated Performance Assessment Remedial Training System evaluation.
- o Select candidate for Navy demonstration of Personal Electronic Aid to Maintenance technology.

(U) The planned FY 1985 - 1988 program will develop proof of concept device and conduct testing of Missile Envelope Recognition; develop functional specifications for generic Job Performance Aid and Navy application of Personal Electronic Aid for Maintenance; select high payoff variables, develop proof of concept device and begin testing sensor/vehicle-control operator training such as for Remotely Controlled Vehicles.

(U) Subproject 05: Product Area, Intelligent Training Systems Development: Included within this project area are projects: (1) W1206, Automation of Part Task Trainers; (2) W1675, Decision Training for Tactical Teams; and (3) W1674, Expert Systems for Instructor Support. This product area will focus on: (1) providing more efficient use of expensive full mission training systems by augmentation with intelligent part-task trainers; (2) providing the capability to train tactical teams with or without all team members being present and (3) providing the basis for intelligent embedded/organic systems which can be used during transit for highly sophisticated gaming scenarios. Emphasis will be placed on automation, augmentation and work load reduction of instructor and training personnel functions in order to improve productivity and effectiveness of training devices. Artificial intelligence, voice technology, and training assistance packages (which include automation of intelligent adversaries, simulation of missing team members and simulation of instructor/operator functions) will be tested for application to embedded/organic on-board operational systems and shore-based trainers. Interfacing techniques for team, operator and maintenance training will be evaluated.

(U) Expected Payoff: Work in this area provides technology for gaming approaches to the development of specific warfare skills. This will result in higher levels of operational readiness.

(U) In FY 1982 developments in Artificial Intelligence and related technologies, and lessons learned from 6.4 projects in "strap-on" training packages were reviewed.

(U) The FY 1983 program will develop plans for identification of target systems.

(U) For FY 1984 it is planned to:

- o Initiate missing team member models for surface Combat System Team Trainers.
- o Identify wargaming application for training assistance package proof-of-concept.

(U) Planned FY 1985 - FY 1988 program will complete and evaluate mission team member models for combat System Team Trainers; develop and evaluate intelligent adversary for tactical training.

Program Element: 63733N

Title: Training Devices Technology

(U) Subproject 06: Product Area, Sensor Simulation Development: Included within this project area are projects: (1) W1390, Multi-Spectral Image Simulation; and (2) W1676, Acoustic Signal Generator for Sensor Training. New operational target acquisition/weapon delivery suites are designed to receive and correlate data from a variety of sensor sources. Current trainers and training simulators have limited sensor capabilities but are not able to effectively simulate multi-spectral sensors for low altitude missions. Advanced multi-spectral weapon systems are being studied to determine their training requirements and possible simulation technologies. The capability to effectively simulate these new multi-spectral platforms must be available to the fleet by the mid-80s. This product area will develop the capability to simulate sensors employed in air, surface and subsurface weapon system platforms. Forward Looking Infrared, Low Light Level TV, sonar and radar sensor systems must be modeled; data received from the trainee pertaining to these sensors must be consistent and correlate with data provided by the visual system. Achieving this capability requires adapting/developing sensor models and providing realistic data bases to coordinate sensor inputs to displays and to the simulated visual environment.

(U) Expected Payoff: Current weapon systems, F/A-18 and A-6E, employ sensors which cannot be efficiently simulated. This work will allow flight personnel to increase training readiness significantly.

(U) In FY 1982 under exploratory development, technology gaps in simulating Multi-Spectral Images have been identified and development of real-time demonstration system initiated to produce required high resolution, high detail sensor imagery. Design provides correlation between sensors for combat engagement/weapon delivery for multipatform applications with emphasis on low level flight.

(U) The FY 1983 program will establish an ASW system to demonstrate the performance of ocean and target models developed under exploratory development.

(U) For FY 1984 it is planned to:

- o Complete procurement of Multi-Spectral Image simulation system.
- o Install in Visual Technology Research Simulator facility.
- o Initiate evaluation of training acceptability and effectiveness.
- o Transition ASW system to training technology demonstration and utilization effort.

(U) The planned FY 1985 - 1988 program will complete Multi-Spectral Image training evaluation and prepare specification for use in acquisition; add Electronic Warfare and radar simulation capability and evaluate.

I. (U) PROJECTS OF MORE THAN \$10 MILLION IN FY 1984: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63739N  
DoD Mission Area: 352 - Environmental and Life Sciences

Title: Personnel Productivity  
Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No | Title                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|            | TOTAL FOR PROGRAM ELEMENT | 0              | 0                | 733              | 2,157            | Continuing               | Continuing           |
| 21756      | Personnel Productivity    | 0              | 0                | 733              | 2,157            | 8,000                    | 10,890               |

While this is a continuing program element, the funding for the above project includes out-year escalation and encompasses all work or development phases now planned or anticipated.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program meets the requirements for the Deputy Chief of Naval Operations (Logistics) for increased productivity of Navy logistics support organizations. These organizations are being reindustrialized by such new technology as automated warehouses and fully automated administrative networks. This program matches the new technology with development of new organizations and personnel management systems to increase the ability of management and workers to adapt quickly and further enhance productivity. Previous efforts in exploratory and advanced development have been very successful.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: Not applicable. FY 1984 new start.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY: Not applicable. FY 1984 new start

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: Not applicable

F. (U) RELATED ACTIVITIES: FE 65872, Productivity Improvement, is developing automated systems for the administration of Navy Laboratories. Work to improve individual and group productivity has been undertaken in P.E.s 61102A (74), Training, Personnel and Human Engineering; 62722A, Manpower, Personnel and Training; 63731A, Manpower and Personnel and 62703F, Personnel Utilization Technology. Generally, the work conducted under these program elements has not been concerned with productivity per se, but addresses it as an ancillary issue or from a limited perspective, e.g., recruiter productivity. In the Navy, productivity has been addressed under P.E.s 61153N (42), Behavioral and Social Sciences, and preparatory to work in advanced development, under 62763N, Personnel and Training Technology. The present program element, 63739N, was funded because of the increasing importance of productivity as personnel costs rise and the significant gains demonstrated in Z1169, a project ending in FY 1983 and dealing with the productivity of civilian workers. This project was conducted under P.E. 63707N, Manpower Control System Development.

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is the Navy Personnel Research and Development Center, San Diego, CA.  
CONTRACTORS: To be determined

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project Z1756, Personnel Productivity: (NEW START) This project will design a personnel management system to accommodate technological changes in the production and administrative functions of logistic organizations. With the implementation of new technology, the need for changes in organizational structure and personnel policy will be evaluated. A model of the change process will be developed as well as a system for evaluating and testing proposed changes. The personnel management system that evolves will enable the Navy to use new technology in the most effective way possible to increase productivity and improve administrative functions.

(U) EXPECTED PAYOFF: Increase of at least 10% in productivity of targeted work groups and organizations.

Program Element: 63739N

Title: Personnel Productivity

(U) For FY 1984, it is planned to:

- o Identify logistic facilities (such as automated warehouses) which are adopting new technology.
- o Develop work flow analyses and work measurement systems for them.
- o Analyze production flow designs for the new technologies to determine new job requirements, new organizational configurations, and supporting personnel system requirements.

(U) In the outyears, organizational changes will be simulated on a computer model and implemented for testing in the organizations identified in FY 1984. Productivity and other indicators of organizational effectiveness will be evaluated and the personnel management system needed to accommodate technological changes planned for the 1990's will be designed.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63786N Title: Airborne Electromagnetic and Optical Systems (Advanced)  
DoD Mission Area: 351 - Electronic and Physical Sciences Budget Activity: 2 - Advanced Technology Development

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                    | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                | 3,060          | 2,960            | 488              | 0                | TBD                      | TBD                  |
| W0646       | Airborne Electro-Optical Countermeasures | 3,060          | 2,960            | 488              | 0                | TBD                      | TBD                  |

The above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Airborne Electro-Optical Countermeasures project continues the Navy's portion of a joint service effort to develop an Electro-Optical Countermeasures system and develop techniques and equipments to enhance survivability of Navy/Marine aircraft in operations against visual, electro-optical or laser directed ship or shore based anti-aircraft control systems. The Electro-Optical Guided Weapons Countermeasures Test project was established by the Under Secretary of Defense (Research and Engineering) as the focal point for coordinating, supporting and evaluating countermeasures test and analysis activities applied to laser/electro-optical, guided weapons.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in FY 1983 Descriptive Summary and that shown in this Descriptive Summary for W0646 are as follows: FY 1982, a decrease of 3,687 due to reprogramming to higher priority programs. FY 1983, a decrease of 4,321 resulted from a restructuring of the program in response to the FY 1982 reprogramming. FY 1984, 7,291 reduction in funding as a result of decisions during budget development. Project W0659 funding was deleted in FY 1982 and no funding is provided for FY 1983-1985.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                         | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-----------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                     | 4,273*         | 8,057            | 8,790            | 9,423            | Continuing               | Continuing           |
| W0646       | Airborne Electro-Optical Countermeasures      | 4,252*         | 6,747            | 7,281            | 7,779            | Continuing               | Continuing           |
| W0659       | Electro-Optical Guided Weapons Countermeasure | 21*            | 1,310            | 1,509            | 1,644            | Continuing               | Continuing           |

\* Formerly Program Element 63796.

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None.

F. (U) RELATED ACTIVITIES: Liaison with the Air Force Optical Countermeasure Program (PE 63743F) and the Army Optical Countermeasure Program (PE 63711A) will be maintained to keep abreast of their concepts, technology and equipment development to avoid duplication of effort. The pod-mounted COMPASS HAMMER Electro-Optical countermeasures is a joint Navy/AF development. The helo Optical Warning location-detection (AN/ALQ-169) and Helo Warning Receiver (AVR-2) are Army developments with United States Navy monitoring progress and testing.

Program Element: 63786N

Title: Airborne Electromagnetic and Optical Systems (Advanced)

G. (U) WORK PERFORMED BY: IN-HOUSE: Pacific Missile Test Center, Point Mugu, CA (lead laboratory); Naval Weapons Center, China Lake, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Support Center, Crane, IN; Naval Air Test Center, Patuxent River, MD; Naval Avionics Center, Indianapolis, IN. CONTRACTORS: SNL, Inc., McLean, VA; Martin Marietta Corporation, Orlando, FL; Perkin-Elmer Corporation, Norwalk, CT; Pacific-Sierra Research Corporation, Santa Monica, CA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project W0646, Airborne Electro-Optical Countermeasures: This project develops countermeasures equipment to protect USN/USMC aircraft against Electro-Optical and [ ] directed threats.

(U) In FY 1982, joint United States Air Force and United States Navy testing of the COMPASS HAMMER pod continued and joint United States Army and United States Navy testing of the AVR-2 [ ] warning receiver continued.

(U) The FY 1983 program consists of:

- o Completion of the COMPASS HAMMER testing.
- o Completion of the United States Navy Development Test/Operational Test II testing of AVR-2 [ ] warning receiver.
- o Testing of competing sensors for use on fixed wing aircraft.
- o Continue [ ] countermeasure analysis.

(U) For FY 1984, it is planned to:

- o Complete [ ] warning countermeasures ensuring full documentation in the event funds become available for later resumption of efforts.

(U) Program to Completion: To be determined.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: Not applicable.



FY 1984 BDT&N DESCRIPTIVE SUMMARY

Program Element: 11221N  
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT              | 65,621         | 30,770           | 28,241           | 55,335           | Continuing               | Continuing           |
| B0005       | LINEAR CHAIR                           | 1,596          | 0                | 0                | 0                | 0                        | 25,499               |
| J0091       | Fleet Ballistic Missile System         | 10,841         | 16,476           | 20,037           | 29,170           | Continuing               | Continuing           |
| J0094       | Improved Accuracy Program              | 43,822         | 0                | 0                | 0                | 0                        | 625,001              |
| S0942       | SSBN Unique Sonar                      | 6,166          | 10,083           | 4,303            | 16,497           | Continuing               | Continuing           |
| S1265       | SSBN Unique Countermeasure Development | 3,196          | 4,211            | 3,899            | 9,668            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only, except for projects B0005, LINEAR CHAIR, and J0094, Improved Accuracy Program, which were completed in FY 1982.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds development related to the POSEIDON Strategic Weapon System as well as other improvement projects for Fleet Ballistic Missile Submarines. Current Fleet Ballistic Missile System efforts are related to improvements in fleet ballistic missile submarine unique sonars, fleet ballistic missile submarine unique countermeasures, and the Strategic Weapon System aimed at extending effectiveness and survivability of the POSEIDON (C-3) Fleet Ballistic Missile Weapon system.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall decrease of 705 in FY 1982, in S1265, SSBN Unique Countermeasures, due to a reduction in the Mobile Submarine Simulator development effort; an overall decrease of 2,177 in FY 1983, 2 in S0942, SSBN Unique Sonar, and 25 in S1265, SSBN Unique Countermeasures, due to net repricing adjustments, and 2,150 in S1265, SSBN Unique Countermeasures, as partial off-set for undistributed Congressional reduction; and an overall decrease of 15,372 in FY 1984, 2,304 in J0091, Fleet Ballistic Missile Submarine System, due to a reduction of the Towed Array Signal Processor Equipment Operator Trainer Baseline, 10,351 in S0942, SSBN Unique Sonar, due to restructuring of the Towed Array Signal Processor Equipment (AM/BQQ-9) program to extend the basic development effort and delay by one year planned studies to upgrade information processing capabilities, and 2,717 in S1265, SSBN Unique Countermeasures, 12 due to Congressional reductions in Consultants, Studies and Analyses, and Management Support, and 2,705 due to restructuring of the Mobile Submarine Simulator Development efforts.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                  | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT              | 137,485        | 66,326           | 32,947           | 43,613           | Continuing               | Continuing           |
| B0005       | LINEAR CHAIR                           | 5,042          | 1,596            | 0                | 0                | 0                        | 25,499               |
| J0091       | Fleet Ballistic Missile System         | 11,013         | 10,841           | 16,476           | 22,341           | Continuing               | Continuing           |
| J0094       | Improved Accuracy Program              | 93,644         | 43,822           | 0                | 0                | 0                        | 625,001              |
| S0942       | SSBN Unique Sonar                      | 24,138         | 6,166            | 10,083           | 14,636           | Continuing               | Continuing           |
| S1265       | SSBN Unique Countermeasure Development | 3,648          | 3,901            | 6,386            | 6,616            | Continuing               | Continuing           |

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Program Element: 11221N

Title: Fleet Ballistic Missile System

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                           | <u>FY 1982</u><br><u>Actual</u> | <u>FY 1983</u><br><u>Estimate</u> | <u>FY 1984</u><br><u>Estimate</u> | <u>FY 1985</u><br><u>Estimate</u> | <u>Additional</u><br><u>to Completion</u> | <u>Estimated</u><br><u>Cost</u> |
|---------------------------|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------------------------|---------------------------------|
| OPN 1/                    | 50,460                          | 48,271                            | 88,800                            | 103,158                           | Continuing                                | Continuing                      |
| OPN (BA 2) (LI 332210) 2/ | 6,970                           | 7,092                             | 5,690                             | 8,308                             | Continuing                                | Continuing                      |
| SGN 3/                    | 1,100                           | 3,000                             | 900                               | 142,500                           | 145,000                                   | 292,500                         |
| WPN 4/                    | 45,800                          | 30,800                            | 23,900                            | 70,600                            | Continuing                                | Continuing                      |

- 1/ (U) These funds provide for the procurement of test instrumentation; equipment for maintenance, calibration, handling, data processing and tests at shore facilities; alterations to tactical hardware; overhaul equipment, new tactical hardware; and initial and replenishment spares and repairs parts. Beginning in FY 1984, the allocation between POSSIDON and TRIDENT items will no longer be maintained and all OPN costs will be shown in this program element rather than divided between this program element and Program Element 11228N, TRIDENT.
- 2/ (U) These funds will procure Submarine Acoustic Warfare Systems equipments, including Mobile Submarine Simulator items.
- 3/ (U) Funding shown relates to the conversion of two cargo ships to Fleet Ballistic Missile capability (FY 1981 and FY 1985) and the replacement of the YAGN-22 (USS Range Sentinel) Range Instrumentation Ship (FY 1986).
- 4/ (U) These funds, in support of the POSSIDON missile and missile modification programs (which includes production of POSSIDON MK-3 reentry body nosecones made of advanced graphite material developed for TRIDENT), provide for ancillary checkout and test flight equipment, spares and repair parts, production tooling and facilities, production support and astronautics.

F. (U) RELATED ACTIVITIES: The following Program Elements include related technologies which contribute directly to the Fleet Ballistic Missile System: TRIDENT I missile and TRIDENT submarine development under Program Element 11228N; advanced sonar signal processor development under Program Element 64266N; TRIDENT II Missile under Program Element 63371N, Project R0951; Fleet Ballistic Missile Submarine Security Improvements under Program Element 11224N; and Tactical Towed Array Sonar development under Program Element 64713N.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Underwater Systems Center, New London, CT; Naval Electronics Systems Command, Washington, DC; Naval Air Development Center, Warminster, PA; Norfolk Naval Shipyard, Portsmouth, VA; Naval Surface Weapons Center, Dahlgren, VA; Naval Coastal System Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; and David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. CONTRACTORS: Lockheed Missiles and Space Company, Sunnyvale, CA; Sperry Systems Management Division, Great Neck, NY; Rockwell International Corporation, Anaheim, CA; Honeywell, Incorporated, West Covina, CA; Control Data Corporation, Minneapolis, MN; Kaman Sciences Corporation, Colorado Springs, CO; Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; The Analytic Sciences Corporation, Reading, MA; Charles S. Draper Laboratory, Cambridge, MA; and RCA Corporation, Princeton, NY.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project R0942, SSBN Unique Sonar: Provides signal processing and display for the modified AN/BQR-15 Towed Array Sonar. Designated as the AN/BQQ-9 Sonar, it is considered part of the Fleet Ballistic Missile Submarine Strategic Weapons System. The AN/BQQ-9 will provide expanded search and classification capabilities using digital processing of the acoustic data from the modified AN/BQR-15 array.

Program Element: 11221N

Title: Fleet Ballistic Missile System

(U) In FY 1982,

- o Installed an engineering development model of AN/BQQ-9 system aboard a fleet ballistic missile submarine.
- o Successfully completed technical evaluation.

(U) The FY 1983 program consists of:

- o Completing development of Towed Array Signal Processing Equipment.
- o Conducting Operational Evaluation.
- o Initiating sonar contact management studies and continue vulnerability and effectiveness studies.

(U) For FY 1984, it is planned to:

- o Continue sonar contact management, vulnerability, and effectiveness studies.
- o Correct any outstanding system deficiencies identified by Technical and Operational Evaluations.

(U) The program to completion: This a continuing program. Planned efforts include:

- o Install AN/BQQ-9 Equipment on 31 Fleet Ballistic Missile Submarines and provide 5 trainers.
- o Install reliability and maintainability upgrades on 31 Fleet Ballistic Missile Submarines and in all trainers.

(U) Project 81265, SSBN Unique Countermeasures Development: This project will provide for the design and development of items extending the effectiveness and improving the survivability of the Fleet Ballistic Missile Weapon System. These items include increased performance capability of the AN/BLR-14 Acoustic Countermeasure Receiving Set by providing enhanced stern detection, improved torpedo detection and increased memory capabilities; development of an expendable six-inch diameter acoustic countermeasure device designated EX-9; and development of an expendable six-inch advanced sonar countermeasure device designated the Acoustic Device, Countermeasure Mark 4.

(U) In FY 1982,

- o Completed component analyses and design specifications for the AN/BLR-14 improvements.
- o Completed feasibility investigations and measurements of effectiveness criteria in the areas of acoustic projection, battery, and propulsion technologies for the Acoustic Countermeasure Device, EX-9.

(U) The FY 1983 program consists of:

- o Completion of technical data package, engineering development model contract award, and start-up of the engineering development model design for the acoustic countermeasure device, EX-9.
- o Fabrication, installation, and technical and operational testing of the AN/BLR-14 improvements.
- o Start-up, feasibility investigations, and component analyses for the acoustic device, Countermeasure, Mark 4.

(U) For FY 1984, it is planned to:

- o Obtain production approval for the AN/BLR-14 improvements.
- o Complete the engineering development model design and fabrication for the acoustic countermeasure device, EX-9.
- o Complete the design specifications and award an engineering development model contract for the Acoustic Device, Countermeasure, Mark 4.

(U) Program to completion: This is a continuing program.

Program Element: 11221N

Title: Fleet Ballistic Missile System

I. (U) PROJECT OVER \$10 MILLION IN FY 1984:

(U) Project J0091, Fleet Ballistic Missile System

1. (U) DESCRIPTION (Requirement and Project): Basic objective of U.S. strategic offensive forces is to deter nuclear attack on the United States. This is accomplished by deployment of a highly credible force capable of surviving a coordinated surprise attack and effectively retaliating. Any rational enemy will be deterred from attack by knowledge that a retaliatory strike will inevitably inflict such damage on his country as to deny him any gain from initiating a war. In support of national strategy, the major share of the Fleet Ballistic Missile portion of the assured retaliatory objective is currently provided by the POSEIDON(C-3) strategic weapon system. The launching vehicle is the fleet ballistic missile submarine equipped for computing accurate positional and geo-ballistic data, and for launching 16 C-3 missiles. Effort since completion of development and deployment of POSEIDON in FY 1972 has been related to improvements in the strategic weapon system and fleet ballistic missile submarine unique sonars which are aimed at extending the effectiveness and the survivability of the Fleet Ballistic Missile weapon system.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o Continued vulnerability and effectiveness investigations to identify potential improvements to the Fleet Ballistic Missile Weapon System, including missile, launcher, fire control, and navigation subsystems, to decrease potential vulnerabilities or increase effectiveness of the weapon system.
- o Continued development of sonar training programs for AN/BQQ-9 (V) Towed Array Signal Processing Equipment and AN/BQR-15 Array Modification.
- o Completed development of capability to launch two Navy navigation satellites on one SCOUT booster.
- o Started development of contract drawings and specifications for conversion of a cargo ship to Fleet Ballistic Missile cargo ship capability to replace an aging ship in the fleet.

b. (U) FY 1983 Program:

- o Will complete cargo ship conversion development effort.
- o Continue vulnerability and effectiveness efforts at a level to support continuing assessment of survivability implications of weapon subsystem operations and the engineering investigations of applicable corrective measures.
- o Continue development of sonar training programs including initiation of procurement of first AN/BQQ-9 (V) Towed Array Signal Processing Equipment Operator Trainer.
- o Start planning and validation effort for installation of NAVSTAR Global Positioning System on missile submarines.

c. (U) FY 1984 Planned Program:

- o Continue to identify potential improvements to the Fleet Ballistic Missile Weapon System to decrease potential vulnerabilities or to increase effectiveness; effort includes:
  - evaluation of new threat postulations,
  - investigation of potential system performance improvements,
  - assessment of survivability implications of subsystem operations and formulation of corrective measures,
  - investigation of methods for reducing submarine observability by increasing interval between navigation fixes.
- o Continue development of sonar training programs including procurement of first AN/BQQ-9 (V) Towed Array Signal Processing Equipment Operator Trainer and initiation of procurement of AN/BQR-15 Maintenance Trainer.
- o Continue to develop Global Positioning system configuration for installation on fleet ballistic missile submarines including initiation of procurement of pre-production hardware from Global Positioning System Joint Program Office.
- o Increased funding requirement for FY 1984 over FY 1983 is due to initiation of hardware procurements for AN/BQR-15 Maintenance Trainer and Global Positioning System.

Program Element: 11221N

Title: Fleet Ballistic Missile System

- d. (U) Program to Completion: This is a continuing program.
- e. (U) Milestones: Not applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 11224N  
DoD Mission Area: III - Sea Based Strike

Title: SSBN Security Program  
Budget Activity: 3 - Strategic Programs

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | 36,774         | 36,691           | 39,782           | 46,167           | Continuing               | Continuing           |
| J0092       | SSBN Security                                    | 36,774         | 35,449           | 36,708           | 42,955           | Continuing               | Continuing           |
| R1585       | Advanced Technology Concepts and Countermeasures | 0              | 1,242            | 3,074            | 3,212            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This program provides for an authoritative technological assessment of potential Soviet capability to threaten the deterrent effectiveness of the U. S. Fleet Ballistic Missile Submarine Force, and development of countermeasure technology. New technology advances will be evaluated for application as countermeasures to potential threats to Fleet Ballistic Missile Submarine Force covert mobility.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall increase of 45 in FY 1982, in J0092, SSBN Security, due to revised cost estimates, including inflation; and an overall decrease of 19,984 in FY 1984, caused by a 21,746 reduction in J0092, SSBN Security, due to program restructuring, and an increase of 1,762 in R1585, Advanced Technology Concepts and Countermeasures, due to increased scope of effort.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b>                 | 42,312         | 36,729           | 36,691           | 59,766           | Continuing               | Continuing           |
| J0092       | SSBN Security                                    | 39,812         | 36,729           | 35,449           | 58,454           | Continuing               | Continuing           |
| R0092       | SSBN Security                                    | 2,500          | 0                | 0                | 0                |                          |                      |
| R1585       | Advanced Technology Concepts and Countermeasures | 0              | 0                | 1,242            | 1,312            | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** Not applicable.

**F. (U) RELATED ACTIVITIES:** Director, Naval Warfare (OP-093) and Director, Defense Advanced Research Projects Agency conduct related research and development. Although technologies are similar, emphasis of the SSBN Security Program is on U. S. fleet ballistic missile submarine survivability in the face of anti-submarine warfare against the U.S. for the long term future, whereas Director, Naval Warfare efforts are directed at U.S. offensive anti-submarine warfare against the Soviets. Director, Defense Advanced Research Projects Agency conducts a variety of pertinent technological investigations. Fleet Ballistic Missile System, Program Element 11221N; TRIDENT I Missile and Submarine, Program Element 11228N; and TRIDENT II Missile, Program Element 63371N.

Program Number: 11224R

Title: SSBN Security Program

G. (U) WORK PERFORMED BY: IN-HOUSE: David W. Taylor Naval Ship Research and Development Center, Annapolis, MD; Naval Ocean Systems Center, San Diego, CA; Naval Oceanographic Office, Bay St. Louis, MS; Naval Underwater Systems Center, Newport, RI, and New London, CT; Naval Coastal Systems Center, Panama City, FL; Naval Research Laboratory, Washington, DC; and Institute for Defense Analysis, Arlington, VA. CONTRACTORS: Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; TRW, McLean, VA and Redondo Beach, CA; ORI Inc., Silver Spring, MD; Flow Research Incorporated, Seattle, WA; Dynamics Technology, Torrance, CA; Arete Associates, Encino, CA; Poseidon Research, Los Angeles, CA; Science Applications, Inc., LaJolla, CA, Seattle, WA, McLean, VA, and Tucson, AZ; North American Rockwell, Anaheim, CA; and Bolt, Beranek, and Newman, Cambridge, MA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project R1505, Advanced Technology Concepts and Countermeasures: This project evaluates new technology advances for application as countermeasures to potential threats to strategic submarines. The goal is to apply newly available and experimentally verified technology to the design of prototype countermeasures to potential threats.

(d) In FY 1983, its first year, the program consists of:

- o Investigation of the use of new fiber optic technology for improving Extremely Low Frequency communications receiver sensitivity, allowing submarines to operate at deeper depths and thus reducing detectability.
- o Survey of [ ] sound and a modeling effort aimed at [ ] active sensors.
- o An at-sea experiment to demonstrate the feasibility of [ ] retaining Very Low Frequency communications reception capability.

(U) For FY 1984, it is planned to:

- o Continue investigation of concepts to improve Extremely Low Frequency communications receiver sensitivity.
- o Continue study of [ ]
- o Investigate new concepts for mobile decoys.
- o Investigate techniques for monitoring self noise.
- o Continue evaluation of technology advances for exploitation as countermeasures to potential threats.

(U) For FY 1985 and out years:

- o Continue to evaluate technology advances for exploitation as countermeasures to potential threats to strategic submarine security.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(U) Project J0092, SSBN Security

1. (U) DESCRIPTION (Requirement and Project): Effort under this program was initiated in FY 1970 and is directed toward research, technology development and systems applications related to the security of the Fleet Ballistic Missile Submarine Force. Because the development of a threat to that security could arise out of one or more of several technologies, the program is vigorously pursued on a broad front spanning many technical areas. As maturity is approached in any technical area, efforts are more sharply focused upon the key technical issues and more heavily dedicated to at-sea experiments to resolve those issues to permit an authoritative assessment of the severity of the potential threat. Operational forces are being utilized under this program to collect at-sea data for survivability assessments. Principal efforts are concentrated upon the technical characterization of potential threats and counters, critical experiments that carry such concepts to the point of proof of principle, and assessments of the net effects upon force survivability. Technologies considered are acoustic, hydrodynamic, electro-magnetic and direct

Program Element: 11224H

Title: SSB Security Program

observables associated with fleet ballistic missile submarines; the ambient characteristics that relate to the observables and the counters to any potentially serious threats identified. A project is terminated when an authoritative assessment can be made or in the case of countermeasure technology, when proof of principle has been satisfactorily demonstrated.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

(U) Acoustics

o Participated with Defense Advanced Research Projects Agency in a preliminary at-sea experiment exploring the feasibility of utilizing [ ] technology in a [ ] surveillance system and initiated the associated data analysis effort.

o Completed analysis of data from FY 1980 at-sea test [ ] to demonstrate the potential for [ ]

o [ ] the fleet ballistic missile submarine

o Analyzed data from two at-sea experiments evaluating the performance of [ ]

o Began preparations for a FY 1983 major at-sea experiment addressing the threat potential [ ]

(U) Direct Observables

o Analyzed data from a major at-sea test assessing the detectability of [ ] over a wide range of environmental and operational parameters.

o Developed statistical models [ ] for use in an updated threat analysis.

o Continued study of several countermeasure techniques for reducing the [ ]

o Completed analysis of data from a preliminary at-sea test assessing the detectability of [ ]

o Completed development of preliminary detection model to predict the [ ] from a submerged fleet ballistic missile submarine [ ] and initiated a preliminary detectability (threat) analysis using the model and best available estimates for noise and clutter.

o Performed trade-off study to determine best approach to a full-scale, at-sea measurement program to complete the assessment of the detectability of the [ ] fleet ballistic missile submarine.

o Completed preliminary assessment of the [ ]

o Completed work of the major multi-contractor working group quantifying the [ ] detectability of submerged fleet ballistic missile submarines.

o In accordance with the findings of the working group, conducted a major field test to assess the detectability of [ ] and initiated analysis of the associated data.

(U) Hydrodynamics

o Conducted major at-sea experiment to obtain preliminary hydrodynamic signature data on a fleet ballistic missile submarine

o Initiated analysis of the associated data.

o Conducted experiment to obtain [ ] measurements using advanced sensors [ ]

and initiated analysis of the associated data.

o Analyzed data on submarine operating [ ] conditions.

o Completed analysis of data collected during [ ] experiment conducted in FY 1981.

o Continued development of advanced sensors for use in a major at-sea detection experiment in FY 1984.



Program Element: 11224N

Title: SSBN Security Program

- o Continued development of [ ] sensor system for use in FY 1984 fleet ballistic missile submarine experiment.
- o Provided support to a major Navy and multi-contractor working group chartered by Planning and Steering Advisory Group to assess status of U.S. Navy's hydrodynamic investigations.
- o Conducted countermeasure-related investigations.
- o Conducted essential supporting laboratory experiments and theoretical studies.

(U) Magnetics

- o Completed threat element analysis of concept employing advanced sensors against the submarine [ ]

(U) Environment

- o Acquired and evaluated environmental data in (or representative of) submarine operational areas to support tests and assessments related to fleet ballistic missile submarine security [ ]

h. (U) FY 1983 Program:

(U) Acoustics

- o Conduct major at-sea experiment addressing the threat potential of [ ]
- o Initiate analysis of associated data.
- o Begin preparations for a major FY 1984 at-sea experiment addressing the threat potential of [ ]
- o Conduct [ ] measurements of a TRIDENT Class fleet ballistic missile submarine.
- o Complete analysis of data collected in FY 1981 experiment evaluating performance [ ]
- o Complete analysis of the threat potential [ ]
- o Conduct countermeasure-related investigations and necessary theoretical studies.

(U) Direct Observables

- o Complete updated Threat Element Analysis [ ] based upon the FY 1982 analysis of the data from the FY 1981 detection experiment.
- o Assess whether [ ] detectability is increased [ ]
- o Continue assessment of countermeasure techniques [ ]
- o Initiate analytical assessment of countermeasure techniques [ ]
- o Complete the preliminary detectability (threat) assessment [ ]
- o Begin development and testing of an upgraded [ ] system for use in [ ] experiments to be conducted in FY 1984.
- o Complete analysis of data collected in major FY 1982 field test assessing detectability [ ]
- o Initiate threat element analysis to evaluate and document detectability [ ]

Program Element: 11224N

Title: SSBN Security Program

(U) Hydrodynamics

- o Complete analysis of data from the FY 1982 [ ] experiment.
- o Complete analysis of data from the FY 1982 experiment utilizing advanced sensors [ ]
- o Complete analysis of data on [ ] POSEIDON Class fleet ballistic missile submarines [ ]
- o Collect data on [ ] TRIDENT Class fleet ballistic missile submarines [ ]
- o Perform preliminary detectability (threat) assessment [ ] /concept, based on FY 1981 experiment results.
- o Complete development and begin at-sea testing of advanced sensors for use in a major at-sea detection experiment in 1984.
  - At-sea testing this year will include extensive background data collection and analysis and preliminary submarine signature measurements.
- o Complete development and begin at-sea testing of sensor system for use in 1984 [ ]
  - At-sea testing this year will include extensive background data collection and analysis.
- o Initiate preliminary detectability (threat) assessment for various hydrodynamic detection concepts.
- o Continue countermeasure related investigations.
- o Conduct necessary supporting laboratory experiments and theoretical studies.

(U) Magnetics

- o Produce detectability assessment [ ]

(U) Environment

- o Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues pertaining to fleet ballistic missile submarine detectability at sea [ ]
- o Update and promulgate environmental data requirements to support program objectives.
- o Assess use of tactical oceanography as a countermeasure.
- c. (U) FY 1984 Planned Program:

(U) Acoustics

- o Continue analysis of data collected in FY 1983 [ ] experiment.
- o Conduct major at-sea experiment addressing the threat potential [ ] and initiate analysis of associated data.
- o Complete analysis of data from FY 1983 [ ]
- o Conduct [ ] measurement of TRIDENT Class fleet ballistic missile submarines.
- o Initiate threat element analysis [ ]
- o Conduct countermeasure-related investigations and needed supporting theoretical investigations.

(U) Direct Observables

- o Complete assessment of countermeasure techniques [ ]
- o Complete analytical assessment of countermeasure techniques [ ]
- o Conduct experiment to characterize the [ ] fleet ballistic missile submarine [ ]
  - in two areas with significantly different [ ] potential.
  - Initiate analysis of the associated data.
- o Complete [ ] threat element analysis.

Program Element: 11224N

Title: SSBN Security Program

(U) Hydrodynamics

- o Complete analysis of data on [ ] TRIDENT Class fleet ballistic missile submarines collected [ ]  
in FY 1983.
- o Conduct major at-sea [ ] experiment for [ ] utilising sensor  
system developed in FY 1982 and FY 1983.
  - Initiate analysis of associated data.
- o Complete preliminary detectability (threat) assessment for various hydrodynamic detection concepts.
- o Continue countermeasure-related investigations.
- o Conduct necessary supporting laboratory experiments and theoretical studies.

(U) Environment

- o Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues pertaining to fleet ballistic missile submarine detectability at-sea, including tactical oceanography.
- d. (U) Program to Completion: This is a continuing program.
- e. (U) Milestones: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11228N  
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                              | 100,164        | 66,057           | 72,387           | 74,634           | Continuing               | Continuing           |
| B0003       | TRIDENT I Missile System                                               | 41,471         | 14,683           | 2,539            | 2,346            | Continuing               | Continuing           |
|             | QUANTITY (Development flight test and Performance Evaluation missiles) |                |                  |                  |                  |                          | (25)                 |
| B0004       | TRIDENT Submarine System                                               | 58,693         | 51,374           | 69,848           | 72,288           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the continuing development of the TRIDENT System, whose Initial Operational Capability (IOC) was achieved in October 1982. TRIDENT is a long term U. S. Navy program, undertaken in accordance with Decision Coordinating Paper 67, for the modernization and orderly replacement of earlier deployed submarine ballistic missile systems (POLARIS and POSEIDON). These systems are a key element of the nation's strategic nuclear deterrent.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall decrease of 1,786 in FY 1982, in B0004, TRIDENT Submarine, 184 due to revision of cost estimates including inflation, and 1,600 in order to support an urgent shortfall in K1452, Geodetic/Geophysical Satellite, Program Element 63371N, TRIDENT II; an overall decrease of 24,508 in FY 1983, due to a Congressional decrease of 21,565 in B0003, TRIDENT I Missile, to terminate the MK 500 Evader Readiness Maintenance Program, and a reduction of 2,943 in B0004, TRIDENT Submarine, 30 due to revision of cost estimates and 2,913 transferred to B0951, TRIDENT II Missile, Program Element 63371N, to support essential Missile development efforts in order to meet current schedules and approved system Initial Operational Capability of 1989; and an overall decrease of 64,694 in FY 1984, 36,102 in B0003, TRIDENT I Missile, of which 29,402 is caused by termination of the MK 500 Evader program, and 6,700 due to a reduction in scope of efforts to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness, and 28,592 in B0004, TRIDENT Submarine, 9 due to Congressional reductions in Consultants, Studies and Analyses, and Management Support, and 28,583 due to program restructuring and revised estimates.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                                                  | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|------------------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                              | 76,295         | 101,950          | 90,365           | 137,081          | Continuing               | Continuing           |
| B0003       | TRIDENT I Missile System                                               | 26,047         | 41,471           | 36,248           | 38,641           | Continuing               | Continuing           |
|             | QUANTITY (Development flight test and Performance Evaluation missiles) |                |                  |                  |                  |                          | (25)                 |
|             | Department of Energy Costs                                             |                |                  |                  |                  |                          | 1,897,900            |
| B0004       | TRIDENT Submarine System                                               | 50,248         | 60,479           | 54,317           | 98,440           | Continuing               | Continuing           |
|             | Department of Energy Costs                                             |                |                  |                  |                  |                          | 400,000              |

Program Element: 11228N

Title: TRIDENT I

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                  | <u>FY 1982<br/>Actual</u> | <u>FY 1983<br/>Estimate</u> | <u>FY 1984<br/>Estimate</u> | <u>FY 1985<br/>Estimate</u> | <u>Additional<br/>to Completion</u> | <u>Total<br/>Estimated<br/>Cost</u> |
|----------------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------------|-------------------------------------|
| SCN (BA 1) (LI 321040) 1/        | 112,407                   | 216,875                     | 180,900                     | 53,000                      | 0                                   | 8,007,000                           |
| Quantity (TRIDENT Submarines) 1/ | (0)                       | (0)                         | (0)                         | (0)                         | (0)                                 | (8)                                 |
| WPN (BA 1) (LI 301140) 2/        | 876,824                   | 662,800                     | 587,200                     | 204,600                     | 381,400                             | 7,570,755                           |
| Quantity (TRIDENT I Missiles)    | (72)                      | (62)                        | (52)                        | (0)                         | (0)                                 | (570)                               |
| MILCON 3/ 4/                     | 18,500                    | 2,180                       | 7,200                       | 42,100                      | Continuing                          | Continuing                          |
| OPN (BA 2) 5/                    | 71,400                    | 0                           | 0                           | 0                           | 0                                   |                                     |

1/ (U) Commencing in FY 1983, TRIDENT Submarines will be constructed with TRIDENT II (D-5) capability, and will be listed in Program Element 63371N, TRIDENT II.

2/ (U) Total TRIDENT I and Backfit. Excludes funds for replenishment spares and missile industrial facilities, which are not acquisition costs.

3/ (U) Excludes Backfit costs, which are reported in the Descriptive Summary for Program Element 11221N, Fleet Ballistic Missile System.

4/ (U) Not subject to authorization.

F. (U) RELATED ACTIVITIES: Fleet Ballistic Missile System, Program Element 11221N; TRIDENT II, Program Element 63371N; SSN 688 Class Attack Submarine, Program Element 24281N; Fleet Ballistic Missile Submarine Security, Program Element 11224N; Extremely Low Frequency Communications, Program Element 11401N; and Navy Strategic Communications, Program Element 11402N.

G. (U) WORK PERFORMED BY: IN-HOUSE: TRIDENT System Project Office (Project Management), Washington, D.C.; Naval Sea Systems Command, Washington, DC; Strategic Systems Project Office, Washington, D.C.; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Underwater Systems Center, Newport, RI, and New London, CT; Naval Surface Weapons Center, Dahlgren, VA; Pacific Missile Test Center, Point Mugu, CA; Eastern Space and Missile Center, Cocoa Beach, FL; and others. CONTRACTORS: Electric Boat Division of General Dynamics Corp., Groton, CT; Lockheed Missiles and Space Company, Sunnyvale, CA; Charles Stark Draper Laboratory, Cambridge, MA; Automatic Industries, INC., Vitro Division, Silver Spring, MD; Kaman Sciences Corporation, Colorado Springs, CO; and others.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project 80003, TRIDENT I Missile System: This project provides for the ongoing investigation of improvements and potential threats to the TRIDENT I Strategic Weapons System and conducts the MK 500 Evader Readiness Maintenance program, which is ending in FY 1983.

(U) In FY 1982,

- o Deployed the TRIDENT I (C-4) Missile aboard a TRIDENT submarine.
- o Continued investigation of improvements to counter potential TRIDENT I (C-4) strategic weapon system vulnerabilities or increase system effectiveness.
- o Attained readiness posture to MK 500 Evader initial operational capability for the Advanced Evader Vehicle.

Program Element: 11228H

Title: TRIDENT I

(U) The FY 1983 program consists of:

- o Conducting a flight test of advanced MK 500 Evader Vehicle and completing comprehensive design disclosure package to bring MK 500 Evader Readiness Maintenance Program to an orderly conclusion.
- o Continuing investigation of improvements to counter potential TRIDENT I (C-4) strategic weapon system vulnerabilities or increase system effectiveness.

(U) For FY 1984, it is planned to continue:

- o Investigation of improvements to counter potential TRIDENT I (C-4) strategic weapon system vulnerabilities or increase system effectiveness.

(U) The program to completion will continue to investigate improvements to counter potential TRIDENT I (C-4) Strategic Weapon System vulnerabilities or increase system effectiveness.

(U) TEST AND EVALUATION DATA:

1. (U) Development Test and Evaluation:

(U) The TRIDENT I (C-4) missile development program was conducted under the management control of the Strategic Systems Project Office. Major development contractors/agencies are as follows:

| <u>MAJOR SUBSYSTEM</u>               | <u>CONTRACTORS/AGENCIES</u>                                                                                                    |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Missile System                       | Lockheed Missiles and Space Company                                                                                            |
| Missile Propulsion                   | Hercules, Inc. and Thiokol (Joint venture)<br>(Subcontractors to Lockheed Missiles and Space Company)                          |
| MK-500 Evader (Advanced Development) | General Electric Company, Reentry and Environmental Systems Division<br>(Subcontractor to Lockheed Missiles and Space Company) |
| Guidance                             | Charles Stark Draper Laboratory                                                                                                |
| Fire Control                         | General Electric Company, Ordnance Systems                                                                                     |
| Navigation                           | Sperry Systems Management Division                                                                                             |
| Launcher                             | Westinghouse Electric Corporation                                                                                              |
| Test Instrumentation                 | Interstate Electronics Corporation                                                                                             |
| Warhead                              | Department of Energy                                                                                                           |

(U) The path of development followed closely those of the POLARIS and POSSEIDON programs. Critical components are being procured in a continuous production program. Particularly in electronics components, continuous production run buys are essential to insure quality because the total quantities required for the TRIDENT I program comprise an extremely small fraction of the supplier's normal production. The plan for TRIDENT I places more emphasis than in the previous POLARIS and POSSEIDON programs on quality acceptance screening of parts, environmental screening during manufacture and assembly, acceptance testing in more stringent environments, and the extension of design and process assessment tests.

(U) An integral part of early development included laboratory testing of components and modules along with the application of suitable production controls and correction of deficiencies discovered, including retest as required, to demonstrate reliability. Development included necessary ground tests, including static firing of motors, under controlled conditions. Certain missile body hardware and reentry body materials, structures, and tactical designs have undergone nuclear effects testing to assess vulnerability. An advanced development phase to demonstrate TRIDENT I/MK-500 Evader compatibility on C-4X missile development flight tests was conducted.

Program Element: 11228N

Title: TRIDENT I

(U) The missile development flight test program included 25 tests. These were completed in July 1979. Eighteen of the tests were development missiles (C-4X) flown from a flat pad at Space and Missile Test Center Detachment 1, Cape Canaveral, FL, into calibrated impact areas. The objectives of C-4X development flights were: to evaluate system interactions and critical new functions/environments, to begin long term missile environmental assessment, to obtain data for performance model refinements/verifications, and to obtain data to validate criteria for extended limits tests. Compatibility between the MK 300 Evader and the C-4 missile, the performance of the stellar inertial guidance system, and the ability of the missile to fly to various velocity/reentry angle conditions and perform as specified, were specific examples of the items evaluated on C-4X flights.

(U) Seven Performance Evaluation Missiles were flown to evaluate the ability of the production process to produce missiles conforming to the tactical design disclosure package and to meet performance goals. While part of the development program, they were the first missiles produced employing the manufacturing processes, tooling methods, test checkout, and assembly procedures which are being used in the tactical production program. Performance Evaluation Missiles were flown from a Fleet Ballistic Missile Submarine to demonstrate underwater launch capability and prove the concept of backfitting POSEIDON (C-3) Fleet Ballistic Missile Submarines to carry TRIDENT I (C-4) missiles. Commander, Operational Test and Evaluation Force (COMOTEPFOR) monitored development testing.

2. (U) Operational Test and Evaluation (OT&E):

a. (U) The initial operational assessment of the TRIDENT I Strategic Weapons System (SWS) was conducted in conjunction with the Development Test and Evaluation (DT&E) C-4X and Performance Evaluation Missile firings. In July 1980 Commander, Operational Test and Evaluation Force reported that the TRIDENT I Strategic Weapons System demonstrated the potential to meet range, accuracy, payload and reliability goals although the testing was insufficient to assess operational effectiveness and operational suitability. Operational Testing is continuing with the Demonstration and Shakedown Operation and Operational Test Programs.

b. (U) The objective of the Demonstration and Shakedown Operation program is to demonstrate the readiness of a Fleet Ballistic Missile Submarine's Strategic Weapon System and its crew for deployment. This program also provides for evaluation of any design changes which might be introduced after commencement of production and early verification of both hardware and software technical changes. These continuing Demonstration and Shakedown Operation exercises provide for final post-construction certification of the weapon system. Since August 1977, thirteen Demonstration and Shakedown Operation missile launchings have been conducted, eleven from backfitted POSEIDON Fleet Ballistic Missile Submarines and two from the TRIDENT (OHIO Class) Fleet Ballistic Missile Submarines.

c. (U) The Operational Test program for the TRIDENT I missile is being conducted in a manner similar to POLARIS/POSEIDON; however, more tests were conducted earlier in the program to provide an early assessment of production hardware. These tests will also provide data on weapon system reliability and accuracy to the Joint Chiefs of Staff, and to Unified and Specified Commanders. Operational Tests are conducted by the Fleet Commander, with technical advice and management provided by the Strategic Systems Project Office. Data analysis and reporting are provided by the Applied Physics Laboratory - Johns Hopkins University. An Integrated Test Plan insures that Operational Tests will exercise the missile over the full range of its capabilities. Targeting and flight profiles are provided by the Naval Surface Weapons Center, Dahlgren, VA. Commander, Operational Test and Evaluation Force is observing flight testing and reviewing test reports in order to conduct an independent assessment of the TRIDENT I Strategic Weapons System and provide a separate Operational Test and Evaluation report to the Chief of Naval Operations and to the Director, Defense Test and Evaluation within the Office of the Secretary of Defense.

d. (U) The Operational Test program is divided into two phases. An initial Operational Test phase, in which a relatively large number of missiles are launched during a short (two-three year) period immediately following initial deployment, has the objective of early determination of deployed system performance. Testing then reverts to a Follow-On Test (FOT) phase, normally involving a somewhat lower launch rate, with the objective of detecting any changes in system performance over its service life. Both phases of the Operational Test program exercise all elements of the TRIDENT I Strategic Weapons System under conditions as close to those expected of a strategic launch as political and safety considerations will permit.

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Program Element: 11228N

Title: TRIDENT I

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(U) Project B0004, TRIDENT Submarine System:

1. (U) DESCRIPTION (Requirement and Project): The TRIDENT System will provide a highly survivable strategic deterrent for the 1980s and beyond. Designed to be a cost effective replacement for the POLARIS/POSEIDON Systems, TRIDENT incorporates new technology acquired since the POLARIS/POSEIDON force was designed. The principal objectives of the TRIDENT submarine design and development are:

- a. (U) Survivability in a vigorous, sophisticated anti-submarine warfare environment.
- b. (U) High reliability and maintainability, minimizing the frequency of overhauls and reducing their complexity and duration.
- c. (U) Minimal personnel manning;
- d. (U) Deployment from continental United States bases and operating capability in large ocean areas, continuously within range of targets, with ability of immediate response to a weapon launch order.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o Lead and second ships delivered.
- o Commenced TRIDENT modernization program.
- o Continued efforts to support deployment of follow-on ships.
- o Continued test and evaluation in the areas of propulsion systems, and command, control and communications.
- o Continued prototype development of the command and control subsystems with Revision 4 undergoing evaluation.
- o Continued TRIDENT design and component improvement.
- o Continued design and development efforts for the East Coast TRIDENT Base.
- o Initiated studies to accelerate TRIDENT II (D-5) program.

b. (U) FY 1983 Program:

- o Commence planning to introduce TRIDENT II (D-5) missile starting with the ninth TRIDENT submarine.
- o Continue test and evaluation of ship systems.
- o Continue TRIDENT modernization program.
- o Continue East Coast TRIDENT Base development efforts.
- o Continue Command, Control, and Communications prototype efforts.
- o Provide hull, mechanical, and electrical related investigations, special tests and developments required as a result of deficiencies identified during equipment testing, system and subsystem shipboard testing, and ship trials of developmental systems and components.

c. (U) FY 1984 Planned Program:

- o Continue test and evaluation of ship systems.
- o Continue TRIDENT modernization program.
- o Continue East Coast TRIDENT Base development.
- o Deliver fourth ship, and deploy third ship.

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d. (U) Program to Completion:

- o Continue development aspects of the TRIDENT submarine program supporting TRIDENT submarine deployment.
- o Continue engineering and design effort to review and update TRIDENT specifications.
- o Continue TRIDENT modernization program.
- o Complete East Coast TRIDENT Base development.

e. (U) Milestones:

| <u>Milestone</u>                                                                                                          | <u>Date</u> |
|---------------------------------------------------------------------------------------------------------------------------|-------------|
| 1. (U) TRIDENT Decision Coordinating Paper approved                                                                       | 9/71        |
| 2. (U) Submarine baseline design completed                                                                                | 3/72        |
| 3. (U) Secretary of Defense approval for full scale development<br>(Defense Systems Acquisition Review Council, Phase II) | 12/72       |
| 4. (U) Complete submarine contract design                                                                                 | 5/73        |
| 5. (U) Award lead submarine construction contract                                                                         | 7/74        |
| 6. (U) Approval for production<br>(Defense Systems Acquisition Review Council, Phase III)                                 | 10/74       |
| 7. (U) Award construction contract for second and third submarines                                                        | 2/75        |
| 8. (U) Award construction contract for fourth submarine                                                                   | 2/76        |
| 9. (U) Conceptual goals identified                                                                                        | 8/76        |
| 10. (U) Award construction contract for fifth submarine                                                                   | 6/77        |
| 11. (U) Start concept formulation                                                                                         | 9/77        |
| 12. (U) Award construction contract for sixth and seventh submarines.                                                     | 2/78        |
| 13. (U) Award construction contract for eighth submarine                                                                  | 1/81        |
| 14. (U) Final Site Selection - East Coast Base                                                                            | 10/80       |
| 15. (U) Contract delivery date lead submarine                                                                             | 10/81       |
| 16. (U) Delivery lead submarine                                                                                           | 10/81       |
| 17. (U) Award construction contract for ninth submarine                                                                   | 1/82        |
| 18. (U) Initial Operational Capability                                                                                    | 10/82       |
| 19. (U) Award construction contract for tenth submarine                                                                   | 11/82       |

\* Date shown in FY 1983 Program Element Descriptive Summary.

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f. (U) TEST AND EVALUATION DATA:

(U) TRIDENT submarine test data will be presented in three sections corresponding to the following major TRIDENT submarine systems:

- I. Hull and Acoustic Quieting
- II. Command and Control System
- III. Propulsion/Electrical System

I. (U) HULL AND ACOUSTIC QUIETING:

(U) The hull subsystem is fabricated and installed to specifications previously used in earlier Fleet Ballistic Missile and Attack submarines modified as required by the following factors:

- Larger hull size required to support the missile battery.
- Difference in dimensional relationships of structural subsystems in comparison with past submarine experience.
- Hull structure design to accommodate required hull penetrations including the larger Logistics/Escape Trunk necessary to facilitate maintenance requirements imposed by the extended TRIDENT operating cycle.
- Use of Glass-Reinforced Plastic sonar domes in lieu of earlier mild steel fabricated domes for improved sonar self-noise performance.

A. (U) Hull and Logistics/Escape Trunk

1. (U) Development Test and Evaluation:

a. (U) Photoelastic and steel model tests of the missile compartment and logistics access hull penetration were conducted in 1970-71 by Naval Civil Engineering Laboratory, Port Hueneme, California, to evaluate the hull stress loading under hydrostatic pressure in support of the design agent's (General Dynamics/Electric Boat Division) hull design effort.

b. (U) Full-scale tests were conducted in October 1972 in an operational Fleet Ballistic Missile submarine to measure missile tube deflection under submerged loading. These tests were conducted by the design agent (General Dynamic/Electric Boat Division) to validate modified stress analysis programs being used in the TRIDENT submarine design.

c. (U) Two small-scale bulkhead models, using existing submarine cylinders, were designed, fabricated and tested to evaluate the structural arrangements determined by analytical techniques to be the most efficient. Data collected were used to refine the analytical model. A final test collapsed the model, ascertaining the ultimate holding capacity of the structure. This testing was conducted by David W. Taylor Naval Ship Research and Development Center.

d. (U) A full-scale operational model of a portion of the missile compartment, including the missile tube, was fabricated to evaluate structural fabrication techniques, accessibility, and system operation. The missile tube assembly has been installed and factory tests completed, including a satisfactory hydrostatic test. Testing was conducted by General Dynamics/Electric Boat Division.

e. (U) The Logistics/Escape Trunk design, because of its increased size (6 foot diameter), underwent full-scale explosive testing by David Taylor Naval Ship Research and Development Center Underwater Explosive Research Division in mid-1977. Preliminary shock test results indicated the Logistics/Escape Trunk met the threshold objective. A failure of the lower hatch hinge bolts (an SSN 688 Class design) required a lower hatch redesign; however, this failure did not invalidate the successful demonstration of the 6 foot logistics hatch concept. The Logistics/Escape Trunk was provided by General Dynamics/ Electric Boat Division and was retested in the Submarine Shock Test Vehicle in June 1979 and again in September 1980 to requalify a redesigned lower hatch assembly. Results of the retests were satisfactory.

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2. (U) Operational Test and Evaluation:

(U) In view of the fact that hull and access hatches pose a technical risk only, no operational test and evaluation will be conducted by Commander, Operational Test and Evaluation Force.

3. (U) System Characteristics (Logistics/Escapes Trunk):

| <u>Characteristic</u>                                                                  | <u>Threshold</u> | <u>Demonstrated Performance</u>                |
|----------------------------------------------------------------------------------------|------------------|------------------------------------------------|
| Maintaining structural integrity of Logistics/Escapes Trunk following shock factor of: | [ ]              | Threshold requirements have been demonstrated. |

B. (U) Acoustic Quieting:

(U) The following are the specific equipments being developed to meet the acoustic quieting goal, but have not completed test and evaluation:

1. (U) Development Test and Evaluation:

a. (U) Hovering System Four-Way Valve. The four-way valve was subjected to laboratory tests at General Dynamics/Electric Boat Division from July through October 1973 to determine the noise level and the pressure drop across the valve. The pressure drop was determined with design system flow and with the valve at various pre-determined operating positions, thereby simulating closely the shipboard hovering evolutions. The tests verified that the valve could satisfy system noise and pressure drop requirements.

b. (U) Torpedo Turbine Pump Ejection System (Mark 17 Mod 0). Testing of the prototype was accomplished at the Naval Underwater Systems Center, Newport, RI, between May 1973 and February 1974. Tests were conducted to establish proper operation of the system and to validate the results of a computer simulation. Test objectives were achieved. Two units were delivered to Naval Underwater Systems Center, Newport, in March of 1977. One unit underwent land-based evaluation. After testing, the pump diffuser was mated with a new pump part and a new turbine gear train for utilization on the first TRIDENT. Upon completion of all tests, these two units were delivered to the shipbuilder in June of 1977 and installed in USS OHIO.

2. (U) Operational Test and Evaluation:

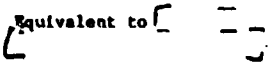
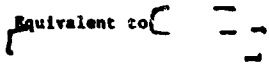
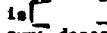
a. (U) Initial Operational Test and Evaluation (IOT&E) of the Torpedo Turbine Pump Ejection System was conducted concurrently with Development Testing Phase IIIS at the Naval Underwater Systems Center, Newport, RI, between September 1976 and March 1977. Based on demonstrated performance, Commander, Operational Test and Evaluation Force concluded that the Torpedo Turbine Pump Ejection System has the potential to be operationally effective and operationally suitable.

b. (U) Follow-on Operational Test and Evaluation (FOT&E) was conducted by Commander, Operational Test and Evaluation Force on the lead ship in connection with Production Acceptance Test and Evaluation (PAT&E) "Acoustic Trials" and other pre-deployment schedule events. Data collected during special events that occur during refit or patrol will be included as a part of Follow-on Operational Test and Evaluation.

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3. (U) System Characteristics:

| <u>Characteristic</u>                                       | <u>Threshold</u>                                                                                 | <u>Demonstrated Performance</u>                                                                                                                                                                                                   |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The acoustic quieting objective for the TRIDENT design is:  |                                                                                                  |                                                                                                                                                                                                                                   |
| Radiated Noise at 5 knots<br>(measured in 1/3 octave bands) | Equivalent to  | Acoustic Trials conducted,<br>analysis not yet complete.                                                                                                                                                                          |
| Specific equipment objectives are:                          |                                                                                                  |                                                                                                                                                                                                                                   |
|                                                             | <u>Hovering System Four-Way Valve</u>                                                            |                                                                                                                                                                                                                                   |
| Structureborne Noise Level                                  | Equivalent to  | Threshold requirements<br>have been demonstrated.                                                                                                                                                                                 |
|                                                             | <u>Torpedo Turbine Pump Ejection System</u>                                                      |                                                                                                                                                                                                                                   |
| Structureborne Noise Level                                  | < Ram pump levels<br>based on land based<br>test site data.                                      | Peak structureborne noise level<br>is  lower than the Ram<br>pump depending on accelerometer<br>location. At-sea data is being<br>collected. |

II. (U) COMMAND AND CONTROL SYSTEM (CCS):

(U) The TRIDENT Command and Control System (CCS) is an integrated complex of installed equipment, user and machine-oriented computer programs, operational data, and standard operating procedures configured for the performance of specified command, control, communications, defense and ship support functions. The Command and Control System makes extensive use of digital computers, computer peripherals, interequipment communications channels, and interactive digital displays. The Command and Control System is functionally comprised of the following major subsystems: AN/BQQ-6 Sonar, Mark 118 Fire Control System, Exterior Communications, Data Processing Equipment including AN/UYK-7 and AN/UYK-20 computers, Monitoring subsystem, Ship Control, Interior Communications subsystem, Tactical Navigation, and the Identification Friend or Foe/Radar/Electronic Support Measures (ESM)/Periscope subsystems. The operational mission of the Command and Control System is to give the TRIDENT submarine the ability:

- To remain undetected, to evade if detected, and to defend itself from attack.
- To measure and display real-time ship operational status and to monitor the performance of designate equipments.
- To maintain receipt of strategic communications and to communicate with other fleet units as required.

(U) The following systems, which are portions of the Command and Control System are described in the TRIDENT System Test and Evaluation Master Plan 113: AN/BQQ-6 Sonar, Mark 118 Fire Control System, and Integrated Radio Room (IRR).

(U) The test plan for the Command and Control System requires acceptance testing of each of these new or extensively modified systems by the development activity. Following this stand-alone testing, all major equipments and subsystems are installed at the Land Based Evaluation Facility (LBEF) at Naval Underwater Systems Center, Newport, RI. Extensive integration testing is conducted to verify software and hardware compatibility and to demonstrate specified performance prior to installation in the submarine. Command and Control System Engineering and Integration (E&I) is accomplished by the Command and Control System Engineering and Integration contractor (Electric Boat Division/International Business Machines). Integrated Land Based Evaluation Facility testing

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commenced in 1976 with Commander, Operational Test and Evaluation Force participation. Integrated testing has been completed through Command and Control System Revision 3.4. Command and Control System revision 3.4 was installed in the lead TRIDENT submarine during Post Shakedown Availability (PSA) and will be installed in the second TRIDENT submarine during Post Shakedown Availability. Further operational evaluation is being conducted at sea during deployment of the lead ship.

A. (U) AN/BQQ-6 Sonar System

(U) The AN/BQQ-6 Sonar Set is an advanced sonar system developed for the TRIDENT submarine. The primary detection group is a digital integrated system employing spherical array, hull mounted line array, and towed array sensors with an active emission acoustic intercept receiver and high-frequency active (short-range) sonar. In addition, support equipment has been added to provide for underwater communications, environment-sensing, magnetic recording, enhanced maintenance capabilities, and acoustic emergency devices.

1. (U) Development Test and Evaluation:

(U) All units of the AN/BQQ-6 Sonar are required to undergo Development Test and Evaluation (DT&E). In particular, the following phases of testing are required:

- a. (U) Preproduction Inspection (conducted once on first contract):
  - System Design Certification Testing
  - Environmental Testing
  - Reliability/Maintainability Testing
- b. (U) Quality Conformance Inspection
  - Production Inspection (each system)
  - Production Control Inspection (conducted on a sample basis)
  - Environmental Tests (conducted on a sample basis)

(U) In-plant Development Test and Evaluation, which has been combined with Production Acceptance Test and Evaluation (PAT&E), is conducted at International Business Machines, Manassas, VA, on all AN/BQQ-6 hardware scheduled for installation in the TRIDENT submarines. The in-plant portion of this test and evaluation has not uncovered any significant design problems. The AN/BQQ-6 production system, less sensors, undergoes integration testing at the Land Based Evaluation Facility as part of the Command and Control System integration testing. Integrated testing at the Land Based Evaluation Facility has been completed through Command and Control System Revision 3.4. Command and Control System Revision 3.4, which contains a sonar software revision, was installed in the lead TRIDENT Submarine during Post Shakedown Availability (PSA) and will be installed in the second TRIDENT submarine during Post Shakedown Availability. Future installations will be made during new construction.

2. (U) Operational Test and Evaluation:

a. (U) Initial Operational Test and Evaluation (IOT&E) was conducted by Commander, Operational Test and Evaluation Force in combination with Development Test and Evaluation (DT&E) at the Land Based Evaluation Facility in order to certify Command and Control System Revision 2.1 ready for installation in the lead ship. The system tested included the complete lead ship sonar, except for external arrays and transducers. Results of testing completed in June 1978 indicated that an excessive number of sonar restarts were required during the 240-hour operability test. Following problem correction and further integrated testing at the Land Based Evaluation Facility, Commander Operational Test and Evaluation Force concluded that the AN/BQQ-6 had the potential to be operationally effective and operationally suitable.

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b. (U) Integrated testing of sonar software (Command and Control System Revision 3.4) was completed at the Land Based Evaluation Facility and reported by Commander, Operational Test and Evaluation Force message 041840Z MAY 82. Commander, Operational Test and Evaluation Force concluded that the AN/BQQ-6 (Command and Control System Revision 3.4) sonar demonstrated potential to be operationally effective and operationally suitable. Additional conclusions were:

- (1) (U) Not all deficiencies previously identified have been corrected.
- (2) (U) [ ] deficiencies significantly degrade ships capability [ ]
- (3) (U) [ ] processing does not fully support TRIDENT strategic mission [ ]
- (4) (U) Insufficient flexibility [ ]
- (5) (U) [ ]
- (6) (U) AN/BQQ-6 sonar effectiveness was reduced by newly reported deficiencies.
- (7) (U) Documentation continues to lag system development.
- (8) (U) Additional team training is required to ensure effective conduct of a myriad of operations required for effective use of the AN/BQQ-6.

Commander, Operational Test and Evaluation Force recommended correction of deficiencies relating to the following areas:

- (1) (U) Review/modify/disable [ ] as necessary to support the TRIDENT operational mission.
- (2) (U) Update AN/BQQ-6 documentation to Command and Control System Revision 3.4 level in time to support post Post Shakedown Availability testing.

c. (U) Follow-on Operational Test and Evaluation (FOT&E) was conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and will continue on a not-to-interfere basis during deployment.

d. (U) Because of its unique design, the sonar could not be installed in any other submarine to permit Initial Operational Test and Evaluation before the lead TRIDENT went to sea.

3. (U) System Characteristics (AN/BQQ-6 Sonar):

(U) The following definitions are used in the specification of the Required Technical Characteristics (RTC):

- a. (U) Software Failure - Occurrence of one of the following:
  - (1) (U) Loss of the most recent five minutes of passive broadband intermediate time average data history.
  - (2) (U) Loss of computer/software operation for five minutes.
- b. (U) Software Fault - Occurrence of any defect/problem which produces a system halt or requires a restart, but does not cause a software failure.
- c. (U) Hardware Reliability - Hardware reliability is defined as the reliability of the sonar system hardware only (as opposed to data processing system (DPS) hardware failures).
- d. (U) Software Reliability - Software reliability is defined as the reliability of the computer program only, and does not include hardware failures of the computer, peripherals, data converters, power supplies or input devices. In addition, all input data to the software programs are considered valid.

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e. (U) Figure of Merit (FOM) - Sonar performance is stated in terms of sonar Figure of Merit in order to provide a basis for computing expected ranges against specific targets under any given operational situation.

(1) (U) "Figure of Merit THRESHOLD" values take into account expected operational system losses plus an estimate of the measurement uncertainty which would be expected under at-sea conditions.

(2) (U) Opposite each listed Figure of Merit is the range expected if a [ ] submarine threat (as described in Figure 1 of enclosure (2) to Naval Underwater Systems Center secret letter SA111-S539 of 30 July 1975) were running [ ] in the North Atlantic, with the detecting array [ ] knots. Propagation loss predictions for that situation which were used for the range calculations are set forth in Figure 6 of enclosure (2) to the Naval Underwater Systems Center reference previously cited.

| Characteristic                   | Threshold                 | Demonstrated Performance                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Figure of Merit (Decibels (dB))  | Decibels (dB)/Range (kyd) |                                                                                                                                                                                                                                                                                                                                                                                          |
| Passive [ ] Detection            |                           | The Figure of Merit (Decibels) thresholds have been achieved based on in-plant subsystem certification. 1/ Data for validation of Figures of Merit of the ship installed system was collected during sonar certification. Additional data will be collected at other opportunities during predeployment of follow-on ships and on a not-to-interfere basis during lead ship deployments. |
| Spherical Array [ ]              | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Towed Array [ ]                  | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Passive [ ] Tracking             |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Spherical Array [ ]              | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Towed Array [ ]                  | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Passive [ ] Detection            |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Spherical Array [ ]              | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Towed Array [ ]                  | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Passive [ ] Tracking             |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Spherical Array [ ]              | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Towed Array [ ]                  | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Classification                   |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Spherical Array [ ]              | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Towed Array [ ]                  | [ ]                       |                                                                                                                                                                                                                                                                                                                                                                                          |
| Reliability and Maintainability  |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Hardware                         |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Mean Time Between Failure (MTBF) |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Passive [ ]                      | [ ]                       | [ ] 2/                                                                                                                                                                                                                                                                                                                                                                                   |
| Passive [ ]                      | [ ]                       | [ ] 2/                                                                                                                                                                                                                                                                                                                                                                                   |
| Active Emission Detection        | [ ]                       | [ ] 3/                                                                                                                                                                                                                                                                                                                                                                                   |
| Mean Time to Repair (MTTR)       |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Software                         |                           |                                                                                                                                                                                                                                                                                                                                                                                          |
| Mean Time Between Failure (MTBF) | [ ]                       | [ ] 4/                                                                                                                                                                                                                                                                                                                                                                                   |
| Mean Time to Fault               | [ ]                       | [ ] 4/                                                                                                                                                                                                                                                                                                                                                                                   |
| Mean Time to Repair              | [ ]                       | [ ]                                                                                                                                                                                                                                                                                                                                                                                      |
| Failure                          | [ ]                       | [ ]                                                                                                                                                                                                                                                                                                                                                                                      |
| Fault                            | [ ]                       | [ ]                                                                                                                                                                                                                                                                                                                                                                                      |



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- 1/ (U) See IBM Document Numbers 76-916-019 through 76-916-028, April through July 1976, AN/BQQ-6 System Design Certification Test Reports.
- 2/ (U) See IBM Document Number 77-EQ2-022 dated 15 March 1977, Reliability, Test, and Demonstration Report.
- 3/ (U) See IBM Document Number 76-A71-023 dated 22 December 1976, AN/BQQ-6 Maintainability Demonstration Test Report.
- 4/ (U) See IBM Document Number 78-916-002 dated 31 January 1977, Final Report, Software Reliability Demonstration.

**B. (U) Mark 118 Fire Control System and Command Subsystem**

(U) The Mark 118 Mod 0 Fire Control System contains the equipments and software required to provide the TRIDENT submarine with a self-defense capability including contact motion analysis, coordination of defensive operations, and effective control of weapons and countermeasure devices. The resources of the Data Processing System (DPS) are used for its required computation, display generation, data storage and data retrieval functions. Standard Information Displays (SIDs) provide the system with interactive Cathode Ray Tube (CRT) display capabilities. An Attack Control Console (ACC) Mark 92 Mod 1 indicates status and directs the firing of the Torpedo Mark 48 Mod 1 and countermeasure devices. Two bearing and Range Indicators (BRIs) Mark 116 Mod 0 provide remote display of selected data for command information. A Weapon Launch Console (WLC) Mark 96 Mod 0 provides the interface and conversion capabilities to pre set and control the Torpedo MK 48 Mod 1 and the Mobile Submarine Simulator (MOSS) Mark 57 Mod 0.

(U) The Mark 118 Fire Control System, with appropriate interfacing support, shall perform the following primary functions in support of the TRIDENT submarine self-defense capability:

- Perform Contact Motion Analysis (CMA), both manually assisted and automatic.
- Perform weapons and countermeasure control.
- Perform defensive coordination.
- Provide essential data for ship control.

**1. (U) Development Test and Evaluation:**

a. (U) All units, including software, of the Mark 118 Fire Control System are required to undergo the Development Test and Evaluation (DT&E) program specified by MIL-E-16400. The in-plant Development Test and Evaluation effort did not uncover any significant design problems.

b. (U) Mark 118 Fire Control System integration testing at the Land Based Evaluation Facility, followed by shipboard installation, has been completed for the first three TRIDENT submarines. Integrated testing of a Mark 118 Fire Control System software revision, which is part of Command and Control System Revision 3.4, has been completed at the Land Based Evaluation Facility, was installed on the lead TRIDENT submarine during Post Shakedown Availability, and will be installed in the second TRIDENT submarine during Post Shakedown Availability. Installation at shore sites has also been completed.

**2. (U) Operational Test and Evaluation:**

a. (U) Initial Operational Test and Evaluation (IOT&E) was conducted by Commander, Operational Test and Evaluation Force in combination with Development Test and Evaluation (DT&E) at the Land Based Evaluation Facility in order to certify Command and Control System Revision 2.1 ready for installation in the lead ship. The System tested included the complete lead ship Fire Control System.

b. (U) Integrated testing of Mark 118 Fire Control System (Command and Control System Revision 3.4) was completed at the Land Based Evaluation Facility and reported by Commander, Operational Test and Evaluation Force message 041840Z MAY 82.

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Commander, Operational Test and Evaluation Force concluded that the MK 118 Fire Control System (Command and Control System Revision 3.4) demonstrated potential to be operationally effective and operationally suitable. Additional conclusions were:

(1) (U) Significant number of previously identified deficiencies were corrected.

(2) (U) Mark 118 Fire Control System (Command and Control System Revision 3.4) supports mission oriented functions.

(3) (U) Documentation, although improved, still lags system development.

Commander, Operational Test and Evaluation Force recommended the following:

(1) (U) Eliminate incorrect results identified during Land Based Evaluation Facility testing.

(2) (U) Update Mark 118 Fire Control System documentation to Command and Control System Revision 3.4 level in time to support post Post Shakedown Availability testing.

c. (U) Follow-on Operational Test and Evaluation was conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and will continue on a not-to-interfere basis during deployment.

### 3. (U) System Characteristics:

The Required Technical Characteristics for the Fully Operational state of the Mark 118 Fire Control System are:

| <u>Characteristic</u>                                                                                                                                                                     | <u>Threshold</u>                                            | <u>Demonstrated Performance</u> 1/                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------|
| <u>Contact Motion Analysis (CMA)</u>                                                                                                                                                      |                                                             |                                                                   |
| Range, course and speed solution<br>Position keeping (continuous tracking capability)<br>Independent methods of bearings only<br>contact motion analysis                                  | [ simultaneous contacts<br>simultaneous contacts<br>methods | [ simultaneous contacts<br>simultaneous contacts<br>methods       |
| <u>Weapons and Countermeasure (CM) Control</u>                                                                                                                                            |                                                             |                                                                   |
| Torpedo remote set and fire                                                                                                                                                               | [ ]                                                         | Threshold requirements have been demonstrated by subsystem tests. |
| Wireguide Torpedoes 2/                                                                                                                                                                    | [ ]                                                         | Threshold requirements have been demonstrated by subsystem tests. |
| Remote launch countermeasures from<br>Mark 118 Fire Control System                                                                                                                        | Two 3" Countermeasures                                      | Threshold requirements have been demonstrated. 3/                 |
| Remote set and fire Mobile Submarine Simulator<br>(MOSS) from Mark 118 Fire Control System                                                                                                | Set pre-sets and fire.                                      | Threshold requirements have been demonstrated. 3/                 |
| <u>Defensive Coordination</u>                                                                                                                                                             |                                                             |                                                                   |
| Hostile torpedo defense - Reaction time to<br>release first 3-inch countermeasure after<br>firing circuit activated. (Assume tubes loaded,<br>additional devices in 30 second intervals.) | 15 seconds                                                  | Threshold requirements have been demonstrated.                    |

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| <u>Characteristic</u>                                                                                                        | <u>Threshold</u>                    | <u>Demonstrated Performance</u> 1/                                   |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------|
| <u>Defensive Coordination (continued)</u>                                                                                    |                                     |                                                                      |
| Status of Launchers                                                                                                          | Display status of all torpedo tubes | Threshold requirements have been demonstrated by subsystem tests. 3/ |
| <u>Hardware</u> 4/                                                                                                           |                                     |                                                                      |
| Reliability (Failure) 5/<br>Contact Motion Analysis (CMA)<br>Generate Target Position (GTP)<br>Weapon Order Generation (WOG) | [ ]                                 | [ ] 6/<br>6/<br>6/                                                   |
| <u>Software</u> 7/ 8/                                                                                                        |                                     |                                                                      |
| Mean time between failure (MTBF)<br>Mean time to fault (MTTF)<br>Mean time to repair (MTTR)<br>Failure<br>Fault              | [ ]<br>10 mins<br>5 mins            | [ ]<br>5 mins<br>1 min                                               |

1/ (U) See Defensive Weapon System/Combat System Design Certification Test Report IBM-78-T52-012 dated 20 Oct 1978.

2/ (U) It is not specifically required that [ ] torpedoes be wireguided at sea to demonstrate this capability.

3/ (U) See Defensive Weapon System/Combat System Design Certification Test Report IBM-78-T52-012 dated 20 Oct 1978. Additional validation was obtained during at-sea Combined Operability Test (COT).

4/ (U) Hardware reliability is defined as the reliability of the Fire Control System (FCS) hardware only (as opposed to Data Processing System (DPS) hardware failures).

5/ (U) Probability of performing the function [ ] without an interruption caused by a hardware failure.

6/ (U) See Standard Information Display Failure/Malfunction Report dated 30 November 1979 and Attack Control Console Mark 92/Weapon Launch Console Mark 96 Failure/Malfunction Report dated 5 November 1979.

7/ (U) Software failure is defined as a Mark 118 Fire Control System degradation resulting in loss of greater than five minutes of most recently developed target, solution, and Weapon Order Generation data. A Master Data Clear procedure is used to clear all accumulated data tables and restart the system in its initial state without the use of previously developed data tables.

8/ (U) Software fault is defined as a Mark 118 Fire Control System degradation without loss of more than the most recent five minutes of target, solution, and Weapon Order Generation data. A Check-point Restart procedure is used to restart the system using previously developed data tables. No more than five minutes of this most recently developed data can be lost between the time of the last checkpoint and the time to Checkpoint Restart.

Program Element: 11228N

Title: TRIDENT I

C. (U) Integrated Radio Room.

(U) The AN/BSC-1 Integrated Radio Room (IRR) is comprised of 22 operational racks (cabinets) of equipment and associated interconnecting cables. The system also includes provisions for future planned subsystems. The Integrated Radio Room contains six subsystems:

- (1) Antenna Interface Subsystem (AIS), including Antenna Control and Switching;
- (2) Very Low Frequency/Low Frequency (VLF/LF) equipments;
- (3) Data Switching equipments;
- (4) High Frequency/Ultra High Frequency (HF/UHF) equipments;
- (5) Control, Monitor, and Test functions, including the control and message processors; and
- (6) Support equipments.

(U) The Integrated Radio Room is a principal component of the TRIDENT Exterior Communications System which also includes the Integrated Submarine Communications Antenna System (ISCAS). The Integrated Radio Room, with the associated antenna system, provides the TRIDENT submarine with reliable and secure communications to maintain contact with National Command Authorities in the pre-, trans- and post-attack environments.

1. (U) Development Test and Evaluation:

(U) The Integrated Radio Room completed the three phases of developmental testing at Radio Corporation of America, Camden, NJ, and Springfield, VA, (Development Testing Phase IIA):

- (1) Design testing;
- (2) Subsystem testing for conformance to performance specifications; and
- (3) System tests which are used to demonstrate compliance to specifications.

(U) Development Testing Phase IIA was completed in late 1977. Integration testing commenced in February 1978 at the Land Based Evaluation Facility with the Command and Control System. Development Testing Phase IIB was completed in April 1979 and the Integrated Radio Room has been installed in the first two TRIDENT submarines. Additional Development Test and Evaluation for deficiency corrections and verification of additional modifications will occur on follow ship-art Integrated Radio Rooms being sequenced through the Land Based Evaluation Facility. This deficiency correction has continued through lead ship Post Shakedown Availability to support implementation of changes prior to first patrol. Testing included certification of revision packages of deficiency corrections that were available for lead ship implementation prior to deployment.

2. (U) Operational Test and Evaluation:

a. (U) Initial Operational Test and Evaluation (IOT&E) of the AN/BSC-1 Integrated Radio Room (IRR) was conducted concurrently with Development Testing Phase IIB at the Land Based Evaluation Facility between February 1979 and April 1979. Based on demonstrated performance, Commander, Operational Test and Evaluation Force concluded that TRIDENT Integrated Radio Room has the potential to be operationally effective and operationally suitable.

b. (U) Testing of Integrated Radio Room software (Command and Control System Revision 3.4) was conducted during December 1981 and reported by Commander, Operational Test and Evaluation Force message 191600Z FEB 82. Commander, Operational Test and Evaluation Force concluded that Integrated Radio Room (Command and Control Revision 3.4) /

Commander, Operational Test and Evaluation Force recommended:

- (1) (U) Installing Integrated Radio Room (Command and Control System Revision 3.4) in the TRIDENT submarine.
- (2) (U) Prior to completion of Post Shakedown Availability:
  - (a) (U) Correct
  - (b) (U) Correct
  - (c) (U) Correct technical documentation deficiencies.

deficiencies.

Program Element: 11220H

Title: TRIDENT I

- (3) (U) Conduct operational evaluation at sea to determine operational effectiveness.
- (4) (U) Correct the remaining reported deficiencies and conduct ontheair testing at the Land Based Evaluation Facility.

c. (U) During April 1982 Integrated Radio Room (Command and Control System Revision 3.4) deficiency correction certification testing was conducted at the Land Based Evaluation Facility as reported by Commander, Operational Test and Evaluation Force message 241850Z MAY 82. Commander, Operational Test and Evaluation Force recommended that Integrated Radio Room CW (Continuous Wave) capabilities be upgraded prior to the first patrol of the lead ship and that remaining deficiencies be corrected in future software revisions.

d. (U) Follow-on Operational Test and Evaluation was conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and will continue on a not-to-interfere basis during deployment.

3. (U) System Characteristics:

(U) The Required Technical Characteristics for the fully operational state of the Integrated Radio Room are:

| <u>Characteristic</u>                                      | <u>Threshold</u> | <u>Demonstrated Performance</u>                                                      |
|------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------|
| <u>Communication Capabilities</u>                          |                  |                                                                                      |
| Very Low Frequency/Low Frequency (VLF/LF)/LORAN Capability | [ ]              | Threshold performance has been demonstrated.                                         |
| Very Low Frequency Anti-Jam Capability                     | [ ]              | Threshold performance has been demonstrated at Land Based Evaluation Facility.       |
| Very Low Frequency/Low Frequency Availability              | [ ]              | Exceeds Required Technical Characteristics Threshold due to system redundancy.       |
| Medium Frequency/High Frequency (MF/HF) Capability         | [ ]              | Threshold requirements have been demonstrated at the Land Based Evaluation Facility. |
| Ultra High Frequency (UHF) Capability                      | [ ]              | Threshold requirements have been demonstrated at the Land Based Evaluation Facility. |

Program Element: 1:228N

Title: TRIDENT I

| <u>Characteristic</u>                                                                                                        | <u>Threshold</u> | <u>Demonstrated Performance</u> |
|------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------|
| Maintainability 1/                                                                                                           |                  |                                 |
| Mean Time To Repair (MTTR)<br>(DCP 67 states that Mean Time Between Failure<br>does not apply because of system redundancy.) | [ ]              | [ ]                             |

1/ (U) Maintainability includes Integrated Radio Room (IRR) hardware only and excludes the Antenna System. Software maintainability is not defined.

III. (U) PROPULSION/ELECTRICAL SYSTEM:

(U) The TRIDENT submarine propulsion plant consists of:

(U) Reactor Plant - The TRIDENT submarine reactor plant design is an extension of existing and operationally proven submarine reactor plants.

(U) Steam and Electric Plant - The TRIDENT submarine steam and electric plant will be capable of producing [ ] Shaft Horsepower.

(U) The prototyping of the TRIDENT nuclear propulsion plant was accomplished in accordance with the methods in use by the Department of Energy. Testing of the nuclear propulsion plant components is being performed at the component vendor's plants and at a land-based test site in accordance with Department of Energy requirements. Operational testing of nuclear propulsion plant systems is being performed in each ship at the construction shipyard in accordance with Navy and Department of Energy requirements. The development and testing of the reactor and propulsion plant is the responsibility of the Deputy Commander for Nuclear Propulsion, Naval Sea Systems Command (SEA-08).

IV. (U) PROGRAM DOCUMENTATION

| <u>DATE</u> | <u>SUBJECT</u>                                                                 | <u>SERIAL NO.</u>                                                                           |
|-------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 22 DEC 76   | AN/BQ-6 FI/PL and Maintainability Demonstrations<br>Test Reports               | IBM Document Number 76-471-023                                                              |
| 31 JAN 77   | Final Report, AN/BQ-6 Software Reliability Demonstration                       | IBM Document Number 78-916-002                                                              |
| 15 MAR 77   | AN/BQ-6 Reliability, Test and Demonstration Report                             | IBM Document Number 77-EQ3-022                                                              |
| 25 SEP 78   | Defensive Weapons System/Command System Software<br>Reliability Test Report    | IBM Document Number 78-T52-008                                                              |
| 20 OCT 78   | Defensive Weapons System/Command System Design<br>Certification Test Report    | IBM Document Number 78-T52-012                                                              |
| 19 FEB 82   | Initial Operational Test and Evaluation Report,<br>Integrated Radio Room (IRR) | Commander, Operational Test and<br>Evaluation Force message (COMOPTEVFOR)<br>191600Z FEB 82 |
| 4 MAY 82    | Operational Test and Evaluation Report, Command<br>and Control Subsystem (CCS) | Commander, Operational Test and<br>Evaluation Force message (COMOPTEVFOR)<br>041840Z MAY 82 |
| 12 AUG 82   | Test and Evaluation Master Plan (TEMP) Number 113                              | PH2/415/SH, CA2                                                                             |

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 11401M  
DoD Mission Area: 333 - Strategic Communications

Title: Extremely Low Frequency Communications  
Budget Activity: 3 - Strategic Programs

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands):**

| Project No. | Title                            | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>38,755</b>  | <b>49,677</b>    | <b>58,497</b>    | <b>29,156</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| X0792       | ELF Communications               | 38,755         | 49,677           | 58,497           | 29,156           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** On October 8, 1981, President Reagan directed the deployment of the two-site, synchronously linked Extremely Low Frequency communications system with an Initial Operational Capability in FY 1985. The Full Operational Capability will be achieved in FY 1987. The Extremely Low Frequency communications system will minimize the operational limitations imposed on submarines by near-surface observables by allowing submarines to maneuver and transit at operational speeds and depths. The improved Extremely Low Frequency system adds a new dimension of capability separate from the airborne Very Low Frequency transmission system, but complementary to it, and will provide continued insurance against an unforeseen Soviet antisubmarine warfare breakthrough.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall increase of 4,000 in FY 1982, due to contractor cost proposals exceeding original Navy estimates; an overall decrease of 150 in FY 1983, due to revised cost estimates, including inflation; an overall increase of 4,235 in FY 1984, caused by a decrease of 108 due to Congressional reductions in Contractors, Studies and Analyses, and Management Support, and an increase of 4,343 due to contractor cost proposals exceeding original Navy estimates.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                            | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | <b>TOTAL FOR PROGRAM ELEMENT</b> | <b>2,478</b>   | <b>34,755</b>    | <b>49,827</b>    | <b>54,262</b>    | <b>Continuing</b>        | <b>Continuing</b>    |
| X0792       | ELF Communications               | 2,478          | 34,755           | 49,827           | 54,262           | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDING:**

|                                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|--------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OPN (NA 2) (333105)<br>(Quantity) (ELF Receiver) | 0              | 0                | 0                | 26,482<br>(58)   | 19,372<br>(42)           | 46,054<br>(100)      |

Program Element: 11401N

Title: Extremely Low Frequency Communications

F. (U) RELATED ACTIVITIES: RLF will be installed in TRIDENT (PE 11228N), FBH (PE 11221N), and Attack (PE 24281N) Submarines.

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is Naval Underwater Systems Center, New London, CT. Others: Naval Facilities Engineering Command, Washington, DC; Northern Division, Naval Facilities Engineering Command, Philadelphia, PA; Naval Research Laboratory, Washington, DC; Naval Sea Systems Command, Washington, DC; Naval Ocean Systems Center, San Diego, CA; Naval Telecommunications Command, Washington, DC; National Security Agency, Washington, DC; Naval Surface Weapons Center, White Oak, MD; CONTRACTORS: General Telephone and Electronic Corporation, Sylvania, Needham Heights, MA, is prime contractor. Others: IIT Research Institute, Chicago, IL; Computer Sciences Corporation, Falls Church, VA; NITRE Corporation, McLean, VA; Booz-Allen & Hamilton, Inc., Washington, DC; R.M. Vredenburg & Co., McLean, VA; Spears Associates, Inc., Norwood, MA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY1984: Not Applicable.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984:

(U) Project X0792, Extremely Low Frequency Communications

1. (U) DESCRIPTION (Requirement and Project): The Extremely Low Frequency communications system will provide a unique capability that will fulfill an important and immediate submarine Command and Control requirement by freeing the submarine from vulnerabilities and limitations of near surface operations. Current communications systems have one major deficiency in that they are unable to penetrate the ocean more than a few tens of feet. To obtain communications at present, a submerged submarine must have a receiving antenna at or very near the surface of the water. Extremely Low Frequency communications system will provide a capability to maintain continuous broadcast contact with submarines required to maneuver or transit at speeds and depths incompatible with Very Low Frequency reception capability. Because any type of random detection can be correlated over a period of time, any operations that place the platform or its antenna at or near periscope depth should be minimized. Extremely Low Frequency communications reduces this potential vulnerability and counters any unforeseen enemy antisubmarine breakthrough. The program consists of full scale development of antennas, transmitters, and submarine receivers. There will be two transmitter sites. One is to be constructed in Michigan, near K.I. Sawyer Air Force Base using 36 miles of overhead antennas. The other site, already in existence, is the Wisconsin Transmitter Facility near Clam Lake, Wisconsin, in the Chequamegon National Forest. The Wisconsin site will use its existing 28 miles of overhead antenna without expansion and the transmitter will be electronically upgraded. Control of the system will be in facilities located at K.I. Sawyer Air Force Base. An initial operating capability for the system is planned for FY 1985. Deployment of this project was the result of a Presidential decision on October 8, 1981, in which SECDEF was directed to proceed with the system in order to make critical improvements in connectivity to the submarine force.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o System evaluation operations continued at the Wisconsin transmitter site.
- o Awarded contract to General Telephone and Electronic Corporation, Sylvania Division, to commence preliminary full scale development work and to complete preliminary design of the system.
- o Awarded letter contract to General Telephone and Electronic Corporation, Sylvania Division to commence full scale development of the system.
- o Began surveys of the Michigan site after approval of the proposed antenna configuration by the Board of Commissioners of the Michigan Department of Natural Resources.
- o Awarded follow-on contract to IIT Research Institute for interference mitigation and environmental compatibility efforts.
- o Awarded follow-on contract to Computer Sciences Corporation for system engineering and technical assistance to the Project Manager.



Program Element: 11401R

Title: Extremely Low Frequency Communications

b. (U) FY 1983 Program:

- o Continue design efforts within full scale development.
- o Continue system evaluation operations.
- o Complete approval of the Wisconsin and Michigan sites' base electronic system engineering plans.
- o Complete awarding subcontracts with local (Wisconsin and Michigan) university and industrial laboratories for environmental work.
- o Complete Michigan surveys and complete design of the Michigan site.
- o Commence construction on the Wisconsin site upgrade.
- o Complete system's preliminary and critical design reviews.

c. (U) FY 1984 Planned Program:

- o Continue full scale development.
- o Commence Michigan site construction.
- o Begin producing engineering development model receivers.
- o Complete Wisconsin site upgrade.
- o Complete system evaluation operations.
- o Award a follow-on contract to IIT Research Institute for continued interference mitigation and environmental compatibility assurance.
- o The increase in funding is for increased material and labor in costs projected by the prime contractor in the development and installation of the shore equipment such as site surveys, antenna construction, installing low step potential grounds, upgrading the Wisconsin site, and developing the associated transmitting and power amplification hardware - including software design and development.

d. (U) Program to Completion:

- o During FY 1985, the following is planned:
  - Engineering Development Model submarine receiver development terminates.
  - Shore equipment development and installation terminates.
  - System test and evaluation of the upgraded Wisconsin site is completed.
  - Technical and operational evaluation is initiated and completed.
  - The system achieves an initial operating capability.
  - Fleet receiver production is initiated.
  - Full scale development terminates.
  - Michigan site construction is completed.
  - Follow-on test and evaluation of system synchronization is completed.
  - Environmental safety development and ecological monitoring will continue.
  - Receiver production is planned to conclude at the end of FY 1987.
- o This program is scheduled for completion at the end of FY 1987 when it will attain full operational capability.

Program Element: 11401N

Title: Extremely Low Frequency Communications

a. (U) Milestones:

| <u>Milestone</u>                                                 | <u>Date</u> |
|------------------------------------------------------------------|-------------|
| 1. (U) Obtain Milestone II Approval                              | FY 1982     |
| 2. (U) Develop Environmental Protection Plan                     | FY 1982     |
| 3. (U) Commence Michigan Site Surveys                            | FY 1982     |
| 4. (U) Commence Wisconsin Test Facility Improvement              | FY 1982     |
| 5. (U) Complete Critical Design Review                           | FY 1983     |
| 6. (U) Obtain Limited Production Approval                        | FY 1984     |
| 7. (U) Commence Construction - Michigan (FY 1983) *              | FY 1984     |
| 8. (U) Commence Technical and Operational Evaluation (FY 1984) * | FY 1985     |
| 9. (U) Complete Technical and Operational Evaluation             | FY 1985     |
| 10. (U) Initial Operational Capability                           | FY 1985     |
| 11. (U) Obtain Production Approval                               | FY 1986     |
| 12. (U) Complete Michigan Site                                   | FY 1986     |
| 13. (U) Final Operational Capability                             | FY 1987     |

\* Date listed in FY 1983 Program Element Descriptive Summary. Change in Milestone 7 caused by availability of MILCON funding. Change in Milestone 8 caused by construction delay (Milestone 7).

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11402N  
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications  
Budget Activity: 3 - Strategic Programs

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT              | 23,844         | 64,854           | 88,889           | 101,074          | Continuing               | Continuing           |
| X0793       | TACAMO                                 | 15,275         | 14,798           | 10,875           | 10,498           | Continuing               | Continuing           |
| X1083       | Shore-to-Ship Communications Systems   | 7,591          | 12,812           | 1,506            | 3,727            | Continuing               | Continuing           |
| X1384       | Survivable and Enduring Communications | 0              | 0                | 4,743            | 10,368           | Continuing               | Continuing           |
| W1438       | ECX                                    | 978 *          | 37,244           | 71,765           | 76,481           | Continuing               | Continuing           |

\* Funding reprogrammed from Project X0793, TACAMO, in order to initiate Project W1438, ECX, TACAMO replacement efforts.

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the development of reliable, survivable and secure communications systems from the National Command Authorities/Commanders-in-Chief to deployed Fleet Ballistic Missile forces and selected Single Integrated Operations Plan forces in modes which transcend disturbances expected to be in effect immediately before, during, and after a nuclear attack. The project includes TACAMO (including ECX development initiatives), VERDIN, Enhanced VERDIN, Fixed Very Low Frequency, POSSIDON Communications Improvement Program, Integrated Submarine Communications Antenna System, Surviving Communications and Systems Engineering. Navy Strategic Communications programs relate to specific tasks that enhance the capability of submarines to receive communications and which improve operational performance and produce improvements in message processing.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall decrease of 500 in FY 1982, 130 from X0793, TACAMO, and 370 from X1083, Shore-to-ship Communications, due to revised cost estimates, including inflation, as well as a transfer of 978 from X0793, TACAMO, to W1438, ECX, in order to initiate efforts to develop the replacement airframe for the TACAMO airborne mission; an overall decrease of 4,460 in FY 1983, caused by decreases of 55 in X0793, TACAMO, and 91 in X1083, Shore-to-Ship Communications, due to revised cost estimates, and a Congressional reduction of 4,314 in W1438, ECX; an overall decrease of 10,653 in FY 1984, 33 from X0793, TACAMO, 64 from X1384, Survivable and Enduring Communications, and 238 from W1438, ECX due to Congressional reductions in Contractors, Studies and Analyses, and Management Support, 860 from X0793, TACAMO, due to revised cost estimates, including inflation, giving that project a total decrease of 893, a decrease of 8,798 in X1083, Shore-to-Ship Communications, due to restructuring of program to delay by at least one year replacement Very Low Frequency transmitter efforts and submarine antenna projects, a decrease of 1,660 from X1384, Survivable and Enduring Communications, due to rephasing of candidate system developments, focusing on Very Low Frequency transmitting balloons with future systems moved to out years, giving that project a total decrease of 1,724, and an increase of 1,000 in W1438, ECX, due to project rephasing to support the FY 1988 Operational Capability, giving that project a total increase of 762.

Program Element: 11402N

Title: Navy Strategic Communications

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                  | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENTS             | 19,746         | 24,344           | 69,314           | 99,342           | Continuing               | Continuing           |
| X0793       | TACAMO                                 | 9,052          | 16,383           | 14,853           | 11,768           | Continuing               | Continuing           |
| X1083       | Shore-to-Ship Communications Systems   | 9,947          | 7,961            | 12,903           | 10,304           | Continuing               | Continuing           |
| X1384       | Survivable and Enduring Communications | 0              | 0                | 0                | 6,467            | Continuing               | Continuing           |
| W1438       | ECX                                    | 747            | 0                | 41,558           | 71,003           | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                                   | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OPN (BA 2) (PE 11315N)<br>(Quantity)              | 6,726          | 13,965           | 7,167            | 15,623           | Continuing               | Continuing           |
| 1600 CPS Kits                                     | (0)            | (33)             | (0)              | (17)             | Continuing               |                      |
| CP 1071A/WR Processor                             | (7)            | (16)             | (0)              | (17)             | Continuing               |                      |
| Fixed Very Low Frequency Equipment                | Var            | Var              | Var              | Var              | Continuing               |                      |
| Cesium Beam Frequency/Time Standards              | (0)            | (0)              | (55)             | (80)             | Continuing               |                      |
| Submarine Keyboard Printer                        | (111)          | (0)              | (0)              | (0)              | (0)                      |                      |
| Medium Frequency/High Frequency Multicouplers     | (0)            | (17)             | (17)             | (0)              | (0)                      |                      |
| Frequency Standard Transfer Switch                | (12)           | (23)             | (0)              | (0)              | (0)                      |                      |
| Secure Teletype Switch (SB-3917/BQC)              | (31)           | (0)              | (0)              | (0)              | (0)                      |                      |
| High Frequency Scanning Receiver                  | (0)            | (0)              | (66)             | (0)              | (0)                      |                      |
| Standard Buoyant Cable Antennas                   | (0)            | (17)             | (17)             | (0)              | (0)                      |                      |
| Circuit Mayflower Shore Rehabilitation Equipments | (0)            | Var              | Var              | Var              | Continuing               |                      |
| APN (BA 4)                                        |                |                  |                  |                  |                          |                      |
| EC-130Q Aircraft                                  | 72,792         | 35,900           | 0                | 0                | 0                        | (22)                 |
| (Quantity)                                        | (2)            | (0)              | -                | -                | -                        |                      |
| ECX (E-6A) Aircraft                               | 0              | 0                | 107,700          | 391,034          | 1,197,593                | 1,696,327            |
| (Quantity)                                        | -              | -                | (0)              | (2)              | (12)                     | (14)                 |
| APN (BA 5)                                        |                |                  |                  |                  |                          |                      |
| EC-130Q Mod Aircraft                              | 21,592         | 49,478           | 12,386           | 17,234           | Continuing               | Continuing           |
| APN (BA 6)                                        |                |                  |                  |                  |                          |                      |
| EC-130Q Mod Aircraft/ECX (E-6A) Spares            | 6,465          | 4,546            | 428              | 36,314           | Continuing               | Continuing           |

F. (U) RELATED ACTIVITIES: Fleet Ballistic Missile System (Program Element 11221N) and the TRIDENT Submarine System (Program Element 11228N) relate to this Program Element for system-to-platform integration and interoperability. Navy Strategic Communications transmissions will be received by the improved terminals developed for the Defense Communications Agency's Minimum Essential Emergency Communications Network (Program Element 33131K).

Program Element: 11402N

Title: Navy Strategic Communications

G. (U) WORK PERFORMED BY IN-HOUSE: Naval Ocean Systems Center, San Diego, CA; Naval Underwater Systems Center, Newport, RI; Naval Research Laboratory, Washington, DC; Naval Air Systems Command, Washington, DC; Naval Surface Weapons Center, Silver Spring, MD; Naval Air Development Center, Warminster, PA; Naval Air Test Center, Patuxent River, MD; Naval Avionics Center, Indianapolis, IN; Naval Sea Systems Command, Washington, DC; Air Force Weapons Laboratory, Albuquerque, NM. CONTRACTORS: Radio Corporation of America, Camden, NJ; KAMAN Sciences Corporation, Colorado Springs, CO; Electrospace Systems, Inc., Richardson, TX; General Telephone and Electronics Corporation, Needham, MA; Rockwell International Corporation (Collins and Autonetics), Richardson, TX, and Newport Beach, CA; Spears Associates, Newton, MA; MITRE Corporation, McLean, VA; International Business Machines, Gaithersburg, MD; Westinghouse Corporation, Baltimore, MD; Boeing, Seattle, WA; Lockheed, Marietta, GA; and five others.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project X1083, Shore-to-Ship Communications Systems: This project provides funds to develop communications systems to enable positive command and control over deployed Fleet Ballistic Missile Submarines. Many communications systems and techniques have been initiated under this project and have migrated to separate projects or program elements due to uniqueness, maturity or magnitude. Presently in this project are efforts predominantly to provide enhancements to current shore-to-ship transmitting and receiving systems. Projects included are: VENUDIN (Shipboard Very Low Frequency receiving system); Fixed Very Low Frequency (Shore based transmitting system); POSEIDON Communications Improvement Program (POSEIDON Radio Room Improvements) and POSEIDON Integrated Submarine Communications Antenna Systems (Submarine Receiving Antennas).

(U) In FY 1982,

- o Continued development of Dynamic Antenna Tuning and High Efficiency Power Amplifiers for Fixed Very Low Frequency Submarine Broadcast sites.
- o Procured Submarine Advanced Keyboard Printer to replace all the electro-mechanical teletypes currently on board POSEIDON Fleet Ballistic Missile Submarines.
- o Completed development of a new buoyant cable antenna and medium frequency/high frequency multicoupler for POSEIDON Fleet Ballistic Missile Submarines.
- o Continued development of a new very low frequency multicoupler.
- o Initiated procurement of a frequency standard transfer switch to enable operators to switch between precise time standards in the event of failure or drift of the primary unit.
- o Initiated development of a reconstitutable very low frequency system for the survivable/enduring communications network.
- o Provided engineering system analysis and support in the areas of configuration management, system performance models and analysis, message compression techniques and investigation of advanced technology in the area of reconstitutable very low frequency communications.

(U) The FY 1983 program consists of:

- o Installing Submarine Keyboard Printers.
- o Procurement of 17 Standard Buoyant Cable Antenna Systems and 17 medium frequency/high frequency multicouplers.
- o Completing development of dynamic antenna tuning.
- o Initiating full scale development of high efficiency power amplifiers for the very low frequency broadcast.
- o Investigating possibilities for increasing reliability of precise frequency time standards.
- o Developing an integrated test bed to measure and maintain very low frequency communications performance.
- o Completing development of the very low frequency multicoupler.
- o Initiating third year of Enhanced VENUDIN processor procurements.
- o Systems engineering support in the areas of configuration management, systems performance modeling and analysis, message compression techniques and investigation of advanced technology.
- o Continuing development of the reconstitutable very low frequency system as a part of the overall survivable/enduring communications network.

Program Element: 1402N

Title: Navy Strategic Communications

(U) In FY 1984, it is planned to:

- o Complete development of the high efficiency power amplifiers and very low frequency multicoupler.
- o Install 17 buoyant cable antenna systems and 17 mediumfrequency/high frequency multicouplers.
- o Begin installations of Enhanced VERDIN processor.
- o Procure additional 17 standard buoyant cable antennas and medium frequency/high frequency multicouplers and 55 precise frequency time standards.

(U) This is a continuing program. During FY 1985 and the out years, it is intended to:

- o Concentrate on efforts to develop new state-of-the-art fixed very low frequency transmitting capabilities and enhancements to submarine receiving equipments.

(U) Project X1384, Survivable and Enduring Communications: Presidential Decision 59 requires that the United States have flexibility in the deployment of strategic nuclear weapons, wherein war scenarios can last from a few hours to periods in excess of one-half year. This project is to provide for reconstitution of communications with Fleet Ballistic Missile Submarines when the services of TACAMO and other strategic communications relay assets are no longer available either through enemy actions, or when the endurance of the asset is exceeded.

(U) In FY 1982,

- o Defined baseline network based primarily on qualitative analysis. (Developments to date have been completed under project X1083, Shore-to-Ship Communications, within this Program Element.)

(U) The FY 1983 program consists of:

- o Completing the initial functional requirements allocation of the systems.
- o Starting the network signals and protocol design.
- o Entering into full scale development phase for a Free Floating Balloon Relay.
- o Concept formulation on other systems funded under project X1083, Shore to-Ship Communications.

(U) In FY 1984, it is planned to:

- o Continue conceptual development of all systems.
- o Complete full scale development phase for the Free Floating Balloon Relay.
- o Continue technology and network analysis work.

(U) This is a continuing program. For FY 1985, and the outyears it is intended to:

- o Complete development of all systems.
- o Enter into production.
- o Pursue promising concepts such as Blue/Green Laser satellite communications when the technology matures.

Program Element: 11402N

Title: Navy Strategic Communications

1. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(U) Project XO793, TACAMO

1. (U) DESCRIPTION (Requirement and Project): TACAMO aircraft are an integral part of the Joint Chiefs of Staff directed Minimum Essential Emergency Communications Network. This project provides an airborne communications capability for a survivable link for command and control of Fleet Ballistic Missile Submarines.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o Continue TACAMO nuclear vulnerability assessment and hardening to include initiation of Electromagnetic Pulse hardness qualification testing and surveillance methodology.
- o Initiated development of a survivable time system and continued development of very low frequency receive antenna improvements for improved Air Force/Navy connectivity.
- o Continued development of nuclear hardness assurance and maintenance techniques.
- o Initiated analysis of future TACAMO requirements to ensure future compatibility with emerging Minimum Essential Emergency Communications Network requirements.
- o Provide support to ECK program startup efforts.

b. (U) FY 1983 Program:

- o Complete TACAMO nuclear vulnerability assessment and qualification testing.
- o Continue full scale development of survivable time system.
- o Continue to develop and test very low frequency receive antenna improvements and Electromagnetic Pulse hardness assurance and maintenance techniques.
- o Initiate design analysis of advanced TACAMO communications system concepts.
- o Initiate full scale development of a very low frequency receiver.
- o Initiate development of TACAMO ultra high frequency/extremely high frequency Fleet Satellite/Military Satellite Relay upgrades to ensure Air Force/Navy satellite communications compatibility.

c. (U) FY 1984 Planned Program:

- o Initiate development of very low frequency receive antenna system and complete development of survivable time and Electromagnetic Pulse hardness assurance and maintenance efforts.
- o Continue development of ultra high frequency/extremely high frequency Fleet Satellite/Military Satellite Relay terminal upgrades and initiate very low frequency receiver development.
- o Commence advanced system design for communications control subsystem architecture to accommodate phased system preplanned product improvements.

d. (U) Program to Completion: This is a continuing program to ensure a survivable communications link to deployed strategic forces.

e. (U) Milestones: Not Applicable.

Program Element: 11402N

Title: Navy Strategic Communications

(U) Project W1438, ECX (E-6A)

1. (U) DESCRIPTION (Requirement and Project): ECX is the planned replacement for the airframe currently supporting the TACAMO strategic communications mission. TACAMO is the manned airborne relay platform within the Minimum Essential Emergency Communications Network that provides survivable communications connectivity from the National Command Authorities to the Fleet Ballistic Missile Submarines and other Single Integrated Operational Plan/Strategic Reserve Forces. It is the Navy system for the delivery of Emergency Action messages. To accomplish this mission, ECX must be airborne and capable of communications with the Worldwide Military Command and Control System at all times. It must be able to monitor and transmit on a wide variety of frequencies. ECX must be airborne beginning in the late 1980's. It must be able to withstand the Electromagnetic Pulse effects of a nuclear detonation.

Orbit maneuvers are required to provide verticality of the trailing wire antenna.

Since its inception, TACAMO has continued to mature in communications capability resulting in substantial weight growth of the current vehicle, the EC-130. This aircraft is currently operated about seven thousand pounds overweight. This condition results in unacceptable performance limitations. A competitive Request for Quotations was issued 11 March 1982. Responses were received by 1 July 1982 and have been evaluated. A best and final offer is expected in January 1983 with contract anticipated in March-April 1983. The program will utilize a currently in-production aircraft that has been hardened against the Electromagnetic Pulse threat, and integrate the existing version of the AN/USC-13 mission avionics into the new aircraft.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o Issued Request for Quotations on 11 March 1982.
- o Proposals received 1 July 1982 were reviewed and competitive range determination made at a Source Selection Advisory Council meeting.
- o Work continued on a Request for Proposal for best and final offer from the bidder.
- o Funding for FY 1982 was provided from Project XU793, TACAMO, within this program element.

b. (U) FY 1983 Program:

- o Commence research and development efforts at Navy field activities on integration/interface of mission avionics.
- o Issue final detailed specifications and proposal request and receive best and final offer from the contractor.
- o Complete best and final offer evaluation, negotiations, and milestone review.
- o Award contract for full scale development in March-April 1983 time frame dependent upon speed and complexity of negotiations.
- o Preview briefings to be presented to Navy Systems Acquisition Review Council in Fourth quarter FY 1983.

c. (U) FY 1984 Planned Program:

- o Conduct Preliminary Design Review in October 1983.
  - To provide Government with necessary information to validate contractor design plans for accommodating the communications system in the selected airframe.
  - Short design time possible since no new communications subsystems are being introduced and the selected airframe, hereafter designated E-6A, is the basic Boeing E-3A (AWACS) which has over 200,000 flight hours.
- o Conduct Navy Systems Acquisition Review Council Milestone II/III Review in December 1983.



Program Element: 11402N

Title: Navy Strategic Communications

- o Continue design and fabrication toward critical design review in September-October 1984 to set final configuration.
- o Initiate design and fabrication of mission integration facility.
- o No experimental or advanced technology systems are being used.
- o Aircraft Procurement, Navy Appropriation funds are for advanced procurement of long-lead production items for the FY 1985 production procurement.

d. (U) Program to Completion: This is a continuing program. For out years it is intended to:

- o Aircraft are planned to be procured at the following rate:
  - FY 1985 - 2.
  - FY 1986-1989 - 3/year.
- o This allows for the removal of mission avionics from the present EC-130 aircraft with minimal adverse effect on the required operational force level.
- o Navy Preliminary Evaluation and Technical Evaluation will be conducted on the production prototype during first half of FY 1987.
- o Electromagnetic Pulse Hardening Evaluation and Operational Evaluation will commence on the first production aircraft in the second quarter of FY 1987.

e. (U) Milestones:

| <u>Milestone</u>                                             |                     | <u>Date</u>   |
|--------------------------------------------------------------|---------------------|---------------|
| 1. (U) Navy Systems Acquisition Review Council Milestone II. | (Feb 1983) *        | December 1983 |
| 2. (U) Contract Award (Prototype).                           |                     | March 1983    |
| 3. (U) Request for production approval.                      | (Jul 1983) *        | March 1983    |
| 4. (U) Production initiation.                                | (Apr 1986) *        | December 1984 |
| 5. (U) Contract test.                                        | (Oct 1986) *        | January 1987  |
| 6. (U) Technical Evaluation/Board of Inspection and Survey.  | (Jan 85 - Apr 87) * | May 1987      |
| 7. (U) Electromagnetic Pulse Evaluation.                     | (Mar - Apr 1987) *  | June 1987     |
| 8. (U) Operational Evaluation.                               | (May 1987) *        | August 1987   |
| 9. (U) Production deliveries commence.                       | (Mar 1987) *        | August 1987   |
| 10. (U) Initial Operational Capability.                      |                     | 1988          |

\* Dates listed in FY 1983 Descriptive Summary. Milestone adjustments are based on more precise program definition. Accelerated production initiation is based on a favorable sole source offer response to the Request for Proposal.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12427N  
DoD Mission Area: 337 - Strategic Surveillance and Warning

Title: Naval Space Surveillance System  
Budget Activity: 3 - Strategic Programs

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                           | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT       | 550            | 501              | 179              | 510              | 1,510                    | 5,260*               |
| X0125       | Naval Space Surveillance System | 550            | 501              | 179              | 510              | 1,510                    | 5,260*               |

\* Includes 1,239 funded in Project R0125 in FY 1979 and prior.

The above funding includes out-year escalation and encompasses all work or development phases now planned or anticipated.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The U. S. Naval Space Surveillance System is a bi-static, continuous wave radar which provides detection and tracking of satellites and other space objects. A catalog of space objects is maintained at the Systems Computational Center in Dahlgren, Virginia, where ocean area as well as unit-specific reconnaissance vulnerability reports are compiled and transmitted to fleet units. As part of the North American Aerospace Defense Space Detection and Tracking System, the Naval Space Surveillance System is under the operational control of the North American Aerospace Defense Command, Colorado Springs, Colorado. The modernization program is replacing obsolete transmitters, receivers and antennas with solid state components, which will increase system high altitude detection capabilities and increase system effectiveness.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and this Descriptive Summary result are as follows: a net reduction of 312 in FY 1984 due to Navy budgetary constraints during budget development.

## D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                           | FY 1983 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT       | 539            | 550              | 501              | 521              | 1,570                    | 5,152*               |
| X0125       | Naval Space Surveillance System | 539            | 550              | 501              | 521              | 1,570                    | 5,152*               |

\* Includes 1,239 funded in Project R0125 in FY 1979 and prior.

## E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| OPN (BA 2) (332901) | 3,359          | 5,216            | 6,195            | 5,024            | 13,978                   | 40,837               |
| WILCON TOTAL        | -              | -                | 495              | 550              | 3,620                    | 4,665                |

F. (U) RELATED ACTIVITIES: There are no other RDT&E activities currently within Navy which directly relate to this development. As an element of the North American Aerospace Defense Command Space Detection and Tracking System (NORAD/SPADATS), the Naval Space Surveillance System supports the North American Aerospace Defense Command Space Defense Operations Center (NORAD/SPADOC), Program Element 12311F, as Backup Computation Facility.

Program Element: 12427N

Title: Naval Space Surveillance System

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is the Naval Space Surveillance System, Dahlgren, VA. OTHERS: Naval Research Laboratory, Washington, D.C. CONTRACTORS: Raytheon Company Equipment Division, Wayland, MA.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project X0123, Naval Space Surveillance System: This project provides for the engineering investigations necessary for modernization of operational station receiver and transmitter electronics and antennas; improving system effectiveness and conducting engineering investigations leading to concept formulation for a CY 2000 era space surveillance system.

(U) In FY 1982, system analysis was continued to identify more effective ways of using the system; and a long range concept formulation engineering investigation was initiated to identify space surveillance requirements and project plans for the CY 2000 era in conjunction with the National Space Defense Program.

(U) The FY 1983 program consists of:

- o Continuing engineering/analysis investigations with emphasis on improving efficiency of modernized transmitter stations.
- o Improving selected computational algorithms for deriving data output.
- o Analyzing other system hardware and software in the modernized system, and where indicated, make improvements based on life cycle costs.
- o Continuing long range planning for development of a CY 2000 era system to obtain information needed to initiate and document a System Development Plan.

(U) For 1984, it is planned to:

- o Conclude long range planning based on concept formulation engineering investigations for a CY 2000 era system.
- o Using information from long range planning, initiate preparation of a System Development Plan.

(U) Program to Completion: update software programs for modernized receiving stations to improve overall system effectiveness, reduce costs, and improve system efficiency; and complete preparation of a System Development Plan for development of a CY 2000 era system. In FY 1986, a Navy Decision Coordination Paper and an Advanced Development Project will be initiated to support development of the CY 2000 era system.

I. (U) PROJECTS MORE THAN \$10 MILLION IN FY 1984: Not applicable.

FY 1984 RDT&R DESCRIPTIVE SUMMARY

Program Element: 33131N  
DoD Mission Area: 333 - Strategic Communications

Title: Minimum Essential Emergency Communications Network  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                                         | FY 1982<br>Actual | FY 1983<br>Estimate | FY 1984<br>Estimate | FY 1985<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|-------------|---------------------------------------------------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
|             | TOTAL FOR PROGRAM ELEMENTS                                    | 3,089             | 6,741               | 1,365               | 662                 | Continuing                  | Continuing                 |
| X0795       | Support of Minimum Essential Emergency Communications Network | 3,089             | 6,741               | 1,365               | 662                 | Continuing                  | Continuing                 |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Navy is developing for tri-service use a Minimum Essential Emergency Communications Network Message Processing Mode to reduce the transmission time and improve the throughput for emergency action messages transmitted via the very low frequency/low frequency transmission systems.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall decrease of 3,932 in FY 1983, 32 due to revised cost estimates, including inflation, and 3,900 transferred to X0731, Fleet Satellite Communications, in Program Element 33105N, to support an urgent R,DT&E,N shortfall; and 26 in FY 1984, due to revised cost estimates.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                                         | FY 1981<br>Actual | FY 1982<br>Estimate | FY 1983<br>Estimate | FY 1984<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|-------------|---------------------------------------------------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                     | 2,337             | 3,089               | 10,673              | 1,591               | Continuing                  | Continuing                 |
| X0795       | Support of Minimum Essential Emergency Communications Network | 2,337             | 3,089               | 10,673              | 1,591               | Continuing                  | Continuing                 |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                     | FY 1982<br>Actual | FY 1983<br>Estimate | FY 1984<br>Estimate | FY 1985<br>Estimate | Additional<br>to Completion | Total<br>Estimated<br>Cost |
|---------------------|-------------------|---------------------|---------------------|---------------------|-----------------------------|----------------------------|
| OPN (BA 2) (333115) | 0                 | 0                   | 100                 | 300                 | TBD                         | TBD                        |
| O&M,N               | 324               | 2,896               | 2,545               | 708                 | Continuing                  | Continuing                 |

(U) O&M,N will be used to implement Message Processing Mode software changes for the Fixed Very Low Frequency/Low Frequency and TRIDENT Integrated Radio Room applications.

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Program Element: 33131H

Title: Minimum Essential Emergency Communications Network

F. (U) RELATED ACTIVITIES: Program Element 11402H, Navy Strategic Communications (Shore-to-ship Communications Project X1083) contains the Very Low Frequency/Low Frequency systems into which the Minimum Essential Emergency Communications Network Message Processing Modes will be incorporated. Minimum Essential Emergency Communications Network (Program Element 33131A, F, K).

G. (U) WORK PERFORMED BY: IN-HOUSE: Lead laboratory is Naval Ocean Systems Center, San Diego, CA. CONTRACTORS: Control Data Corporation, San Diego, CA; General Telephone and Electronic Corporation, Sylvania, Boston, MA.

H. (U) PROJECT LESS THAN \$10 MILLION IN FY 1984:

(U) Project X0795, Support of Minimum Essential Emergency Communications Network: develops the Minimum Essential Emergency Communications Network Message Processing Mode, an integral part of Fleet Ballistic Missile Submarine Control System Communications which will improve delivery of Emergency Action Messages via the Navy and Air Force Low Frequency/Very Low Frequency systems. Navy is designated Program Director for System Development and Acquisition of the Tri-Service/Defense Communications Agency Program. Minimum Essential Emergency Communications Network Message Processing Mode encodes the specialized Emergency Action Messages transmitted from the National Command Authorities to Fleet Ballistic Missile Submarines when using the Low Frequency/Very Low Frequency Communications system.

(U) In FY 1982,

- o Completed development of the Minimum Essential Emergency Communications Network Message Processing Mode and commenced testing.
- o Continued development of the processing system for the Worldwide Airborne National Command Post Aircraft.
- o Initiated integration into the Enhanced VERDIN Processor and initiated planning for integration into the Navy Fixed Very Low Frequency sites and TRIDENT Integrated Radio Room.

(U) The FY 1983 program consists of:

- o Conduct interoperability Operational Evaluation of the Minimum Essential Emergency Communications Network Message Processing Mode on Fleet Ballistic Missile Submarines, TACAMO aircraft, and National Emergency Airborne Command Post.
- o Obtain Joint Chiefs of Staff approval of the Mode.

(U) For FY 1984, it is planned to:

- o Begin deployment of Minimum Essential Emergency Communications Network Message Processing Mode in Navy Very Low Frequency/Low Frequency Systems.
- o Interoperability aspects with Air Force and National Command Authorities will be finalized.

(U) The program to completion: This is a continuing program which will involve:

- o Implementation of Minimum Essential Emergency Communications Network Message Processing Modes which are fully interoperable with Air Force and National Command Authorities strategic communications systems.
- o After FY 1984, this program will decrease to a level of effort program for system architecture, configuration control management, and hardware and software life cycle support.

L. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33152H  
DoD Mission Area: 391 - Information Systems

Title: WMCCS Information System Modernization  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No.               | Title                                  | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|---------------------------|----------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| TOTAL FOR PROGRAM ELEMENT |                                        | 0              | 0                | 8,391            | 14,752           | Continuing               | Continuing           |
| 798                       | WMCCS Information System Modernization | 0              | 0                | 8,391            | 14,752           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops Worldwide Military Command and Control System (WMCCS) Information System, Joint Program Manager's requirements. The funds requested for this program represent the Navy's share based on the number of Navy System nodes. The funds are managed solely by the Joint Program Manager for the Worldwide Military Command and Control System Information System for joint requirements. The Services merely act as a bank until the Joint Program Manager requests the funds.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) Not applicable. New start in FY 1984.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY: Not applicable

E. (U) OTHER FY 1984 APPROPRIATION FUNDS: Not applicable

F. (U) RELATED ACTIVITIES: Worldwide Military Command and Control System Information System Architecture, Program Element 63735H.

G. (U) WORK PERFORMED BY: Unidentified at this time. The Joint Program Manager is currently preparing a Request for Proposal for Integration Contract and Common Users System contract.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project Z1798 Worldwide Military Command and Control System Information System Modernization: (NEW START) Project develops Worldwide Military Command and Control System Information System, Joint Program Manager requirements. US Air Force is executive service.

(U) In FY 1984:

\* Integration Contract and Common Users Systems Contract will be awarded.

\* Additional effort will be determined.

(U) This is a continuing program.

I. (U) PROJECT OVER \$10 MILLION IN FY 1984: None.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63371N  
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT II  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                          | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT      | 240,832        | 369,614          | 1,496,406        | 2,145,562        | Continuing               | Continuing           |
| B0951       | TRIDENT II Missile (Quantity)  | 198,650        | 351,029          | 1,475,489        | 2,134,875        | Continuing               | Continuing (30) 1/   |
| R1452       | Geodetic/Geophysical Satellite | 17,551         | 18,585           | 11,159           | 1,351            | 265                      | 48,911               |
| B1546       | TRIDENT II Submarine System    | 24,631         | 0                | 9,758            | 9,336            | Continuing               | Continuing           |

1/ (U) Missile development flight test quantity not specifically funded in any fiscal year as they are part of a multi-year incrementally funded operational system development contract.

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only, except for Project R1452, for which the above funding includes all work and development phases now planned or anticipated.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element will enhance Fleet Ballistic Missile Submarine survivability by increasing Sea Launched Ballistic Missile range at full payload to exploit the total patrol area available to the TRIDENT submarine; minimize total weapon system costs by increasing Sea Launched Ballistic Missile payload to the level permitted by the size of the TRIDENT submarine launch tube, thereby allowing mission capability to be achieved with a lesser number of submarines; balance the Triad by adding efficient hard target kill capability to the Sea Launched Ballistic Missile; enhance essential equivalence with the Soviets in accordance with perceived needs to increase our warhead inventory, throw weight and accuracy in the presence of increasing Soviet capabilities and force levels; and collect geodetic/gravitational data in support of TRIDENT II (D-5) error reduction effort.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands): The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall increase of 1,600 in FY 1982, transferred from B0004, TRIDENT Submarine, Program Element 11228N, to R1452, Geodetic/Geophysical Satellite, due to increased costs of Air Force support for the ATLAS-E launch vehicle; an overall increase of 2,913 in FY 1983, transferred from B0004, TRIDENT Submarine, Program Element 11228N, to B0951, TRIDENT II Missile, along with 9,087 transferred within this Program Element from B1546, TRIDENT II Submarine System, which will provide an overall increase of 12,000 in B0951 to accelerate development of Strategic Weapon System shipboard subsystem components in order to meet earlier shipyard required dates based on decision to introduce the TRIDENT II (D-5) missile during initial construction of the ninth TRIDENT submarine vice during a back-fit period on an already in-commission submarine; and an overall increase of 62,856 in FY 1984, 74,192 in B0951, TRIDENT II Missile, to initiate development of a new reentry vehicle as well as to accelerate development of Strategic Weapon System shipboard subsystem components in order to meet earlier ship-yard delivery requirements in support of TRIDENT II (D-5) missile introduction during initial construction of TRIDENT submarine number nine, 4,343 in R1452, Geodetic/Geophysical Satellite, due to increased costs and to insure that all subsystems are completed, tested and assembled in time to protect satellite launch during FY 1984, and 4,321 in B1546, TRIDENT II Submarine System, due to earlier introduction of TRIDENT II (D-5) Missile.

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Program Element: 63371N

Title: TRIDENT II

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                          | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|--------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT      | 96,683         | 239,232          | 366,701          | 1,413,550        | Continuing               | Continuing           |
| B0951       | TRIDENT II Missile System      | 96,683         | 198,650          | 339,029          | 1,401,297        | Continuing               | Continuing           |
| R1452       | Geodetic/Geophysical Satellite | 0              | 15,951           | 18,585           | 6,816            | 573                      | 41,925               |
| B1546       | TRIDENT II Submarine System    | 0              | 24,631           | 9,087            | 5,437            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:

|                                    | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
| SCN (BA 1) (LI 321040) (Total TOA) | 337,000        | 1,606,100        | 2,355,800        | 2,122,400        | Continuing               | Continuing           |
| (Quantity)                         | (0)            | (1)              | (1)              | (1)              | Continuing               | Continuing           |
| WPN (BA 1) (LI 301150)             | 0              | 0                | 0                | 159,000          | Continuing               | Continuing           |
| (Quantity)                         | -              | -                | -                | (0)              | Continuing               | Continuing           |
| OPN (BA 1,2,4)                     | 0              | 0                | 44,300           | 221,535          | Continuing               | Continuing           |
| MILCON                             | 0              | 0                | 145,640          | 362,200          | Continuing               | Continuing           |

F. (U) RELATED ACTIVITIES: TRIDENT Submarine System, Program Element 11228N/B0004; TRIDENT I Missile System, Program Element 11228N/B0003; POSEIDON support included in Fleet Ballistic Missile System, Program Element 11221N. Development will require joint participation with the Department of Energy in re-entry vehicle development. The capability to meet specified accuracy objectives in the TRIDENT II Strategic Weapon System development is directly dependent upon results of the Improved Accuracy Program, Program Element 11221N/J0094, concluded in FY 1982.

G. (U) WORK PERFORMED BY: IN-HOUSE: Naval Surface Weapons Center, Dahlgren, VA; Eastern Space and Missile Center, Cocoa Beach, FL; Army Armament Command, Rock Island, IL; Naval Weapons Support Center, Crane, IN; Naval Oceanographic Office; Defense Mapping Agency, Los Angeles, CA; Naval Sea Systems Command, Washington, DC; Strategic Systems Project Office, Washington, DC. CONTRACTORS: Westinghouse Electric Corporation, Sunnyvale, CA; General Electric Company, Ordnance Systems, Pittsfield, MA; Sperry Systems Management Division, Great Neck, NY; Charles Stark Draper Laboratory, Cambridge, MA; Lockheed Missiles and Space Company, Sunnyvale, CA; Automation Industries, Inc., Vitro Laboratories Division, Silver Spring, MD; Interstate Electronics Corporation, Anaheim, CA; Rockwell International Corporation, Anaheim, CA; Johns Hopkins University/Applied Physics Laboratory, Laurel, MD; Aerospace Corporation, El Segundo, CA; Electric Boat Division of General Dynamics Corporation, Groton, CT; and others.



Program Element: 63371N

Title: TRIDENT II

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project B1546, TRIDENT II Submarine System: will identify the necessary subsystem changes to incorporate the TRIDENT II (D-5) into the TRIDENT submarine baseline and initiate development of necessary weapon support systems and/or components. The ninth TRIDENT submarine will be the first ship to accommodate the TRIDENT II (D-5) missile, and this will be accomplished during initial construction of the submarine. Ship delivery will be extended one year, to December 1988, to accommodate the required ship modifications, but will still support the December 1989 Initial Operational Capability.

(U) In FY 1982,

- o Conducted preliminary design and engineering studies to support incorporation of the TRIDENT II (D-5) Strategic Weapon System into the TRIDENT submarine baseline.
- Included trade-off studies to determine modifications to ship support systems based on the characteristics of the candidate missiles.

(U) FY 1983 Program:

- o Impact of no FY 1983 funding on weapon support system developments is being evaluated. Impact on weapon system development to be determined.

(U) For FY 1984, it is planned to:

- o Continue development of weapon support system components.
- o Evaluate major weapon support system operational parameters in the missile tube prototype.

(U) The program to completion: This is a continuing program. It is planned to:

- o Complete development of shipboard weapon support systems and components.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984:

(U) Project B0951, TRIDENT II Missile

1. (U) DESCRIPTION (Requirement and Project): Concept formulation effort started in FY 1978 on a TRIDENT II missile with greater range/payload capability and improved accuracy over that available with the TRIDENT I (C-4) missile. The TRIDENT II missile will be carried in TRIDENT Fleet Ballistic Missile Submarines, thus ensuring that the United States will continue to maintain a highly survivable strategic deterrent for the 1990's and beyond. In May 1976 the Deputy Secretary of Defense directed the development of an overall plan for the development of a TRIDENT II missile with an Initial Operational Capability in the 1980's. In March 1980 the Secretary of Defense described to Congress a Sea Launched Ballistic Missile Modernization Advanced Development Program which would lead to an end of FY 1983 Defense Systems Acquisition Review Council Milestone II decision to select a weapon system option which would achieve specific performance objectives with an Initial Operational Capability of CY 1989. The Secretary of Defense reaffirmed the need for an improved Sea Launched Ballistic Missile in the Decision Memorandum of 2 February 1981, stating that the objectives of the Advanced Development Program should include:

- Definition of an optimum new missile configuration within the volume constraints of the TRIDENT submarine launcher.
- Initial development of selected components and subsystems, including guidance and propulsion, to reduce the acquisition lead time following commitment to full-scale engineering development.
- Reduction of risks associated with program cost, schedule, and performance.

The Deputy Secretary of Defense, in his Program Decision Memorandum of 2 October 1981, directed the Navy to fund the development of the TRIDENT II (D-5) Missile with a [ ] 1989 Initial Operational Capability.

Program Element: 63371N

Title: TRIDENT II

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program:

- o Continue Advanced Development Program.
- o Candidate D-5 missile options under study include:
  - three stage through-deck similar to the C-4 concept;
  - three stage clear deck; and
  - two stage clear deck.
- o Each option provides increased payload, using Mark 4 or new Mark 5 Reentry Body, enhanced range, and significantly improved accuracy over that of the currently deployed TRIDENT I (C-4) missile.

b. (U) FY 1983 Program:

- o Third and final year of Advanced Development Program.
- o Thorough assessment of D-5 design alternatives, particularly in the areas of accuracy, range, and payload, with an end of FY 1983 Defense Systems Acquisition Review Council Milestone II decision to select a weapon system option to proceed into full scale engineering development in FY 1984.

c. (U) FY 1984 Planned Program:

- o Start full scale engineering development of selected D-5 weapon system option in October 1983 with major subsystem prime contractors (for launcher, fire control, navigation, test instrumentation, missile, and guidance) under incrementally funded completion contracts.
  - Funding increase over FY 1983 reflects the major effort required to meet the directed Initial Operational Capability date of the TRIDENT II (D-5) Strategic Weapon System.

d. (U) Program to Completion: This is a continuing program. It is planned to:

- o Complete development, including planned flight test program, and deploy TRIDENT II (D-5) Strategic Weapons System in December 1989.

e. (U) Milestones:  
Milestone

1. (U) Initiate Concept Definition.
2. (U) Commence Advanced Development Phase.
3. (U) Defense Systems Acquisition Review Council Milestone II Decision.
4. (U) Commence Full-Scale Engineering Development.
5. (U) First Missile Flight Development Test.
6. (U) First Fleet Ballistic Missile Submarine Launched Performance Evaluation Missile (PEM) Flight Test.
7. (U) First Demonstration and Shakedown Operation (DASO) Flight Test.
8. (U) Operational Availability Date (OAD).

Date

October 1977  
October 1980  
September 1983  
October 1983  
January 1987  
March 1989

August 1989  
1989

Program Element: 63371M

Title: TRIDENT II

(U) Project R1452, Geodetic/Geophysical Satellite

1. (U) DESCRIPTION (Requirement and Project): This project will provide a satellite system for obtaining Geoid information which will increase accuracy of advanced Sea Launched Ballistic Missile systems by reducing error sources. As circular error probability is reduced, geodetic/geophysical error contributors become an increasing portion of total error budget. Reducing this error contributor requires improvements in the earth gravitational models. This can be accomplished by a homogeneous, high density, intermediate and long wavelength data base collected by radar altimeter satellite. The SEASAT (launched in 1978) was to have provided such data, but failed shortly after launch. The objective of this program is to build a duplicate of SEASAT radar altimeter on a bus module derived from GEOS spacecraft. The satellite will be injected into SEASAT orbit on a dedicated ATLAS-E launch vehicle and will obtain detailed altimetry data over all ocean areas during an eighteen month period in order to: (a) provide a homogeneous high density intermediate and long wavelength data base; (b) define general geophysical/geologic provinces for detailed ship survey to analyze the effect of high frequency environment; and (c) detect existence of possible unknown bathymetric hazards to submerged navigation.

2. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE EFFORTS:

a. (U) FY 1982 Program: (Project was a new start in FY 1982)

- o Finalized program plan and let contracts for the satellite, launch vehicle, and orbit insertion stage.
- o Conducted Conceptual Design Review.
- o Established subsystem working groups.
- o Conducted Preliminary Design Review for satellite and launch vehicle systems.

b. (U) FY 1983 Program:

- o Conduct critical design reviews for satellite, launch vehicle, and orbit insertion stage.
- o Complete fabrication, testing, and integration of systems.

c. (U) FY 1984 Planned Program:

- o Final testing, launch, and orbital operations.  
-- The large funding change from FY 1983 to FY 1984 results from the requirement for all subsystems to be completed, tested, and assembled during the first two years in order to meet the launch date in FY 1984.
- o Begin data processing and analysis.

d. (U) Program to Completion:

- o Complete eighteen months of altimeter data collection and processing in coordination with the Defense Mapping Agency and the Naval Oceanographic Office.

e. (U) Milestones:

Milestone

Date

1. (U) Critical Design Review.
2. (U) Launch of Satellite.
3. (U) Complete Data Collection.
4. (U) Complete Data Reduction and Distribution.

November 1982  
Fourth quarter FY 1984  
April 1985  
FY 1987

Program Element: 63371N

Title: TRIDENT II

f. (U) TEST AND EVALUATION DATA:

1. (U) Development Test and Evaluation:

(U) Detailed information for this phase of Test and Evaluation is not available at this time as the program is in the last year of a three year Advanced Development Program. Program structure, schedules and Test and Evaluation objectives are to be determined after further program definition and will be based upon the successful procedures of the TRIDENT I development and evaluation program.

2. (U) Operational Test and Evaluation:

(U) No detailed Operational Test and Evaluation program has been planned to date. Planning will be initiated at the earliest practical date after program concepts are approved, and will be an extension of the TRIDENT I Operational Test and Evaluation Plan.

3. (U) System Characteristics:

(U) The TRIDENT II (D-5) will provide the TRIDENT Fleet Ballistic Missile Submarine with a larger missile with greater range/payload capability and improved accuracy. Specific characteristics are to be determined during the Advanced Development Program

4. (U) TRIDENT II (D-5) Program Documentation:

(U) Not applicable at this time.

FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63588N  
DoD Mission Area: 112 - Sea Based Strike

Title: SSBN Subsystem Technology Program  
Budget Activity: 3 - Strategic Programs

A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                     | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 4,508          | 0                | 7,347            | 11,782           | Continuing               | Continuing           |
| 50001       | SSBN Subsystem Technology | 4,508          | 0                | 7,347            | 11,782           | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The SSBN Subsystem Technology Program, initiated in FY 1977 has as its objective the identification and development of more cost-effective subsystem concepts for future Fleet Ballistic Missile Submarines. All subsystems of fleet ballistic missile submarines are being evaluated exclusive of the main propulsion complex, the nuclear reactor, and the strategic weapon system. The program is composed of two major parts. The first identifies the technologies which offer the greatest potential for improving the cost effectiveness of fleet ballistic missile submarine subsystems and evaluates the life cycle cost benefit of adopting the new technology. The second develops, by engineering analysis, breadboard testing and prototype testing, the most cost effective subsystem concepts. The subsystem concepts identified to date offer acquisition cost savings in the range of 100 thousand dollars to ten million dollars per ship per concept. The full development costs of most concepts are returned as an acquisition cost savings on the first one or two ships that use the concept. Some of the more promising concepts are: Stern Plane rate reduction study which could reduce the size of the hydraulic plant; a simplified torpedo tube turbine ejection pump; missile tube muzzle hatch electric operator; countermeasure ejection by linear springs; flame sprayed coating for sanitary tanks; use of all position flux cored weld rods to increase weld material deposition rate; application of composite non-metallic materials in non-pressure hull areas such as the superstructure and high pressure gas storage flasks; simplified air system; and revision of missile compartment and deep frame structural design criteria.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: a decrease of 4,898 (to 0) in FY 1983 due to Congressional action; and an overall decrease of 4,978 in FY 1984, due to program restructuring following the Congressional elimination of the FY 1983 program.

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                     | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT | 13,808         | 4,508            | 4,898            | 12,325           | Continuing               | Continuing           |
| 50001       | SSBN Subsystem Technology | 13,808         | 4,508            | 4,898            | 12,325           | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None

(418)

Program Element: 63588N

Title: SSBN Subsystem Technology Program

F. (U) **RELATED ACTIVITIES:** The tasks implemented under this program are being coordinated with submarine technology efforts in the Naval Sea Systems Command under the following Programs: TRIDENT Submarine System, Program Element 11228N/80004; Attack Submarine Development, Program Element 63569N; Submarine Silencing, Program Element 25634N; Submarines (Advanced), Program Element 63561N; Submarine Tactical Warfare Systems (target strength reduction and digital technology) Program Element 63562N; Ships Sub and Boats Technology, Program Element 62543N; Materials Technology, Program Element 62761N; HY 130 Steel, Program Element 63531N; and TRIDENT II Missile System, Program Element 63371N. A Submarine Technology Review Board within Naval Sea Systems Command functions to ensure coordination and prevent redundancy between this program and other Navy R&D programs.

G. (U) **WORK PERFORMED BY: IN-HOUSE:** David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Sea Systems Command, Washington, DC; Naval Underwater Systems Center, Newport, RI; Naval Research Laboratory, Washington DC; and Naval Shipyards. **CONTRACTORS:** Battelle Labs, Columbus, OH; Charles S. Draper Labs, Cambridge, MA; General Dynamics/Electric Boat Division, Groton, CT; General Electric Co., Pittsfield, MA; Aerojet Liquid Rocket Co., Marine Systems Div., Sacramento, CA; Franklin Research Center, Philadelphia, PA; Rockwell International, Autonatics and Rocketdyne Divisions, Los Angeles, CA; Suedlow Corporation, Garden Grove, CA; and Southwest Research Institute, Austin, TX.

H. (U) **PROJECT LESS THAN \$10 MILLION IN FY 1984:**

(U) **Project 80001, SSBN Subsystem Technology:** The Fleet Ballistic Missile Submarine (SSBN) is the sea-based element of our strategic deterrent forces. Acquisition and operating costs of fleet ballistic missile submarines have been steadily increasing. If future forces are to be acquired in the required force levels and provide the required effectiveness, then economic considerations dictate that the present trend of escalating acquisition and life-cycle costs must be counteracted by technological improvements. The objectives of the SSBN Subsystem Technology Program are: (1) to identify those areas of technology which offer significant promise for improving the cost-effectiveness of future fleet ballistic missile submarine subsystem designs; (2) to initiate the development of those areas of promising technology not currently under development in other related Navy programs; (3) to apply the technology advances achieved under this program, as well as the technology advances resulting from other related Navy programs to the conceptual design of more cost-effective fleet ballistic submarine subsystems. The new subsystems that will be developed from this program can then be used to develop specific, feasible alternatives when the Navy is tasked to respond to a requirement for the design and construction of a future Fleet Ballistic Missile Submarine. The ultimate goal of this program is to develop feasible alternatives for lower cost Fleet Ballistic Missile Submarines, with many alternatives available for each submarine utilization, as well.

(b) In FY 1982,

- Completed detail design of composite superstructure.
- Completed qualification testing of flat position flux cored weld rod specimens.
- Completed fabrication and testing of breadboard units for simplified air systems.
- Initiated testing of breadboard electrodialysis seawater conversion module.
- Tested spring powered internal countermeasures launcher breadboard unit.
- Completed development and initiated action to invoke in submarine shipbuilding contracts:
  - Torpedo ejection pump inlet redesign.
  - Polyethylene splices for sonar cables.
- Reached agreement with shipbuilder for equitable reduction in contract costs for:
  - High heat welding development.

(U) The FY 1983 Program has been deferred due to zero funding by Congressional action.

Program Element: 63588N

Title: SSBN Subsystem Technology Program

(U) For FY 1984, it is planned to:

- o Continue the effort to identify and assess cost effective subsystem concepts.
  - This effort will be the source for the new developments that will be initiated during this fiscal year.
- o The major efforts to be restarted include:
  - fabrication of a structural element of composite superstructure;
  - procurement of a prototype composite flask;
  - testing of prototype components for simplified air system;
  - catapult torpedo launcher breadboard fabrication;
  - fabrication and testing of further missile compartment models for verification of revised missile compartment design procedures;
  - initiation of prototype design and fabrication of spring powered internal countermeasures launcher;
  - breadboard testing of sanitary tank flame sprayed coating; and,
  - testing one model and designing and fabrication of an additional model for structural deep frame design criteria analysis.

(U) This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: Not applicable.

**FY 1984 RDT&E DESCRIPTIVE SUMMARY**

Program Element: 63735N  
 DOD Mission Area: 331 - Strategic Command and Control

Title: Worldwide Military Command and Control System  
Architecture Support  
 Budget Activity: 3 - Strategic Programs

**A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)**

| Project No. | Title                                                       | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                   | 799            | 900              | 1,170            | 961              | Continuing               | Continuing           |
| X0749       | Worldwide Military Command and Control Architecture Support | 799            | 900              | 1,170            | 961              | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work or development phases now planned or anticipated through FY 1985 only.

**B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This Command, Control and Communications program provides system engineering, advanced development research, and engineering studies and analyses to: (1) integrate Navy Command, Control, and Communications systems with Worldwide Military Command and Control Systems standard systems; (2) provide technical analyses/cost estimates and initial Research, Development, Test and Evaluation efforts for Joint Chiefs of Staff-validated and Chief of Naval Operations approved Worldwide Military Command and Control System Required Operational Capabilities; (3) provide initial Research, Development, Test and Evaluation efforts for validated selected architecture initiatives; (4) assess short and long term impact on Navy Command, Control, and Communications systems.

**C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY:** (Dollars in Thousands) The changes between the funding profile shown in the FY 1983 Descriptive Summary and this Descriptive Summary are as follows: The changes in FY 1982 (-63) are due to reprogramming for other Navy emergent requirements and FY 1983 (-3) are due to revised inflation factors. The increase of 214 in FY 1984 provides for assessment of software impact and required development resulting from programmed upgrades to the existing Worldwide Military Command and Control System Automatic Data Processing hardware central processors.

**D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:**

| Project No. | Title                                                       | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|-------------------------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                                   | 596            | 862              | 903              | 956              | Continuing               | Continuing           |
| X0749       | Worldwide Military Command and Control Architecture Support | 596            | 862              | 903              | 956              | Continuing               | Continuing           |

**E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS:** None.

**F. (U) RELATED ACTIVITIES:** Program Element 63717N, Command and Control System (Advanced); Program Element 64711N, Command and Control System (Engineering); Program Element 65866N, Command and Control Systems Planning/Engineering Support; Program Elements 63735N, 63735P, and 63735K, Worldwide Military Command and Control System Architecture Support developments and progress by other components; Program Element 33126N, Navy Communications, and Program Element 64510N, Communications Systems.

**G. (U) WORK PERFORMED BY:** IN-HOUSE: Naval Electronic Systems Command, Washington, D.C.; Naval Electronic Systems Security Engineering Center, Washington, D.C.; Naval Electronics Systems Engineering Center, San Diego, CA; Naval Shore Electronics Engineering Activity Pacific, Pearl Harbor, HI; Naval Ocean Systems Center, San Diego, CA. CONTRACTORS: Computer Sciences Corp.; San Diego, CA; Booz-Allen, Hamilton, Silver Spring, MD.

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Program Element: 63735N

Title: Worldwide Military Command and Control System  
Architecture Support

N. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project NO749, Worldwide Military Command and Control System Architecture Support: This project supports continued advanced development for the Worldwide Military Command and Control System to provide systems engineering for integration of Navy Command, Control and Communications systems, and engineering plans and Technical Analyses/Cost Estimates for Joint Chiefs of Staff-validated Commander in Chief Atlantic and Commander in Chief Pacific Required Operational Capabilities.

(U) In FY 1982, development of data transfer performance standards was initiated and Navy-supported sites unique interface requirements were assessed. Preparation of a Technical Analysis/Cost Estimate for Commander in Chief Pacific Required Operational Capability 20-81 for U.S. Forces Japan Coordination Center was begun.

(U) In FY 1983, engineering design and development efforts, support to Unified Commanders Required Operational Capabilities, and systems engineering to assure interoperability with Navy Command and Control Systems will continue.

(U) In FY 1984, it is planned to accomplish software development in support of programmed upgrades to the Worldwide Military Command and Control System Automated Data Processing equipment and to continue support for design, development and system engineering for joint command and control systems and to provide tactical support for Unified Commanders' Required Operational Capabilities. The \$270 thousand dollar increase in FY 1984 (over FY 1983) supports this effort.

(U) This is a continuing program that will support the effort of the Worldwide Military Command and Control System Engineering Organization in applying architectural concepts at Navy-supported Worldwide Military Command and Control System activities. Engineering efforts will ensure the development of Navy Worldwide Military Command and Control Elements consistent with Navy Command, Control and Communications requirements and provide initial Research, Development, Test and Evaluation efforts for validated Commanders in Chief Required Operational Capabilities, and validated Worldwide Military Command and Control Selected Architecture Programs.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984. Not applicable.

# FY 1984 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63836N  
DoD Mission Area: 140 - Strategic Support

Title: Strategic Technical Support  
Budget Activity: 3 - Strategic Programs

## A. (U) FY 1984 RESOURCES (PROJECT LISTING): (Dollars in Thousands)

| Project No. | Title                                       | FY 1982 Actual | FY 1983 Estimate | FY 1984 Estimate | FY 1985 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                   | 5,485          | 7,099            | 7,194            | 8,927            | Continuing               | Continuing           |
| J0093       | Advanced Ballistic Reentry Systems Support  | 898            | 868              | 0                | 0                | 0                        | 9,142                |
| N0100       | Biomedical Support for Submarine Systems    | 631            | 598              | 938              | 1,417            | Continuing               | Continuing           |
| R0128       | Management and Technical Support, Strategic | 2,512          | 2,800            | 2,754            | 3,368            | Continuing               | Continuing           |
| Z1259       | Hypervelocity Wind Tunnel                   | 1,444          | 1,653            | 2,038            | 2,477            | Continuing               | Continuing           |
| R1767       | Naval War College Strategic Studies Support | 0              | 1,180            | 1,464            | 1,465            | Continuing               | Continuing           |

As this is a continuing program, the above funding profile includes out-year escalation and encompasses all work and development phases now planned or anticipated through FY 1985 only.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced Ballistic Reentry Systems Support - Identify to the Manager of Advanced Strategic Missile Systems (formerly Advanced Ballistic Reentry Systems), Air Force Program Element 63311F, the unavailable technology which is required for the development of potential Navy strategic systems. Due to major restructuring of Air Force Program Element 63311F to direct its efforts primarily toward Air Force interests, project will be terminated at end of FY 1983. Biomedical Support for Submarine Systems - Provides biomedical knowledge necessary to increase effectiveness and enhance performance of critical Fleet Ballistic Missile Submarine tasks with particular emphasis on human factors involved in sonar systems. Management and Technical Support, Strategic - Develop strategic and theater nuclear concepts, determine technology requirements, define systems and options, evaluate system mixes, evaluate and establish requirements for strategic force survivability, conduct Sea Launched Ballistic Missile/Sea Launched Cruise Missile targeting application studies and examine reentry system requirements in support of sea based strategic and theater nuclear systems. Hypervelocity Wind Tunnel - Provides support for the development and operation of the Navy's Hypervelocity Wind Tunnel facility. Primary objective is to provide ground simulation of aerodynamic and aerothermal flight conditions required for the design and performance evaluation of reentry bodies and hypervelocity interceptors. There is a current and continuing need for ground test support for major systems development such as TRIDENT II (Navy), MX (Air Force), Ballistic Missile Defense (Army), and to a lesser extent, the Space Shuttle (NASA). NWC Strategic Studies Support - Provides the capability for analyzing Naval Strategy and, as a result, providing the CNO with specific recommendations for improvements both in strategy and the means of implementing strategy. The ultimate objective is to illuminate the roles, missions, uses and requirements of the Navy of the future.

C. (U) COMPARISON WITH FY 1983 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1983 Descriptive Summary and that shown in this Descriptive Summary are as follows: an overall increase of 155 in FY 1982, in R0128, Management and Technical Support, Strategic, due to revised cost estimates, including inflation; an overall increase of 1,180 in FY 1983, to initiate funding of R1767, Naval War College Strategic Studies Support; and an overall increase of 824 in FY 1984, made up of a decrease of 941 (to 0) in J0093, Advanced Ballistic Reentry Systems Support, due to project termination after FY 1983, an increase of 297 in N0100, Biomedical Support for Submarine Systems, in order to initiate development of three-dimensional sound penetration system which will improve sonar operator detection, tracking, and classification capabilities, a decrease of 190 in R0128, Management and Technical Support, Strategic, due to Congressional reductions in Contractors, Studies and Analyses, and Management Support, an increase of 194 in Z1259, Hypervelocity Wind Tunnel, to support TRIDENT II (D-5) testing requirements, and an increase of 1,464 to fund R1767, Naval War College Strategic Studies Support.

Program Element: 65856N

Title: Strategic Technical Support

D. (U) FUNDING AS REFLECTED IN THE FY 1983 DESCRIPTIVE SUMMARY:

| Project No. | Title                                       | FY 1981 Actual | FY 1982 Estimate | FY 1983 Estimate | FY 1984 Estimate | Additional to Completion | Total Estimated Cost |
|-------------|---------------------------------------------|----------------|------------------|------------------|------------------|--------------------------|----------------------|
|             | TOTAL FOR PROGRAM ELEMENT                   | 5,362          | 5,330            | 5,919            | 6,370            | Continuing               | Continuing           |
| J0093       | Advanced Ballistic Reentry Systems Support  | 819            | 898              | 868              | 941              | Continuing               | Continuing           |
| NO100       | Biomedical Support for Submarine Systems    | 548            | 631              | 598              | 641              | Continuing               | Continuing           |
| RO128       | Management and Technical Support, Strategic | 2,552          | 2,357            | 2,800            | 2,944            | Continuing               | Continuing           |
| Z1259       | Hypervelocity Wind Tunnel                   | 1,443          | 1,444            | 1,653            | 1,844            | Continuing               | Continuing           |

E. (U) OTHER FY 1984 APPROPRIATIONS FUNDS: None

F. (U) RELATED ACTIVITIES: Program Element 63311F, Advanced Strategic Missile Systems (technology exchange); Program Element 11221N, Fleet Ballistic Missile System; Program Element 11228N, TRIDENT I; Program Element 63371N, TRIDENT II; Program Element 65864F, Test and Evaluation; Program Element 62758N, Biomedical Technology; and Program Element 61153N, Defense Research Sciences.

G. (U) WORK PERFORMED BY: Advanced Ballistic Reentry Systems Support - IN-HOUSE: Lead laboratory is Naval Surface Weapons Center, White Oak, Silver Spring, MD; CONTRACTORS: Lockheed Missiles and Space Company, Sunnyvale, CA. is prime contractor. Biomedical Support for Submarine Systems - IN-HOUSE: Lead laboratory is Naval Submarine Medical Research Laboratory, Groton, CT. CONTRACTORS: None. Management and Technical Support, Strategic - IN-HOUSE: Lead laboratory is Naval Surface Weapons Center, White Oak, Silver Spring, MD, and Dahlgren, VA. CONTRACTORS: Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; Academy for Inter-Science Methodology, Rockville, MD; Kaman Sciences Corporation, Colorado Springs, CO; Control Data Corporation, Rockville, MD; Wagner Associates, Paoli, PA; Operations Research Inc., Silver Spring, MD; and TRW, McLean, VA. Hypervelocity Wind Tunnel - IN-HOUSE: Lead laboratory is Naval Surface Weapons Center, White Oak, Silver Spring, MD. CONTRACTORS: None. NRC Strategic Studies Support - IN-HOUSE: To be determined. CONTRACTORS: To be determined.

H. (U) PROJECTS LESS THAN \$10 MILLION IN FY 1984:

(U) Project NO100, Biomedical Support for Submarine Systems - provides biomedical knowledge necessary to increase effectiveness and enhance performance of critical submarine tasks. Current emphasis is on the development of experimental audio displays to enhance multiple sonar contact management, human factors involved in sonar systems, and the evaluation and development of visual aids to enhance recruitment into submarine service.

(U) In FY 1982:

- o Determined the accuracy of sonar target classification using audio and visual displays.
- o Developed a customized corrective lens system for periscope use to allow relaxation of visual standards for submarine officers.
- o Completed a survey of operating conditions in submarine sonar rooms providing information on variables such as lighting necessary to maximize effectiveness of the sonar operator.

(U) The FY 1983 program objectives are to:

- o Develop optimal sonar synchronized audio/visual mode for target discrimination and classification.
- o Apply new audio display to multiple sonar contact management.
- o Commence development of computer model to permit automatic target acquisition.
- o Evaluate effectiveness of previously developed periscope eyepiece modification.
- o Validate predictive visual test battery for sonar operators.
- o Define optimum conditions for submarine sonar room watchstanders.

(11/21)

Program Element: 65854N

Title: Strategic Technical Support

(U) For FY 1984, it is planned to:

- o Develop a three-dimensional display method which will vastly improve the sonar operator's ability to detect, track and classify multiple contacts.
- o Complete evaluation of vision correction methods to enhance recruitment and retention of submarine personnel.
- o Continue analysis of human factors problems in sonar design, with optimization of signature reference displays and evaluation of secondary displays.

(U) This is a continuing program.

(U) Project R0128, Management and Technical Support, Strategic, develops strategic and theater nuclear concepts, determines technology requirements, defines systems and options, evaluates system mixes, evaluates and establishes requirements for strategic force survivability, conducts Sea Launched Ballistic Missile/Sea Launched Cruise Missile targeting applications studies and examines reentry system requirements in support of sea based strategic and theater nuclear systems.

(U) In FY 1982:

- o Explored tradeoffs related to weapon configuration and operational requirements for current and future strategic sea based systems.
- o Investigated the effect of future targeting policy and plans upon weapon system trade-offs.
- o Continued analyses pertaining to strategic missiles, launch platforms, concept development, development, analytical support (nuclear vulnerability/weapon effects) and analytical methods for strategic analysis.
- o Identified technology objectives to support promising future strategic and theater nuclear system concepts.
- o Analyzed strategy for employment of the nuclear land-attack sea launched cruise missile in the theater role.
- o Use Navy Strategic Force Mix model to examine systems tradeoffs and evaluate submarine alternatives in future force mixes.
- o Conduct analyses of pre-, trans-, and post-nuclear exchange survivability, command and control, and targeting requirements of sea-based forces.
- o Evaluate TRIDENT II (D-5) employment options in a variety of scenarios.
- o Develop Navy Nuclear Warfare Simulation to analyze theater level campaigns of extended duration.
- o Evaluate anti-submarine warfare vulnerabilities of enemy and U.S. strategic submarines in the face of a varying anti-submarine warfare threat over time.
- o Determine the future theater nuclear roles for sea-based strategic reserve forces.

(U) The FY 1983 program consists of:

- o Continued development and use of Force Mix Model to account for phase-in and phase-out of strategic systems over time.
- o Expand development of the Navy Nuclear Warfare Simulation to analyze all naval nuclear warfare areas in greater detail.
- o Based on the theater roles for the sea launched cruise missile, determine their most cost-effective employment.

(U) For FY 1984, it is planned to continue:

- o Development and use of Force Mix Model to account for phase-in and phase-out of strategic systems over time.
- o Assessment of tradeoffs related to weapon configuration and operational requirements for current and future strategic sea based systems.
- o Investigation of effect of future targeting policy and plans upon weapon system trade-offs.
- o Evaluation of anti-submarine warfare vulnerabilities of enemy and U.S. strategic submarines in the face of a varying anti-submarine warfare threat over time.
- o Assessment of operational requirements for current and future sea-based strategic and theater nuclear forces.

(U) This is a continuing program.

Program Element: 65856N

Title: Strategic Technical Support

(U) Project Z1259, Hypervelocity Wind Tunnel, provides ground simulation of aerodynamic and aerothermal flight conditions required for design and performance evaluation of reentry bodies and hypervelocity interceptors. Provides ground test support for major strategic systems development such as TRIDENT II (Navy), MX (Air Force), Ballistic Missile Defense (Army), and, to a lesser extent, the Space Shuttle (NASA).

(U) In FY 1982,

- o Conducted design and performance testing for Army, Navy and Air Force reentry body and interceptor programs.
- o The tunnel currently has operating two parallel legs providing simulation at speeds of Mach 10 and Mach 14.

(U) The FY 1983 program consists of:

- o Initiation of ground test programs in support of TRIDENT II (D-5) reentry body system.
- o Study of advanced Air Force ballistic reentry bodies.
- o Continuing efforts to improve reentry simulation.

(U) For FY 1984, it is planned to:

- o Continue TRIDENT II (D-5) reentry body system support.
- o Initiate ground test programs in support of TRIDENT II (D-5) missile.
- o Study advanced Air Force ballistic reentry bodies and decoys.
- o Study advanced Army Ballistic Missile Defense interceptors.
- o Continue efforts to improve reentry simulation.

(U) This is a continuing program.

(U) Project N1767, NWC Strategic Studies Support, will provide the capability of analysing Naval Strategy and providing the CNO with specific recommendations for improvements in both strategy and the means by which the agreed strategy is executed. This effort brings strategic and tactical concepts together and provides Navy with the ability, for the first time, to test and evaluate these integrated concepts through war gaming techniques. By focusing on requirements related to strategy, doctrine and air/surface/subsurface tactics, integrated employment concepts can be developed and ultimately translated into investment and force allocation alternatives. The ultimate objective of this effort is to illuminate the missions, roles, uses and requirements of the Navy of the future.

(U) In FY 1983, its first year, the program consists of:

- o Providing support to the Naval War College Strategic Studies Group and Center for Advanced Research in furtherance of the stated objectives.
- o Advance the state of the art and science of war gaming techniques and methodologies by analysing wargame results.
- o Develop a capability for real time response to expressed CNO concerns with current strategy and/or tactics.

(U) For FY 1984, it is planned to:

- o Continue with stated objectives.
- o Develop base-line studies that result from the conduct of surveys, the collection and collation of data and the examination of integrated information considered essential to conducting strategic research.
- o Examination of projected U.S. economic trends in terms of expected shares of U.S., DoD, and Navy TOA, and to address the inter-relationship of the U.S. economy and the international economic environment.

(U) This is a continuing program.

I. (U) PROJECTS OVER \$10 MILLION IN FY 1984: None.