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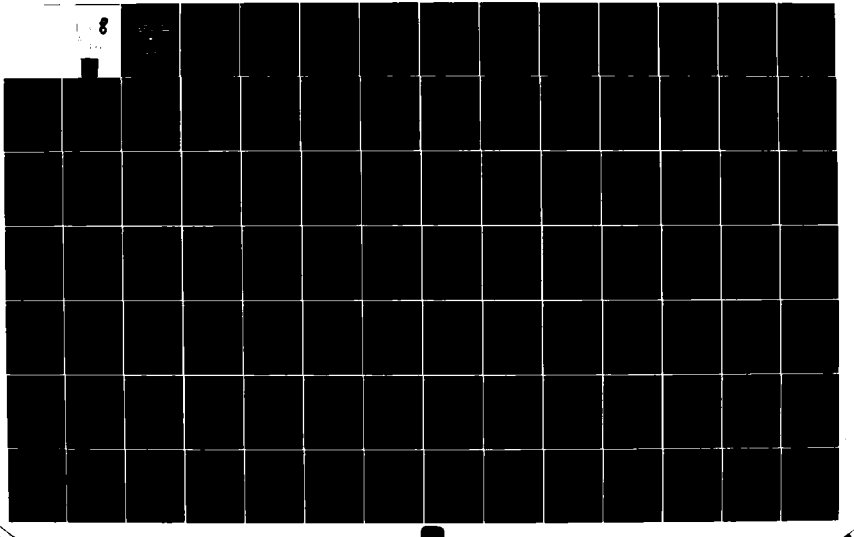

DEPARTMENT OF THE NAVY
SUPPORTING DATA FOR FISCAL YEAR 1983
BUDGET ESTIMATES DESCRIPTIVE SUMMARIES (U)

SUBMITTED TO CONGRESS FEBRUARY 1982

RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY

BOOK 1 OF 3 BOOKS

TECHNOLOGY BASE
ADV. TECHNOLOGY DEVELOPMENT
STRATEGIC PROGRAMS

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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RDT&E, NAVY
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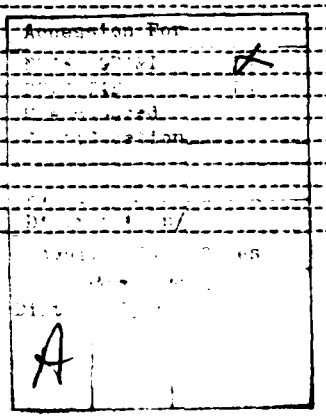
ELEMENT TITLE
SUB-ELEMENT OR PROJECT TITLE

TECHNOLOGY BASE



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DEPARTMENT OF DEFENSE, MILITARY
RDT&E, NAVY
FY 1983 RDT&E DESCRIPTIVE SUMMARY
February 1982

PREFACE

This is an information document designed for use by Congressional Committees in conjunction with FY 1983 Budget hearings on the Navy Research, Development, Test and Evaluation, Navy Program. This document contains a descriptive summary for each program element within the Navy FY 1983 RDT&E Program and for each program element which was funded in FY 1982 but not funded in FY 1983 due to cancellation or deferral of the program. Also included are descriptive summaries for projects of $5 million or more within an element in FY 1982 and/or FY 1983.

Where applicable, descriptive summaries may also include, in addition to RDT&E funds, related procurement costs and quantities, and funds for the Military Construction program.

Classified pages bear the appropriate security classification. Classified data is bracketed [thus].

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61152N
Title: In-House Independent Laboratory Research
DoD Mission Area: 510 - Defense Research
Budget Activity: 1-Technology Base

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

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
MR000-01	Navy Laboratories	832	839	944	1,064	Continuing	Continuing
RR000-01	Navy Laboratories	1,836	2,246	2,511	2,606	Continuing	Continuing
ZR000-01	In-House Laboratories	17,728	18,431	19,882	22,520	Continuing	Continuing

(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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: 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. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary result from a Congressional reduction to the FY 1982 budget. The FY 1981 and FY 1983 changes result from refined estimates.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	18,941	20,397	21,657	23,257	Continuing	Continuing
MR000-01	Navy Laboratories	784	832	852	918	Continuing	Continuing
RR000-01	Navy Laboratories	1,392	1,836	2,346	2,452	Continuing	Continuing
ZR000-01	In-House Laboratories	16,765	17,729	18,459	19,887	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: None.

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

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

(U) DETAILED BACKGROUND AND DESCRIPTION: In-house independent laboratory research provides a principal means for in-house laboratories and centers to initiate and conduct basic research in areas of science and technology related to their missions and needs of the Navy. Objectives are to quickly exploit ideas originating in the laboratories, enhance the productivity and expertise of in-house laboratories, and to attract and retain talented and creative scientists. The laboratory environment provides an opportunity for efficient and rapid technology evolution from concept to research to development.

(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 Department of Defense committees and with the National Institutes of Health and the National Aeronautics and Space Administration; oceanographic research with the National Oceanographic and Atmospheric Administration and the National Science Foundation. 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 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 official Department of Defense policy on Technology Transfer.

(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, Taipei, Taiwan; 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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A major advance was made in the prediction of armor penetration of a shaped-charge jet for a variety of armor systems. A submarine-adapted computerized patient monitoring system has been developed. Photodecomposed mercuric bromide was made to lase in the blue-green spectral region. Methods have been developed for rapid testing, data-recording and on-line data analysis of human brain wave responses to visual or auditory stimulation. The feasibility was demonstrated that a liquid prepolymer can be cured reproducibly to a rubber state by x-rays in the presence of energetic materials, to form a binder matrix. A light scattering technique has been successfully developed to measure microbubbles in the range of 10 to 100 microns in a water tunnel, which is a significant new tool for the dynamics of the cavitation process. A new procedure was developed for the quantification of carboxyhemoglobin and methemoglobin in blood, compounds that are indicators of fire gas intoxication. The value of hyperbaric oxygen therapy for restoration of normal function after spinal cord injury was demonstrated. It has been observed that

eye color can serve as a predictor of susceptibility to temporary and possible permanent hearing loss. A feedback control method was developed to assure high-quality weld properties in metals using infra-red sensing of weld metal cooling rates. A highly accurate finite-difference solution to the acoustic wave equation that includes variable sound velocity profiles and multiple layers (interfaces) in the ocean has been developed. A finite-element method, of extremely high accuracy, has been developed to compute the electric field on an axisymmetric shape moving in a fluid in the earth's magnetic field. Vanadium silicide microbridges have been fabricated which show Josephson Junction action at 8 degrees Kelvin. Operation at 10 degrees Kelvin is anticipated. Annealing procedures were developed for certain magneto-strictive amorphous ferromagnets which substantially enhance their transduction properties. Magnetomechanical coupling factors greater than 0.9, far surpassing that of currently used piezoceramics, have been achieved. A procedure known as the method of additive properties has been developed to accurately predict polymer properties. Two species of microorganisms have been shown to have morbidity to the economically important marine borer Limnoria. Both appear to comprise no threat to other types of marine organisms and thus have promise as a non-toxic mechanism for biological control of marine borers on Navy wooden structures in seawater. Fundamental investigations of the role of venting in internal blast phenomena, together with carefully controlled experimentation, have lead to significant improvements in the performance of reactive metal anti-ship missile warheads. A method for measuring the fatigue damage in aluminum under random loading has been developed using x-ray diffraction techniques. Investigations of the physical processes associated with damage to optical surfaces of metals and dielectrics caused by high intensity laser radiation, together with experimentation on optical surface finishing and multilayer dielectric film deposition technology, have yielded optical components with scattering reduced by an order of magnitude and with damage resistance improved several-fold over those previously available. An enhancement mode metal-insulator-semiconductor field effect transistor showing both good low frequency performance and microwave power gain has been fabricated. New algorithms and error models have been developed for estimating inertial navigation system errors with the new Global Positioning System. The first charge coupled device other than silicon has been built of indium phosphide which should have higher speed and hence wider applications than silicon devices. The nature of hot spots in an explosive has been identified in terms of specific molecular bond disruptions for the first time. Processing and filtering techniques have been devised to enhance submarine sonar signatures affected by mulitple bottom sediment layers. An experimental continuous wave doppler radar operating at 95 Ghz has demonstrated unique target identification and electronic warfare applications. Fourier-transform infra-red investigations have improved understanding of surface phenomena important to the understanding of explosives sensitivity.

2. (U) FY 1982 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.

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

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

3. (U) FY 1983 and 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 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61153N
Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research
Budget Activity: 1-Technology Base

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

Subelement No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	221,022	254,705	290,051	318,860	Continuing	Continuing
11	General Physics	26,696	30,479	33,853	36,897	Continuing	Continuing
12	Radiation Sciences	3,604	3,000	3,495	3,718	Continuing	Continuing
13	Chemistry	15,118	17,073	19,486	21,907	Continuing	Continuing
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	17,536	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this element is to sustain U.S. 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.

(U) BASIS FOR FY 1983 REQUEST:

Implement a research program that 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.

As this is a continuing program, funding in FY 1984 includes escalation and encompasses all work or development phases planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 PROGRAM ELEMENT DESCRIPTIVE SUMMARY: (Dollars in Thousands) The decrease of 394 in FY 1981 results from refinement of cost estimates including escalation indices. The reduction of 9,415 in the FY 1982 is due to Navy and Congressional reductions. *As a result of these reductions*, several major programs were either eliminated or reduced in size. Examples of these include:

* Alternate Weather Forecasting Techniques: (FY 1982 eliminated 600). A research program that would have examined physical mechanics by which solar events influence weather and climate changes. This could have enhanced battle group weather forecasting capabilities.
* Robotics and Advanced Automations: (FY 1982 reduction of 1000). A program to integrate the fields of robotics and artificial intelligence to provide the Navy with highly advanced automation in the areas of weapons systems design, fabrication and maintenance; expert consulting systems for other decision making; and autonomous robots for hazardous or dangerous tasks.
* Ultra Submicron Electronics: (FY 1982 reduction of 760). A research effort to examine electronic materials, fabrication processes, device properties, circuit design, systems architectures, etc., resulting in electronic components which are vastly more efficient, more compact, and more computationally powerful than currently planned electronic devices.

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

* reduced support for combinatorics (mathematical investigation of arrangements, operations, and selections of elements within large but finite systems);
* reduced efforts in classical operations research topics, such as scheduling and queueing;
* reduced support for research in Josephson Junction devices; and
* reduced support for research into radiation hardening techniques against single event upsets in very large scale integration circuits.

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ssion Area: 510 - Defense Research

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

ojected FY 1983 reduction of 23,208 is the result of reductions throughout the five-year planning process. Slight increases tain subelements reflect plans to optimize resource allocations for high priority programs in accordance with the research ng process. Emphasis will be given to multidisciplinary research projects which address key issues. New program starts for 83 include:

- Subelement 51 - "University Research Instrumentation". (FY 1983 funding of 10000). A new subelement will be established to address university equipment needs for major items (>100K per item). These equipment needs could not be satisfied under past funding levels which focused on individual principal investigators vice institutional needs.
- Digital Architecture for Very Large Scale Integrated Circuits. (FY 1983 funding of 1000). A basic research program to create a knowledge base and a set of computer-based tools to aid the design of special purpose Very Large Scale Integrated devices. This effort will provide digital architectures and algorithms for use in the DoD Very High Speed Integrated Circuit program.
- Learning And Memory. (FY 1983 funding of 1320). A multidisciplinary program to develop experimentally verified theories of neural network functioning that accounts for aspects of human perception, learning, and memory. This will make it possible to train individuals to very high skill levels in a minimum of time and to allow more of the work force to enter highly skilled job fields necessary to maintain and operate complex naval equipment.
- High Power Microwave Research. (FY 1983 funding of 700). A research program to develop the technical underpinning for the development of high power microwave sources and diagnostic schemes for atmospheric and target interactions. This effort will contribute to the accurate assessment of the potential for high power microwaves in electronic warfare, countermeasures, and weapon applications. This effort is tied to a substantial industrial Independent Research and Development program.
- Cooperative Research with CNM Laboratories. FY 1983 funding of 1250). A program to building up the basic research elements within the Naval Material Command laboratories and centers by bringing the Contract Research Program into closer working relations with the research in these laboratories.
- Enclosed Atmosphere Control. (FY 1983 funding of 500). An investigation to reduce submarine detectability.
- Chemical Warfare/Biological Warfare Defense. (FY 1983 funding of 1250). An effort to provide the technical base for long-range sensors/alarms necessary to detect CW/BW agents at sea and seawater compatible decontamination processes and materials.
- Naval Research Graduate Fellowship Program. (FY 1983 funding of 1000). A new program to provide Graduate Fellowships to encourage U.S. citizens to seek graduate education in selected areas of science and engineering considered critical to the Navy.
- Kilojoule Advanced Research Laser. (FY 1983 funding of 1500). Design and construction of a versatile high energy gas laser capable of both e-beam and discharge excitation which will provide a pulsed laser for damage studies and controlled energy deposition on surfaces. A variety of experiments in areas such as beam control, spectral control, and air control will be performed in support of strategic laser communication and directed energy weapons applications.

* Spacecraft Survivability. (FY 1983 funding of 800). An effort that will characterize the radiation/threat environment affecting spacecraft operation and identify mechanisms of component degradation. These efforts are required for the development of new techniques to enhance spacecraft survivability such as damage tolerant electronic devices and hardened power sources.
* Shallow Water Geologic and Acoustic Research. (FY 1983 funding of 300). A program to characterize geologic parameters such as bottom roughness, morphology, and sedimentation in shallow water environments and their effects on acoustic propagation.
* Airborne Acoustic ASW Processing and Tracking. (FY 1983 funding of 300). An effort to improve the performance of airborne, acoustic underwater surveillance by developing a systematic methodology for simultaneous optimization of processing and tracking which will permit earlier detection and quicker destruction of quieter, faster submarines.

Programs that started in FY 1981 and 1982 and are undergoing major expansions (greater than $1 million) in FY 1983. (The amounts shown are the increases to these programs in FY 1983):

* Science Base for Materials Processing. (FY 1983 funding expansion of 2943). Determine mechanisms affecting material micro-structure and its relationship to desired properties under conditions related to new materials processing techniques such as rapid solidification processing, electronic materials synthesis, and powder forming, thus taking advantage of the latest advancements in materials technologies in next generation systems.
* Energetic Materials Synthesis and Behavior. (FY 1983 funding expansion of 1829). Synthesis and characterization of advanced materials (high density "diamond-like" nitramines and energetic thermoplastic elastomers) for higher performance explosives and propellants; modeling of ultra-fast phenomena (inter- and intramolecular energy transfer) for predicting controlling susceptibility of an explosive or high energy propellant to detonation by accident or enemy action.
* Solid Dielectrics and Electrolytes. (FY 1983 funding expansion of 2074). Determine characteristics (such as conduction, electrolyte formulation, breakdown, and resonance) of polymeric ionic conductors and high dielectric constant materials which could allow development of solid state batteries and increased miniaturization in microelectronics.
* Life Assurance. (FY 1983 funding expansion of 1532). Identification and characterization of factors (such as wear and fracture mechanisms, contact fatigue, and NDE techniques) which affect life prediction methodologies for high performance materials in such applications as turbines and batteries.
* Marginal Sea Ice Zone Experiment. (FY 1983 funding expansion of 1400). Measurements and model development to determine effects of fronts, air-sea interaction, ice properties, and biological characteristics on ice ocean dynamics and acoustic propagation in the Marginal Sea Ice Zone in the eastern Arctic.

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

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

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 reallocation of resources from areas of reduced emphasis/terminated programs or completed/transitioned programs, including:

* low frequency magnetostrictive transducers (transitioned)
* linear fault analysis for digital electronics (transitioned)
* rechargeable lithium batteries for high energy density primary energy sources for lead acid battery replacement (completed)
* impact damage assessment methodology for composite aircraft structures (transitioned)
* development of an Air Deployed Oceanographic Mooring which has 200 sensors, usable for one year, having satellite relay data link (transitioned)
* advanced surveillance techniques including new tracking algorithms for E2C aircraft (transitioned)
* laser assisted metal working techniques to enhance productivity in the areas of welding, drilling, and heat treating (transitioned)
* incorporation of fog models into forecasting codes (completed)
* principles for designing 3-D displays for use in vehicle control and manipulator control (completed)
* diving physiology research (reduced emphasis/terminated)

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

* surveillance and tracking, target detection, identification and classification
* field effect transistor integrated optics
* ultra low-low glass fibers
* target strength/radiation sound
* extreme low frequency bioeffects
* propulsors and advanced solid propellant combinations
* ship hull - propeller interaction
* harbor shoaling/flow
* adhesion science/technology
* laser bioeffects
* bubble layer silencing and ASW acoustic/non-acoustic research

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

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

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	196,000	221,416	264,120	313,259	Continuing	Continuing
11	General Physics	23,925	26,743	31,424	34,970	Continuing	Continuing
12	Radiation Sciences	3,091	3,625	3,886	4,442	Continuing	Continuing
13	Chemistry	11,468	15,177	17,706	21,379	Continuing	Continuing
14	Mathematical Sciences	15,297	18,742	23,348	29,036	Continuing	Continuing
21	Electronics	19,378	22,471	27,960	33,618	Continuing	Continuing
22	Materials	18,214	19,954	24,315	28,126	Continuing	Continuing
23	Mechanics	13,747	14,919	18,349	21,346	Continuing	Continuing
24	Energy Conversion	9,092	8,478	10,471	12,922	Continuing	Continuing
31	Oceanography	39,322	43,310	51,718	57,862	Continuing	Continuing
32	Terrestrial Sciences	11,207	12,771	15,106	19,676	Continuing	Continuing
33	Atmospheric Sciences	5,701	6,251	7,282	8,168	Continuing	Continuing
34	Astronomy and Astrophysics	4,270	3,929	4,276	4,813	Continuing	Continuing
41	Biological and Medical Sciences	15,052	16,372	18,763	24,099	Continuing	Continuing
42	Behavioral and Social Sciences	6,236	8,674	9,516	12,802	Continuing	Continuing

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

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

(U) DETAILED BACKGROUND AND 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
* Radiation Sciences
* Chemistry
* Mathematics
* Electronics
* Materials
* Mechanics
* Energy Conversion
* Oceanography
* Terrestrial Sciences
* Atmospheric Sciences
* Astronomy and Astrophysics
* Biological and Medical Sciences
* Behavioral and Social Sciences

(U) RELATED ACTIVITIES: See individual Subelement Descriptions.

(U) WORK PERFORMED BY: Performers include various university, industry, not-for-profit institutions, and in-house laboratories. About 50% of the funding goes to universities, 38% to in-house, and 12% to industry. See individual Subelement Descriptions.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Significant progress has been made in many areas of the research program. The following provides a highlighted list of these accomplishments:

* operated and applied the first submicron resolution cryogenic scanning acoustic microscope;
* produced new computer data base architecture ideas which, in simulations, show dramatic improvements in speed and throughput over previous designs;
* demonstrated the use of surface heat pulses and active feedback control for the cancellation of naturally occurring instability waves in laminar boundary layer flows which could have an enormous impact on retarding the transition to turbulent flow with reductions to fluid dynamic drag and self noise of ships and submarines;
* established the potential for acoustic tomography as a technique for acoustic remote sensing of internal ocean dynamics by performing experiments which verified the stability and identification of acoustic paths and related travel times;
* determined the strength of gradients of physical parameters across ocean fronts using the Ocean Fronts Experiment in the North Central Pacific;

* synthesized new electrostrictive materials for transducer and microdisplacement applications, such as high sensitivity sonar sensors;
* established a new field of research in conducting polymers with potential applications, including the development of high energy density batteries and lightweight camouflage, shielding, and electronic materials;
* produced a primary reference catalog of astronomical x-ray sources which will contribute to increased navigational reliability under adverse conditions requiring nonvisible light navigation;
* demonstrated the feasibility of new signal processing technique, minimum cross entropy, which will improve communications in jamming and high density signal environments;
* demonstrated a technique for electronically stimulating organized regeneration of mammal bone and nerve tissue;
* demonstrated the use of Solar Wind Satellite coronagraphy data to study causes of magnetospheric/geomagnetic responses, an approach which will allow the observation of coronal plasma irregularities and the ejection of coronal clouds from the sun resulting in improved ability to predict communication disruptions;
* identified linkages between encoding, processing, and response modalities and refined methods for predicting information processing workload;
* completed research in rechargeable lithium batteries for high energy density primary energy sources for lead acid battery replacement; and
* developed principles required to design 3-D displays for use in vehicle and manipulator control systems.

Examples of research projects that have been completed during FY 1981 and transitioned into either Exploratory Development, Advanced Development, or other activities include:

* completed an assessment methodology for impact damage of composite aircraft structures; transitioned to Exploratory Development;
* completed the open ocean version of an Air Deployed Oceanographic Mooring which has 200 sensors, is usable for one year, and has a satellite relay data line; transitioned to Advanced Development;
* completed research in laser assisted metal working techniques to enhance productivity in welding, drilling, and heat treating; transitioned to manufacturing technology;
* completed research in low frequency magnetostrictive transducers using single crystal and polycrystalline materials; transitioned to Exploratory Development; and
* completed research in linear fault analysis for digital electronics; transitioned to Exploratory Development.

Additional FY 1981 accomplishments are provided in individual Subelement Descriptions.

2. (U) FY 1982 Program: See Individual Subelement Descriptions.

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

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

3. (U) FY 1983 and FY 1984 Planned Programs: 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 Title: General Physics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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; atomic and molecular physics; radiation, optics and laser physics; physical and underwater acoustics; geophysics, plasma and ionic physics; and superconductivity.

(U) RELATED ACTIVITIES: 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, 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; 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 participation in 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.

(U) WORK PERFORMED BY: (Representative) (1) Academic: University of California, Berkeley, CA; Massachusetts Institute of Technology, Cambridge, MA; University of Arizona, Tucson, AZ; University of Illinois, Chicago, IL; University of Texas, Austin, TX; (2) Industrial: United Technologies, East Hartford, CT; IBM Research Laboratories, Yorktown Heights, NY; Science Applications, Inc., Palo Alto, CA; (3) Non-Profit: SRI International, Menlo Park, CA; American Institute of Physics, New York, NY; (4) In-House: Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Silver Spring, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Accomplishments under this subelement include: essential contributions to infrared and laser technology, cryogenics, superconductivity, magnetic materials and sensors, transducer technology and high temperature acoustics, gas discharge devices, and assessment of nuclear weapons effects; relativistic electron beam techniques for generation of high power microwaves, millimeter and infrared waves; rare gas halide lasers with efficient Raman conversion to visible

wavelength; selective separation of rare earth elements from liquid solution via laser photoreduction; magnetic mirrors for the ring laser gyroscope; and achievement of coherent emission from Josephson Junction arrays for frequency synthesizer applications. Demonstration of high power laser beam improvement technique by Stimulated Raman; first radio frequency transversely excited excimer laser; discovery of a new phase in n-alkane and pressure induced changes in energetic chemical solutions; determination of physical mechanisms responsible for decomposition of energetic materials using picosecond optical pulses; drawing of fluoride glass fibers from materials with potential for extremely low attenuation; demonstration of laser-induced charge-transfer collisions; operation and application of the first submicron resolution cryogenic scanning acoustic microscope; demonstration of very high speed switching (picoseconds) in electronic devices by modelocked lasers; improved radiation hardness in optical fibers by photobleaching; generation of 1 megawatt at a wavelength of 400 micrometers with a free electron laser; theory of electromagnetic radiation at very low frequency and at kilometric wavelengths from the quiet and disturbed auroral arcs; successful fabrication of a 400 Josephson Junction series array for digital superconductive electronic studies; construction of a unique miniature non-magnetic 4.2 degree Kelvin cryocooler; demonstration of the role of surface roughness in the gigantic enhancement of Raman Scattering from adsorbed molecules on metal surfaces; clarification of processes involved in Kapitza resistance; determination of structure of metallic glasses; T-matrix methods for scattering from submerged objects; developed new two-stage spatial filter; developed a unified matched filter theory; first demonstration of optical discrete Fourier transform processor; first demonstration of optical calculation of Hankel transforms; developed an acoustically modulated fiber optic interferometer for radiation absorption measurements; first successful experiment and validated theory of photo-excited mercury cadmium telluride mobilities; first demonstration of resonant pumped cascade solid state lasers; and first rare earth laser transition longer than 3 micron - 3.9 micron in holmium; first dual wavelength laser (0.75 and 0.85 micron) using two rare earth activators; demonstration of continuous wave laser action of the first special color center, (F_2^+) A, in lithium doped potassium chloride; discovery and characterization of (F_2^+) A centers in potassium brouride, potassium iodide, and rubidium iodide (RbI); and achievement of broadly tunable laser action beyond 3 micron from (F_2^+) A centers in lithium doped potassium iodide.

2. (U) FY 1982 Program: Current research under this subelement maintains emphasis in areas considered to be of continued importance to the Navy: Solid State Physics - efforts focus on basic electronic, magnetic, optical, structural, and thermal properties of solids offering potential for improvements in navigation, communications, surveillance, and electronic warfare systems; emphasis continues on the electronic structure of semiconductors with emphasis on surfaces, interfaces and defects; new emphasis on computations of thermodynamic properties from first principle models; investigation of the physics of random systems with new thrust in macromolecular physics and picosecond laser spectroscopy of semiconductors. Atomic and Molecular Physics - continued investigation of atomic and molecular species to understand their properties and effects on systems in the military environment and to facilitate their optimum utilization for design of new systems; new emphasis is on low-temperature hydrogen masers; reconciliation of theoretical limits with experimental results for laser cooling of trapped ions; measurement of vibrational-rotational linewidths to permit a test of procedures to obtain detailed state-to-state rotational relaxation rates; determination of inelastic cross sections for collisions involving Rydberg atoms; and structural investigations of intercalated

compounds, of metallic glasses, of materials important to energy problems, and of substances of interest in physiological oxygen transport. Radiation and Optics, and Laser Physics - continued emphasis on efforts to improve efficiency, stability, and lifetime of laser sources, especially in the blue-green region; investigation of new approaches for coherent sources, filters and detectors for the blue-green, vacuum ultraviolet, and x-ray regions; utilization of ultra-short-pulse tunable laser sources for investigations of transient effects in matter and in photo-chemical reactions; investigate optical processors for Electronic Warfare, Radar, and Sonar applications; examination of radiation damage susceptibility of materials, which may be exposed to severe radiation, and investigation of methods to reduce this susceptibility; new emphasis on evaluation of critical issues in two-stage low-voltage free-electron lasers as potential high power tunable sources; examine color center lasers far beyond 4 micron for continuous wave and flashlamp pumping measurement of kinetic rates limiting new pulsed laser concepts; development of non-silica glasses for ultra-low-loss fibers; investigation of noise sources in fiber optic systems; surface-enhanced Raman effect studies; investigation of non-linear optical techniques for microscopy of biological materials; evaluation of conjugate wave processing techniques for correcting optical inhomogeneities in gaseous lasers and other media; and investigation of laser gas cooling techniques for study of condensation phenomena. Acoustics - continuing emphasis on fundamental acoustic phenomena, techniques and devices; investigation of calibration methods for parametric transducers, spectral interactions, and elastic constants of solids; techniques for acoustic nondestructive evaluation of materials and structures; evaluation of the interaction of acoustic waves with complex submerged objects; investigation of anechoic and decoupling materials and mechanisms; description of the interaction of acoustic waves with a medium having complicated sound speed structure and topographical boundaries; investigation of optical techniques for sound field visualization and for acoustic detection; new emphasis on determination of internal structure and dynamics of media from analysis of propagation of acoustic signals. Plasma and Ionic Physics - continuing efforts on interactions of electrons, ions, molecules, atoms, and photons involved in ionospheric processes, pulsed power techniques, gas discharge devices, and laser systems; on autoacceleration and automodulation of intense relativistic electron beams; on collective acceleration of ions and collective wave generation via free-electron laser and maser amplifying mechanisms for powerful, tunable, and compact radiation sources; and on examination of propagation of electron and ion beams in air. Superconductivity - continued effort on characterization of arrays of superconducting junctions in terms of parameters important for applications such as parametric amplification, frequency conversion, logic switching, information storage; on sensitive, broadband magnetic and electromagnetic sensors; on a search for higher-transition-temperature and higher-critical-magnetic-field superconductors; new emphasis on the properties of sub-micron, thin-film, homogenous and inhomogenous superconductive materials for device applications.

3. (U) FY 1983 and FY 1984 Planned Programs: The major program thrusts will be maintained with adjustments as follows: Solid State Physics - extension of the first principles program for calculation of thermodynamic properties of crystalline materials to include ceramics; utilization of nonlinear laser spectroscopy as a means to obtain quantitative measurements of elementary excitations and electronic defects in semiconductors; calculations of electronic properties of defects and defect clusters in semiconductors as related to device performance; investigations of solid state aspects of ultra submicron electronics;

Subelement: 11 Title: General Physics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

increased effort on macromolecular physics; investigations on random systems directed to problems of energy transport, and to elucidation of alloy properties; and synthesis of novel stable and metastable magnetic materials and structures including the preparation of composite materials by molecular beam epitaxial techniques for application to microwave and optical devices; studies of laser initiated chemical reactions at semiconductor surfaces. Atomic and Molecular Physics - evaluation of candidate ions for stored ion spectroscopy applications to precision timing; investigation of the performance of a superfluid-helium-wall hydrogen maser; an attempt to apply laser cooling techniques to a neutral atomic/molecular beam; studies of state changing collisions for Rydberg atoms interacting with ions and electrons; application of laser techniques to the determination of cross sections and rates for atomic and molecular collisions; development of understanding of the atomic and molecular processes involved in explosion initiation in energetic materials; and x-ray, electron, and neutron diffraction structural determinations of device materials, antibiotics and energetic materials. Radiation, Optics and Laser Physics - Investigate real-time image processing techniques; development of compact high performance optical processors; investigate non-linear and magnetic effects for optical processors; theoretical and experimental analysis of saturation and absorption in selected narrow gap materials; calculation of optical heating in extrinsic silicon at 5° K; demonstration of extremely broad laser action using crystals containing multiple lasing species; application of tunable color center lasers towards fundamental problems in spectroscopy; investigate new lasers using resonant pumping; investigate mid-infrared laser sources using flashlamp pumped rare earth doped solids; attempt to achieve laser gain in the extreme ultraviolet; application of conjugate wave processing techniques in optical and real-time holography; development of Kilojoule excimer lasers; determination of limitations for laser chemistry imposed by basic molecular physics considerations; development of materials for higher speed and higher efficiency optical microcircuits; investigate optical limiter concepts for optical countermeasure applications; and investigation high speed semiconductor devices using picosecond optical probes; and development of new fluoride glasses for ultra-low-loss optical fibers. Acoustics - emphasis on fundamental research in nonlinear acoustics; development of acoustic techniques for measurement of physical properties of various liquids and solids; investigations of higher resolution scanning acoustic microscope through use of lower cryogenic temperatures; increased emphasis on acoustic field and tomographic visualization including techniques for imaging three-dimensional fields; increased emphasis on techniques for control and analysis of acoustic scattering by complex submerged objects; and advanced approaches to underwater acoustic transducers, anechoic coating (acoustic decoupling), materials technology, target echo exploitation, and underwater acoustic propagation as influenced by ocean dynamics. Plasma and Ionic Physics - continue emphasis on electron beams; search for new sources of pulsed electromagnetic power over broad spectral regions; investigate new types of compact high-gradient electron and ion accelerators; examine compact energy storage concepts such as homopolar generators; and computer model the dynamics of coupled plasma systems. Superconductivity - increased emphasis on the properties of sub-micron, thin-film, homogenous and inhomogenous superconductive materials and on new concepts for miniature cryocoolers; and continued emphasis on digital superconductive devices and systems.

Subelement: 11 — Title: General Physics
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 11	General Physics	26,696	30,479	33,853	36,897	Continuing	Continuing

Subelement: 12 Title: Radiation Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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. The Radiation Sciences Subelement addresses the problems associated with these radiation environments in the following ways: (i) our understanding of the basic physics of the interactions of x rays and charged particle beams with matter and the production of damage by these radiations in materials and devices is extended by both experiments and development of the theory, (ii) the vulnerability of advanced materials and devices is measured by actual testing with radiation sources, and (iii) measurements are made on the characteristics of various radiation sources to improve our understanding of how hostile radiation environments can be simulated in the laboratory. The Radiation Sciences Subelement also explores ways in which radiation can be used beneficially either to analyze materials and surfaces or to modify their properties. In addition, experimental and theoretical work is performed under this subelement on advanced concepts for measuring the intensity and energy spectrum of radiations in various military applications.

(U) RELATED ACTIVITIES: The research in this Subelement is coordinated by several means: through Department of Defense reviews sponsored by the Under Secretary of Defense for Research and Engineering; through collaborative efforts between scientists from DOD, other government, private industry and university laboratories; for example electron and x-ray transport calculations with the Air Force Weapons Laboratory and the National Bureau of Standards; analysis of amorphous surface layers on metals produced by laser irradiations with Bell Laboratories; and hydrogen embrittlement of metals with Pennsylvania State University; through close relationships between research projects and applied problems; for example charge recombination in insulators as a function of photon energy - these results are related to work on radiation hardness sponsored by the Defense Nuclear Agency; and through representation on technical committees and working groups such as the Defense Nuclear Agency Program Review Committee for Transient Radiation Effects in Electronics, the National Aeronautics and Science Administration - Air Force Space Division Space Parts Working Group, and the DOD - National Science Foundation - Department of Energy Interagency Advanced Power Group.

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Surface properties of metals (such as sliding wear resistance, fatigue resistance, and corrosion resistance) have been found to be substantially improved by the implantation of selected ion species to relative atomic concentrations of about 10% to 20% in the outermost 25 nano-meters to 100 nano-meters of the material. A transition of some of the ion implantation research to 6.2 Exploratory Development was made and was followed by the installation of implanted bearings into Navy service aircraft for fleet testing. These bearings were implanted with chromium and phosphorus ions to impede corrosion during periods when the aircraft are idle. It was demonstrated for the first time that single event upsets can occur in dynamic random access memories and microprocessors when such devices are irradiated with high-energy neutrons or protons.

Subelement: 12 Title: Radiation Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

Quantitative single event upset susceptibility measurements were made for high-energy neutrons, protons, and photons from laboratory accelerators used to simulate radiations from nuclear weapons and those found in space. A 2.5 micrometer diameter beam of energetic ions was used to examine the single event upset sensitivity of individual cells in 16K dynamic random access memories. An important new effect was observed namely that the susceptibility of a microcircuit to single event upsets is increased by the accumulation of total ionizing dose in the device. Bremsstrahlung induced energy straggling in intense electron beams was shown to affect electron beam propagation characteristics significantly. Monte Carlo calculations on radiation damage mechanisms showed, contrary to a long accepted model, that the character of collision cascades and damage clusters changes entirely if the channeling effect in crystal lattices is taken into account. A new technique was developed whereby explosives are initiated by high energy electron beams; this technique has made it possible to perform definitive experiments on the initiation stages. The effects of alpha particle irradiations were observed for the first time on superconducting Josephson tunnel junctions. A new photoelectron technique for analyzing highly excited states of matter with synchrotron radiation was demonstrated. This technique was successfully applied to materials irradiated with a pulsed laser. Unique wide-range x-ray optics were designed for synchrotron radiation beam lines to be utilized jointly by Naval Research Laboratory and National Bureau of Standards at the National Synchrotron Light Source at Brookhaven. A multimillion degree plasma x-ray source involving implosion of a hollow cylinder of gas was constructed and tested. The photon energy dependence of radiation effects in metal oxide semiconductor devices was found to obey a model based on electron-hole recombination; previously these radiation effects were thought to be independent of photon energy. High sensitivity direct atom counting of tritium gas was successfully demonstrated at the Naval Research Laboratory cyclotron. Radiation damage and space performance of a number of advanced types of solar cells, including gallium arsenide cells, were measured, for the first time in an actual space environment, on the Navy Technology Satellite #2. A new formulation of the theory of free electron lasers was developed. An analysis technique using optical emissions from sputtered ions has been developed and investigated. The electronic structure of point (vacancy) defects in aluminum was computed.

2. (U) FY 1982 Program: Effective October 1, 1982, several ion implantation work units were transferred from the Radiation Sciences Subelement to a new task area entitled: "Ion Implantation for Materials Processing," in the Materials Subelement. Selected results of the ion implantation effort are also being transferred to a new Manufacturing Technology Effort. For these reasons the FY 1982 Program described here will be somewhat different from that outlined in the previous program element descriptive summaries. On the occasion of this transfer it should be noted that ion implantation research in the Navy was initiated under the Radiation Sciences Subelement and developed to the point where the importance of its application to a wide variety of materials was successfully demonstrated. The FY 1982 program will include the following areas: Techniques will be developed to extend the application of ion beam analysis tehniques to foreign species and host combinations not now feasible; one such new procedure will be to detect x-rays or gamma rays in time coincidence with scattered incident ions. The high energy charged particle microbeam will be used to examine radiation damage, ionization effects, and single event upset mechanisms in 64K dynamic random access memories and microprocessors and in specially designed microstructures. Single particle effects and neutron

amage investigations will be conducted on superconducting Josephson tunnel junction devices. Heavy cosmic ray fragmentation ontributions to spacecraft radiation environments will be investigated experimentally and theoretically. The effects of intense lectron beams on energetic materials, metals, composites, and ceramics will be examined. Theoretical calculations will be made n radiation damage in various materials produced by nuclear weapons, space radiations, and directed energy weapons. The ollisional and radiative decomposition of explosive molecules will be examined theoretically. Interactions of high energy lectron beams with periodic magnetic structures will be investigated at the Naval Research Laboratory Linear Accelerator (Linac) s a possible source of intense coherent radiation. Survivability of multi-kilowatt power sources for satellites will be analyzed ith respect to nuclear and space radiations and lasers. Methods of improving the sensitivity of direct atom counting of tritium n the Naval Research Laboratory cyclotron will be evaluated. A new technique for detecting magnetic resonances optically will be sed to obtain new microstructure information on radiation induced defects in various compound semiconductors. Laser induced lasma and annealing processes in semiconductors will be characterized by means of synchrotron radiation and the newly development xcited state photoelectron technique. The electronic and optical properties of semiconductor microstrutures will be assessed. he initial phase of beam line design and construction for Navy use at the National Synchrotron Light Source, Brookhaven, will be ompleted. Investigations will be started with synchrotron radiation on x-ray Raman scattering, production of submicron tructures, and calibration of x-ray instrumentation. A new soft x-ray source will be used to measure spectra from materials being nvestigated theoretically by band structure techniques. The electronic and atomic structure of point imperfections, important in adiation damage, will be completed and will include relaxation effects. Examinations of x-ray emission from mixed composition lasmas will be performed with both the gas implosion source and a new high power laser source. Improved calculations of the adiation of free electron lasers will be made. New theoretical approaches to the calculation electron channeling trajectories ill be developed.

3. (U) FY 1983 and FY 1984 Planned Programs: The techniques of materials analysis by means of ion beams will be applied to roblems requiring three-dimension non-destructive microanalysis of surface layers, such as those of advanced semiconductor evices or ion-implanted metals. The microbeam at the Naval Research Laboratory 5 megavolt Van de Graaff will be developed into a ulsed beam and will be used to study time dependence of damage and ionization effects in integrated circuits and in specially esigned microstructures. The use of the semi-empirical reaction model will be extended to study reactions in spacecraft aterials produced by high energy protons in the trapped radiation belts. Radiation effects experiments and theoretical investigations will be initiated for variety of new types of sensors fabricated with integrated circuit tehniques. Atomic ollision theory will be applied to analyze the production of radiation damage, sputtering, ion beam mixing and other effects roduced by energetic particle beams. The production of tunable electromagnetic radiation from the interaction of relativistic lectrons and periodic magnetic structures will be studied. Examinations of radiation induced defects in quaternary emiconductors will be initiated. The effects of defects on compound semiconductor alloy systems will be investigated. The elationship between radiation induced defects in semiconductor materials and the performance characteristics of devices made from hose materials will be studied. Nonlinear stability investigatons will be made of electrons in undulator structures and will be

Subelement: 12 — Title: Radiation Sciences
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

related to free electron laser experiments. 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 using the Naval Research Laboratory facilities at the National Synchrotron Light Source. Laser damage to exterior satellite components will be analyzed and new tehniques for hardening such components will be examined. 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. Interactions between adjacent radiation induced point defects will be examined theoretically, with applications to diffusion, annealing, and ion-induced materials modification. Synchrotron radiation will be used as a pump for parametric conversion processes in single crystals, for materials structural investigations and for calibration of plasma instrumentation.

4. (U) Resources

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 12	Radiation Sciences	3,604	3,000	3,495	3,718	Continuing	Continuing

Subelement: 13 Title: Chemistry
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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; analytical techniques to solve material and environmental problems; and chemical theories related to the above.

(U) RELATED ACTIVITIES: Coordination is maintained through the Office of the Under Secretary of Defense for Research and Engineering reviews and with the Army, Air Force, National Aeronautics and Space Administration, National Science Foundation, Department of Energy, and National Institutes of Health by exchange of information on proposals and actions taken on them, and by regularly scheduled meetings and reviews at which representatives of the agencies discuss interests and problems of their respective programs. 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.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Research Laboratory, Washington, DC. (2) Industrial: IBM, Yorktown Heights, NY; Lockheed Missiles & Space Co. Inc., Palo Alto, CA; Union Carbide Corporation, Tarrytown, NY; EIC Laboratories, Inc., Newton, MA; (3) Academic: 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:

1. (U) FY 1981 and Prior Accomplishments: Past accomplishments include the following: Theoretical understanding and predictive capability have been attained for the wettability of solids which led to numerous applications, including the invention of barrier films for retaining oil in ball bearings. These barrier films have markedly improved the reliability and readiness of missiles and continue to yield large savings in replacement and repair costs for navigational aids in aircraft. A program for research in boron chemistry led to the receipt of the Nobel Prize in Chemistry for one of the participants (W. N. Lipscomb, Harvard). This program laid the chemical foundation for the current use of a boron compound as a propellant burning rate accelerator which significantly improves weapon effectiveness. Some recent accomplishments include the following: 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). Initial funding of research on polyacetylene led to the establishment of a new research field: conducting polymers. Some of 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, while an ongoing naval research effort promises lightweight camouflage, shielding materials, and electronic materials. Novel catalysts have been patented which utilize polymer support in a synergistic way for high reactivity. These improved catalysts have proved effective for the incorporation of carbon monoxide into useful organic compounds. This work points a way to improved atmospheric control and to improved processes for naval 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. Research on chemiluminescent materials for marking and emergency light sources has provided the highest, nonenzymatic chemiluminescent quantum yield ever reported, namely 34 percent versus the previous record of 24 percent. Rechargeable lithium batteries with capacities up to twenty ampere-hours have been prepared on a laboratory scale. These batteries have cycle lives of about fifty cycles. These results suggest that rechargeable lithium batteries having specific energies which exceed those of existing rechargeable batteries by factors of up to ten can be developed. A triple quadrupole mass spectrometer has been invented and is being developed for atmospheric monitoring and analysis. This instrument which is patented, has elicited considerable interest from commercial instrument manufacturers, Navy laboratories and National Aeronautics and Space Administration.

2. (U) FY 1982 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 thick films for underwater acoustic applications and promising new materials; work on novel conducting metal complexes which have potential for improving electro-optical devices and electrochemical processes. The improvement of environmentally stable polymers continues to receive emphasis, including: improved coating systems and toughened adhesives; aging and curing work to improve service life of composite matrix materials; improved fire-resistant organic plastics obtained by incorporation of fire retardant pendant groups on the polymer backbone. The conversion of polymers directly to ceramic materials (e.g., silicon carbide) continues to be pursued, with the objective to provide 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 being expanded 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. In analytical chemistry, advanced chemical instrumentation to investigate the composition, performance and stability characteristics of materials will be stressed. Non destructive evaluation methods for examining the cure states of polymers by nuclear magnetic resonance techniques will be investigated. Rapid methods for the analysis of selected trace metals, dissolved organic materials and chemical agents in seawater will be investigated. The Surface Chemistry program will continue to emphasize the chemical, structural and electronic properties of interfaces by addressing research areas that include surface corrosion, passivation, adhesion and lubrication, catalysis and heat transfer. Optical techniques for surface analysis will be examined with emphasis on instrumentation for in situ chemical characterization of solid/solid and fluid/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 laser stimulated surface chemical processes will be initiated. The wear resistance to laser-sprayed and other coatings will be investigated. In the Electrochemical Power Sources area, research to determine the electrochemical properties of solid dielectrics, polymer based ionic conductors and electrolytes relative to their application to power sources will be expanded. Research will be continued on the mechanisms of lithium cell charge and discharge processes and the interactions of lithium cell with electrolyte solutions. Research on the electrochemical fundamentals necessary to develop a battery lifetime predictive capability will be initiated.

3. (U) FY 1983 and FY 1984 Planned Programs: In Chemical Materials, emphasis on environmentally stable polymers including elastomers and thermosets will continue. This will include the synthesis and evaluation of environmentally resistant coatings, composite materials and adhesives. Polymer research on novel processing methods such as cryogenic processing will be initiated to provide new options for dealing with polymers which are difficult to process; emphasis will also be placed on nonequilibrium aspects of processing. A new program will be initiated on carbon dioxide chemistry as it pertains to the control of atmospheres in submarine vessels. Research on Electroactive Materials 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. 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 Surface Chemistry research related to the chemistry of electronic materials and microstructural fabrication will continue to be stressed. This research will include material synthesis, cluster properties identification, chemical analysis of electronic materials, and work on the fabrication and characterization of micron-sized electrodes. The new experimental program on laser stimulated surface chemical processes will be expanded. Research on the fundamentals necessary to provide a battery state-of-charge and lifetime predictive capability will be continued. Solid electrolytes and their applicability to power sources and other devices will receive increased attention. The electrochemistry of semiconductor materials will continue to be investigated as it affects semiconductor performance as photodetectors and optical frequency converters, and for photoetching applications. Research to elucidate the fundamentals of electrode processes and their influence on power source performance and reliability will continue.

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

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

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 13	Chemistry	15,118	17,073	19,486	21,907	Continuing	Continuing

Subelement: 14 — Title: Mathematical Sciences
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: This subelement comprises research directed towards solving mathematical and analytical problems in the functional military areas of logistics, manpower, intelligence, acquisition and procurement, systems and operations analysis, and command and control; and towards providing new mathematical 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 analytical 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 and information processing systems devices. The effort is conducted in the areas of numerical analysis, mathematical programming, statistical modeling and analysis, digital computer simulation, reliability theory, applied mathematics, systems and control theory, artificial intelligence and robotics, computer hardware and software, logistics and operations research, decision theory and mathematical economics.

(U) RELATED ACTIVITIES: This research relates to efforts in the Army, Air Force, Defense Advanced Research Projects Agency, National Science Foundation and the National Aeronautics and Space Administration. Active liaison is maintained with these agencies through regular professional communication, through annual formal meetings such as 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 Navy exploratory development programs under the Naval Material Command in ship performance evaluation, manpower, logistics and command and control, and with the advanced development studies and analysis programs of the Chief of Naval Operations and the Planning, Analysis and Evaluation Office of the Department of Defense.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Ocean Systems Center, San Diego, CA; Naval Surface Weapons Center, Silver Spring, MD; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Research Laboratory, Washington, DC. (2) Industrial: Systems Control Inc., Palo Alto, CA; Alphatech, Inc., Cambridge, MA; Bolt, Baranek and Newman, Cambridge, MA; Daniel Wagner Associates, Paoli, PA; (3) Non-Profit: SRI International, Menlo Park, CA; (4) Academic: New York University, New York, NY; Georgia Institute of Technology, Atlanta, GA; University of Southern California, Los Angeles, CA; Yale University, New Haven, CT; University of Pennsylvania, Philadelphia, PA; Purdue University, West Lafayette, IN; Carnegie-Mellon University, Pittsburgh, PA; Massachusetts Institute of Technology, Cambridge, MA.

1. (U) FY 1981 and Prior Accomplishments: Previous research in this program has led to logistics system improvement and material maintenance management system policies and procedures now used by the Fleet; computer components such as magnetic core memories; and control system concepts for aircraft and missiles. Computer processing techniques have enabled the Navy to allocate manpower resources more effectively and have led to changed Marine Corps recruitment policies. More recent accomplishments include a

Subelement: 14 Title: Mathematical Sciences
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method of calculating lower bounds on reliability that is being used to investigate highly reliable systems; the development of a theory of aggregation useful in modeling and analyzing large, complex systems, which puts many ad hoc techniques on a rigorous foundation; an approach to distributed decision modeling which is being applied to describe decision making under the Composite Warfare Commander doctrine; an improved tracking algorithm which is being further developed for incorporation into the E2C surveillance aircraft for surface ship tracking; new data base architecture ideas which in simulations show dramatic improvements in speed and throughput over previous designs; and an extension of so-called adaptive schemes for the numerical solution of hyperbolic partial differential equations, the equations used to model many time-dependent fluid flow problems of Naval interest. Adaptive schemes contribute to the more accurate and rapid solution of such equations and are important in attempts to automate solution computation. Non-procedural languages have been successfully developed for financial accounting and budgeting applications. Research in natural language has led to systems currently entering the commerical market place. Methods developed for identifying and estimating jumps in parameters are being applied to fault tolerant control and cruise missile problems. Improved computational methods have been developed for determining flow fields around complex objects above, on or below the water surface. New optimization methods have been developed for problems in production and distribution modeling including design and evaluation of storage alternatives under criteria of floor space utilization and material handling time and new concepts in job-shop production scheduling.

2. (U) FY 1982 Program: Research in Numerical Analysis will continue to emphasize methods applicable to problems in mechanics. It is planned to initiate a center for large scale scientific computing to integrate the research efforts of numerical analysts, computer scientists, and computational mechanicians. In-house efforts to develop numerical methods for prediction of ship hydrodynamic performance will continue to receive emphasis. Adaptive methods for efficiently solving partial differential equations will receive increased attention. Analysis of algorithms will be pursued for enhanced Very Large Scale Integration and other highly parallel architecture designs for applications in signal processing and computational mechanics. Research in combinatorics and complexity will receive less attention. Mathematical Analysis for use in space systems applications such as surveillance, communications, navigation and environmental monitoring will be pursued. Particular emphasis will be given to problems associated with improved orbit determination, control of large structures in space, image analysis and enhancement, and nonlinear waves. Basic research in Artificial Intelligence will continue to pursue advances in Navy interest areas of providing machines with human-like capabilities of vision, written and spoken language understanding, and reasoning or analytical capabilities. Problems to receive special attention include more efficient mechanisms for machine representation of the priorities of real world objects and events; achievements of machine understanding of the relationship between people, objects and events coupled with the modeling of human factors; and creation of a dynamic, data driven concept of context to distinguish individual differences and preferences. Research directed at advanced automation and robotics applications will be expanded. Basic research in Systems Analysis will emphasize mathematical techniques for the multisensor, multitarget environment of future naval engagements arising in submarine targeting and ocean surveillance. Expanded efforts will address fundamental principles for modeling of command-control functions, including risk analysis, multiple goals and distributed communications and decision making.

Subelement: 14 — Title: Mathematical Sciences
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In Statistics research will continue in non-Gaussian signal processing. Statistical image processing and remote sensing research will be further expanded with applications to environmental remote sensing and ocean surveillance. Research in computational statistics will emphasize the use of graphics techniques for analyzing high dimensional, large volume data sets. Additional research in reliability and maintainability will be initiated. In Logistics and Operations Research, a major thrust will be made in combining operations research/management science with advanced computer processing capabilities toward definition and solution of large, complex resource allocation problems. The research will address ways to provide several projected alternative strategies and associated possible outcomes for considerations by the decision maker instead of the currently available single feasible solution. Facilities management will be another focus. In this area, research will begin to bring together the various disciplines needed to solve a wide range of problems associated with industrial type shore facilities such as supply centers, shipyards, Naval Air Rework Facilities and ammunition depots.

3. (U) FY 1983 and FY 1984 Planned Program: Research will continue to be driven by the need for advanced mathematical and computational techniques for more effectively handling increasingly complex and critical problems involved in Navy requirements determination, planning, systems design, engineering, production, and resource allocation and command/control/communications. Effort will continue on numerical methods for application to advanced vehicle design related to prediction and control of ships, aircraft and missiles, and to models for ocean forecasting and explosive prediction. Investigation will continue in mathematical optimization, decision analysis, mathematical economics, scheduling, and sequencing and network theory applications to problems in command and control, logistics, facilities management, manpower planning and economic competition and conflict. Research in computer hardware and software will emphasize artificial intelligence and robotics as it relates to the needs of command/control, intelligence and maintenance, the software life cycle, interactive graphics displays as a tool for management, and expanded effort on advanced architectural concepts for implementing very large scale integration. Research in statistical signal processing will continue an emphasis on non-Gaussian processes. Airborne passive surveillance issues will be investigated. Research in picture processing and reconstruction related to environmental remote sensing by satellite will continue to receive strong emphasis. Control theory research will concentrate on problems in large, distributed decision systems characterized by poorly understood models, limited communications and incomplete information for application to command and control and to control of Vertical/Short Takeoff and Landing aircraft. Applied mathematical research efforts will focus on combined analytical and numerical approaches to problems arising in a variety of physical situations such as wave propagation, fluid-structure interfaces, and elasticity and plasticity. Mathematical inverse problems will receive increased attention.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 14	Mathematical Sciences	18,707	21,750	28,229	30,709	Continuing	Continuing

Subelement: 21 — Title: Electronics
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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 anti-submarine warfare. The major areas of this research are: Electromagnetic Wave Propagation and Radiation, involving generation, propagation, reflection, absorption, refraction and scattering of electromagnetic waves, antenna theory and radar target detection and identification, and electronic warfare; Physical Electronics, involving synthesis characterization and analysis of electronic materials and structures, including semiconductor surfaces, interfaces and defects; Solid State Electronics, including microwave and millimeter wave devices, ion implantation, radiation effects in solids, integrated circuits, signal sources, and radiation detectors; and 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.

(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.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Research Laboratory, Washington, DC; Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA. (2) 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; (3) Academic: Harvard University, Cambridge, MA; Stanford University, Stanford, CA; Ohio State University, Columbus, OH; University of Illinois, Urbana, IL; Colorado State University, Ft. Collins, CO; Texas Tech University, Lubbock, TX.

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

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Previous outstanding accomplishments derived from research under this program include contributions to: atomic frequency standards and clocks; magnetron, klystron and traveling wave tube development; quantum electronic devices such as the maser and atomic magnetometers; establishment of very low frequency propagation characteristics underlying the LORAN-C and OMEGA navigation system; computer-aided design of integrated circuits and the development of the gallium arsenide field-effect-transistor. At the present time, the forcing factors for this program element have been high speed error free communications and radar, and reliable real time signal processing. In the past decade advances in semiconductor components have led to an increase in the number of components per chip largely through decreased feature size, and to the availability of microwave power concentrated Silicon and Gallium Arsenide devices. Substantial progress has been made to exploit these advances for signal processing, communications, and radar. In the radar area, significant progress has been made in our capability to calculate electromagnetic scatter. This has been used as a tool to reduce the radar cross section of the B1 and other aircraft. It has led to an exploratory development program in radar target classification. It is being used to improve electromagnetic compatibility. Finally, the ability to calculate mutual antenna impedance on any convex surface permits conformal arrays to be built into the surface of any aircraft. In the signal processing area, significant progress was made in research on a new class of semiconductor components, Gallium Arsenide, which operate with switching times in the order of ten picoseconds. Both theoretical and experimental advances were made in understanding the causes of defects in these devices. Defects reduce manufacturing yield, and can lead to device failure. An improved understanding of Gallium Arsenide Shottky barrier devices resulted from confirmation of a surface defect model for Fermi level penning. The predicted large ratio of electrons to holes in Gallium Aluminum Arsenide avalanche photo-diodes was confirmed. A potential breakthrough in extremely high speed devices could result from a demonstration that differential negative mobility in multilayer semiconductor heterojunctions is caused by the transfer of hot electrons. The groundwork w s laid for a potentially higher speed than Gallium Arsenide technology; processing technology was developed for metal-insulator-semiconductor devices on Indium Phosphide and devices were fabrciated. In the communications area, the feasibility of a new signal processing technique, minimum cross entropy was demonstrated. This will improve communications in jamming and high density signal environments. A much more precise forecast of communications disruptions caused by solar flares was made possible by the discovery that the direction of the magnetic field at the flare site determines whether or not a geomagnetic storm will follow.

2. (U) FY 1982 Program: Naval research in Electromagnetic Wave Propagation and Radiation will continue on both natural and man-made disturbances of the electromagnetic propagation environment such as solar flares, geomagnetic storms, and high power electromagnetic heating. Theoretical and experimental research is conducted on the interaction of intense electromagetic waves with a beam driven magnetoplasma. Research on the radiation, propagation dispersion, scatter, and coupling of electromagnetic waves will continue, with emphasis on radar target classification and developing analytical methods for designing in electromagnetic compatibility and designing out electromagnetic pulse radiation in future ships and aircraft. Research on radar

target identification will be expanded. The potential utilization of molecular species to produce spectra tailored to match infrared signatures is being investigated. The application of artificial intelligence to fleet defense in an electronic warfare environment is being explored. In Physical Electronics, the structure of semiconductor surfaces, interfaces and defects will be continued; emphasis will be given to problems of distortion and relaxation, and to total energy calculations. Nonlinear optical spectroscopy of electronic defects will be continued, as well as research on effects of defect association. The mechanics of defect formation, and potential methods of defect reduction will be studied for bulk compound semiconductors. Molecular Beam Epitaxy facilities developed during FY 1981 will be used to grow novel structures and examine electronic material properties in submicron geometries. Research on laser initiated surface chemical reactions will be started; growth of metastable electronic materials will be investigated. In Solid State Electronics, theoretical and experimental research will be continued on ion implantation, radiation effects, and new materials preparation. There will be continued research on interfaces between semiconductors, metals, and insulators with goals for improving device reliability and capability; due to recent successes insulators on gallium arsenide and indium phosphide will be emphasized. Investigations of multilayer and superlattice structures will continue, with consideration given to novel device structure. The physics of weak link and silicon barrier Josephson Junction devices will continue to be investigated for signal processing and millimeter wave detection. There will be a continued growth in emphasis on the submicron dimensioned physical structures and devices, and the physics and chemistry of submicron fabrication processes. New millimeter and submillimeter signal sources such as the solid state gyrotron and solid state magnetron will continue to be investigated both analytically and experimentally; and emphasis will be given to single chip millimeter wave circuit technology. In Electronic Systems and Communications Theory, analog/hybrid fault analysis research will continue. Analytic measures for fault testability and diagnosability will continue this will lead to more fault tolerant systems. Energy-efficient electronic system investigations will be intensified to improve the efficiency of electronic power processing and distributing circuitry, and to minimize the power requirements of signal/information processors. Communication theory investigation of the design and performance evaluation of communication/surveillance systems operating in or under uncertain and, possibly, hostile conditions will be continued. Protocols, control, and routing algorithms for large networks will be investigated.

3. (U) FY 1983 and FY 1984 Planned Programs: In Electromagnetic Wave Propagation and Radiation research, a program on inverse electromagnetic scattering and radar cross section reduction will be initiated. An experimental program to examine the robustness of recently invented extremely wide bandwidth, low cost, highly reliable, superresolution phased array antennas with vastly improved antijam capabilities will commence. In Physical Electronics ongoing work on electronic structures will be extended and the properties of a variety of insulating films on semiconductors will be investigated. Efforts in laser initiated surface chemical reactions will be expanded. Superlattice structures involving a wide variety of semiconductor and metallic systems will be investigated. This has a high potential for orders of magnitude faster electronic devices than are available today. The physics of dry processing of submicron compound semiconductors by plasma etching with electron and ion beam writing will be examined. In Solid State Electronics emphasis will continue on increasing the reliability of semiconductor devices used in

Subelement: 21 Title: Electronics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

electronic circuits. The investigation of the properties of surfaces and interfaces of electronic materials will be maintained. The investigation of impurities and defects in solids will continue in order to determine and control their effects on the electronic and optical properties of solid state devices used in electronic circuits and systems. The annealing process for ion implantation doping of technologically important compound semiconductors will continue to be investigated to determine the physical processes involved and to establish a sound basis for device fabrication. Single chip technologies in indium phosphide and gallium arsenide for millimeter wave application will continue to be investigated as well as analog and digital technologies in indium phosphide. Fundamental studies of submicron structures, materials growth and device fabrication science will grow. Research on microwave power interactions and amplification in field emitter array structures will continue. Transitions are expected in 6.2 support for part of this effort. In Electronic Systems and Communications Theory, research into fault recognition of large scale systems will be intensified. Using analytical measures for diagnosibility we will determine via system theory, graph theory, and other techniques, system structures that are fault diagnosable with respect to these measures. Rules for the design of very large scale integrated circuits will be evaluated. The new effort on fundamental problems in electronic warfare and electronic counter-countermeasures will be continued. Theoretical work on random coding will continue toward improved choice of signal waveforms. Efforts on robust signal processing and robust analog to digital conversion procedures be further emphasized. The design of efficient protocols for the operation of computer/communication networks will be supported. Efficient communication techniques for mobile-radius and mobile-vehicle systems will also be supported.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 21	Electronics	22,457	27,051	27,727	29,010	Continuing	Continuing

Subelement: 22 Title: Materials
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: Research is directed at providing: the understanding and capabilities necessary to predict and control the properties of materials used by the Navy/Marine Corps; definition 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 emphasis include: metals and alloys; ceramics, insulators and inorganic solids; composite materials; high temperature and special performance materials; polymers; corrosion, deterioration and protection of naval materials; radiation-resistant materials; materials processing and inspection.

(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 of 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 interactions include the Committee on Materials: Working Group on Rapid Solidification Technology, which involves several federal agencies and the DOD; the DOD/National Aeronautics and Space Administration Composites Working Group (airframe and missile structures); and the DOD Working Group on Directional Solidification (high temperature turbine blading). The Navy is represented on many technical groups such as the American Society of Testing Materials' committee which meets twice a year to discuss test standardization methods in fracture testing, fatigue, corrosion, composites, nondestructive testing, ship building, etc., and the American Institute of Mechanical Engineering's committee on research and development areas of titanium, fracture, powder metallurgy, etc. Reviews of Navy programs are held annually involving other DOD, industry and university personnel in such areas as titanium research, dome materials, sonar ceramic transducers, rocket nozzle materials, laser metalworking, rapid solidification and protective coatings. Navy participation in the National Materials Advisory Board reviews is extensive.

(U) WORK PERFORMED BY: (1) In-House: Naval Research Laboratory, Washington, D.C.; Naval Surface Weapons Center, Silver Spring, MD; Naval Weapons Center, China Lake, CA; David Taylor Naval Ship Research and Development Center, Annapolis, MD. (2) Industrial: Ford Motor Company, Dearborn, MI; United Technologies, East Hartford, CN; Martin-Marietta Labs, Baltimore, MD; Rockwell International, Thousand Oaks, CA; General Electric, Schenectady, NY. (3) Non-profit: Southwest Research Institute, San Antonio, TX; SRI International, Menlo Park, CA; Battelle Memorial Institute, Columbus, OH. (4) Academic: Carnegie - Mellon University, Pittsburgh, PA; University of California, Berkeley, CA; Colorado School of Mines, Boulder, CO; Pennsylvania State University, University Park, PA; North Texas State University, Denton, TX; Ohio State University, Columbus, OH; Harvard University and Massachusetts Institute of Technology, Cambridge, MA; Rensselaer Polytechnic Institute, Troy, NY; Lehigh University, Bethlehem, PA; Northwestern University, Evanston, IL; State University of New York, Albany, NY.

ement: 22 Title: Materials
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ROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

U) FY 1981 and Prior Accomplishments: Major past accomplishments include: clarification of strengthening and toughening nisms in steel; new and improved techniques for processing materials; establishment of fracture mechanics approaches to life ction of metals and ceramics; microstructure - property - processing information on titanium alloys; improved understanding ser surface processing to increase pitting corrosion resistance. More recent accomplishments include: development of phase- ibrium data for titanium alloys; heating and cooling rate models for laser metalworking; use of rare-earth transition nts to improve hot formability in titanium alloy was transitioned into the Naval Sea Systems Command Exploratory Development am; synthesis of new, fiber-reinforced glass ceramics with toughness comparable to aluminum was transitioned into Exploratory opment; creation of new, full scale infrared dome material from a Zinc-aluminum-germanium glass is being evaluated for ition into manufacturing technology; improved processing methods for silicon carbide reinforced aluminum composites; ification of grain boundary scattering as a critical limiting factor in the development of ultra low-loss, polycrystalline al fibers; the finding that absorbed hydrogen damages metals by lowering resistance to plastic flow; synthesis of new rostrictive materials for transducer and microdisplacement applications has been transitioned into Exploratory Development. ious research on superplastic forming of titanium has transitioned to aircraft manufacturing. Research on laser welding has sitioned to manufaturing technology.

(U) FY 1982 Program: The Metallic Materials program includes research on the basic science of welding. This emphasizes anisms of heat transfer and solidification during fusion welding using arcs, electron beams and lasers; factors affecting weld lty and weld penetration are being determined. Research on the metallurgy of titanium alloys of naval interest includes cts of heat treatment on microstructure, phase equilibria, fracture behavior, welding, and nondestructive evaluation. inum-graphite composite fabrication is under investigation to improve transverse strength and toughness. Rapid idification processing is being explored to produce unusual structures and properties in steels and amorphous alloys prepared owders and ribbons. Basic research on powder processing/consolidation methods is being initiated. Response of materials to re environmental factors is under investigation. Corrosion research emphasizes: localized corrosion processes; factors rning protective coating adhesion and coating delamination in corrosive environments; research on environmental-enhanced cure processes, such as stress corrosion cracking and corrosion fatigue; mechanisms of hot corrosion; research on the idation of protective coatings using in-situ experimental techniques; new, non-toxic compounds for use as corrosion inhibitors steels. In Ceramics, continued emphasis is on improved acoustic transducer materials and new concepts for toughening ceramics use as infrared and radar windows. Control of the micro-mechanics of failure and thermal mechanical fatigue in fiber- forced ceramics will continue. Research on new dielectric materials used for microwave modulation, ultrasmall capacitors, and linear devices will be initiated. In Special Materials and Techniques, research is in progress on magnetic and mechanical erties of amorphous metals, understanding the interactions of microwaves with solids, the science of adhesion, investigations imensional instabilities in inertial guidance materials, and structure-property relationships in carbon-carbon materials. In

Subelement: 22 Title: Materials
Program Element: 61153N Title: Defense Research Sciences
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Polymers, research in the subelement is coupled with work carried out in the Chemistry Subelement. It emphasizes environment-microstructure relations, fracture behavior, and effects of defects in these materials under applied loading. Materials Processing research emphasizes novel processing routes (e.g. rapidly solidification) and the effects of processing variables on properties of materials. Special emphasis is being given to processing as a means of lowering strategic alloy content while maintaining good magnetic properties in hard magnets. Life Assurance will include research on the mechanisms of wear in marine seals and new materials for that application.

3. (U) FY 1983 and FY 1984 Planned Programs: In Metals, the program will include research on factors that influence mechanical properties, deformation, and fracture modes in structural alloys. Emphasis will be placed on improving strength and toughness of lightweight metal alloys. Processing effects on the structure and properties of titanium alloys will be emphasized. Research on the science of welding processes will continue. Work on new high metal deposition techniques will be initiated. In Ceramics, toughening ceramics for infrared dome and radome sensor enclosures will continue. Experimental work will continue on carbon fibers and carbon-carbon nosetip and rocket nozzle materials. Wear, fracture, and design investigations will consider the behavior of ceramics as advanced marine seal materials. Work will be expanded on microstructural design of composites for combined electromagnetic functions for such uses as acoustic transducers and sensors. Research on new dielectric materials used for microwave modulation, ultrasmall capacitors and nonlinear devices will be expanded. Synthesis and characterization of advanced multifunctional composites for application as sensors will be initiated. Activity on multiphase composites (fiber-reinforced, second-phase particles) for toughening will be expanded. In Corrosion, new tools such as atom probe field-ion microscopy will be used to gain additional information on corrosive processes on a fine scale never before achievable. Research on methods of improving the performance of protective coatings will continue, as will research on hydrogen-induced damage of metals. In Special Materials and Techniques, research aimed at understanding the physical and mechanical behavior of metallic glasses will be actively pursued. Corrosion resistance of these materials will be initiated. Characterization of the interaction of microwaves with solids will be carried out. Processing research will be expanded during this period to look at new types such as high strength steels and aluminum alloys of novel compositions of materials. Unit processing operations, new methods of producing metallic and ceramic powder, novel solidification and densification techniques, and chemomechanical machining techniques will be explored. Research will continue on low cost, cobalt-free permanent magnet materials emphasizing rapid solidification, powder-metallurgy techniques.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 22	Materials	19,867	24,210	25,759	29,194	Continuing	Continuing

Subelement: 23 Title: Mechanics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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.

(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 Naval Sea Systems Command Hydrodynamics Advisory Committee, the General Hydromechanics Research Council of David W. Taylor Naval Research Ship and Development Center, the Navy Aeroballistics Committee, the National Advisory Council on Materials and the Ship Structures Committee of the National Academy of Science, the Fluid Mechanics Committee of National Aeronautics and Space Administration, and the National Boundary Layer Transition Group. Joint research programs exist with: the Defense Advanced Research Projects Agency in selected hydrodynamic areas; the Air Force and the National Aeronautics and Space Administration on a number of transonic flow problems and transonic tunnel measurement techniques; the Defense Nuclear Agency and Naval Sea Systems Command on the shock response of submarines. Coordination with Naval Air Systems Command, Naval Sea Systems Command and the Air Force occurs in the translation of research results into practical applications, e.g., on projectile and underwater weapon design, crashworthiness tests and mechanical failure criteria.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Surface Weapons Center, Silver Spring, MD; Naval Underwater Systems Center, Newport, RI; (2) Industrial: Grumman Aerospace Corp., Bethpage, NY; Aeronautical Research Associates of Princeton, Inc., Princeton, NJ; Flow Research Co., Kent, WA; Boeing Commercial Airplane Company, Seattle, WA; Douglas Aircraft Company, Long Beach, CA; Dynamics Technology Inc., Torrance, CA; (3) Non-Profit: Franklin Institute Research Laboratories, Philadelphia, PA; Battelle Memorial Institute, Columbus, OH; Southwest Research Institute, San Antonio, TX; (4) Academic: Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; University of Southern California, Los Angeles, CA.; University of California, Berkeley, CA; University of Michigan, Ann Arbor, MI; Georgia Institute of Technology, Atlanta, GA; Virginia Polytechnic Institute and State University, Blacksburg, VA; Applied Research Laboratory, Pennsylvania State University, University Park, PA; Cornell University, Ithaca, NY; University of Arizona, Tucson, AZ; Ohio State University, Columbus, OH; Stanford University, Stanford, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Past accomplishments have included significant contributions to hydrofoils and planing craft, missile reentry, supercavitating marine propellers, prediction of ship motion due to wave interaction at sea, gas dynamic lasers, fatigue and fracture mechanics of metals and composites, the reduction of frictional drag by polymer additives, numerical

Subelement: 23 Title: Mechanics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

procedures for calculating transonic flow fields about three-dimensional wing bodies, and concepts for controllable-wall transonic wind tunnels to reduce adverse wall effects in aerodynamic testing. More recent accomplishments include: demonstration of control of free shear layer growth through low energy active control of coherent turbulent flow structures; experimental demonstration using surface heat pulses and active feed back control of the cancellation of naturally occurring instability waves in laminar boundary layer flows; theoretical prediction of surface waves generated by a ship transom with comparisons with experimental flow measurements; a method for predicting the acoustic energy radiated by vibrating submarine hulls; demonstrated feasibility of new computational methods for solving the full Euler equations for three-dimensional transonic flow problems; feasibility shown for new low frequency ultrasonic nondestructive evaluation method for Navy vehicle structures; a computationally efficient simplified model for surface crack analysis; established plastic energy rate criterion for slow crack growth in elastic-plastic materials; new sparse matrix method permitting meaningful direct simulation of three-dimensional turbulent flows. A planned new initiative in propellers for high speed aircraft was not started due to a large National Aeronautics and Space Administration initiative on the topic.

2. (U) FY 1982 Program: Hydrodynamics: The numerical calculation of free surface flows, previously concentrated on the potential problem of ship wave resistance, will be extended to include the effects of viscosity. Computational methods for the prediction of appendage flow fields and drag will be developed. Both of these thrusts are of primary importance to insure that Navy ships are designed for minimum fuel consumption in every phase of their missions. Research to improve the hyrodynamic and noise performance of ship and torpedo propellers will be undertaken. Experimental investigations of late wakes in stratified fluids will be undertaken. Knowledge of wake development with time is essential in underwater vehicle detection. A major emphasis in the use of compliant coatings for drag reduction in the case of turbulent boundary layers will be continued. Large reductions in drag which will contribute to substantial speed increases for underwater vehicles and weapons are being sought. Analytical methods to predict wave forces, drift forces and rudder forces will be developed. Aerodynamics: Research on the numerical calculation of flow fields about aircraft and missile components and configurations in which the effects of turbulence and viscosity are included will be continued. Boundary layer calculations on bodies of revolution which have been completed for low angles of incidence will be extended to high angles of incidence and compared with experimental results. Investigation of the flow fields associated with lifting jets for vertical and short takeoff and landing aircraft in the ground effect mode will be continued and extended to include analysis of a jet in a cross flow. Performance of powered lift systems in ground effect can determine overall engine sizing for Vertical/Short Take-Off Landing aircraft. Projects to determine the feasibility of spectral numerical techniques to predict both steady and unsteady flow fields will be initiated with the goal of efficient numerical load calculations for aircraft and missiles. Investigations of unsteady aerodynamics including oscillating flows and flows with separations will be continued. Research on low Reynolds number aerodynamics applicable to low-speed decoy air vehicles will be initiated. Structural Mechanics: Efforts continue to improve techniques for machinery mounts to reduce vibration excitation of submarine hulls and the subsequent radiation of acoustic energy. Research to improve the response of submarine structures to underwater explosions will be continued. Analytical and experimental investigations of the flutter of aircraft/missile control surfaces will be conducted for

various structural nonlinearities. The investigation of nondestructive evaluation techniques for determining structural reliability will receive increased emphasis. Compression fatigue and low velocity impact of hybrid composite laminates will be investigated to identify and quantify damage mechanisms and failure modes for new composite materials which will be introduced into the fleet in new aircraft over the next few years. Research on crack propagation will be extended into the elastic-plastic regime and will include the effects of dynamic loading.

3. (U) FY 1983 and FY 1984 Planned Programs: Hydrodynamics: The numerical calculations of free surface flows, including the effects of viscosity in selected cases, will continue to address more realistic and more complex ship-like configurations. Research to extend similar numerical techniques to the calculations of the flow fields associated with marine propellers will be continued with the objective of developing more efficient, quieter propellers. Emphasis will be given to the prediction of full-scale propeller inflow velocity and pressure fields and to the determination of propeller-hull hydrodynamic interactions. Research on drag reduction through the use of compliant coatings and boundary layer heating in both the active and passive modes will be continued and extended to include the effects of the introduction of microbubbles and polymer additives into the boundary layer. Research on ship hydrodynamics including resistance and powering, motions, maneuvering, stability and control, and propulsion will be continued for both conventional displacement ships as well as high performance ships such as hydrofoils, planing craft, surface effects ships and ships of the small waterplane area type. Numerical prediction methods for separation and for modeling three-dimensional vortex shedding on submarine-like bodies will be initiated. These areas are important to both the hydrodynamic performance and to the control of submarines. A new initiative in hydroacoustics will be undertaken with emphasis on the importance of flow structure on the generation and near-field propagation of pressure fluctions. Aerodynamics: Research on the calculation of aerodynamic flow fields will continue, with increased emphasis on the effects of viscosity and unsteadiness. The central problem of the prediction of flow separation, its location and effect on the flow field characteristics, will receive increased attention. Research to improve methods for predicting the wave drag associated with configurations in supersonic flight will be initiated. Research on the calculation of the flow fields about missiles at high angles of attack will be continued. The aeromechanics of stored and deployed wings for cruise missile application will be investigated from the point of view of interference and aerodynamic stability. Investigations will be initiated to determine unique aerodynamic charactistics of aircraft designed for very low radar and infrared signatures to insure that the aerodynamic performance of such concepts is satisfactorily integrated into new concepts. Research on the interactions of vortices and control surfaces in the context of missile stability will be continued. Basic flow phenomena associated with improved take off and landing performance for Navy aircraft will be studied. Efforts toward improvement of numerical techniques for the calibration of turbulent flows in the context of fundamental governing equations of fluid flow will continue. Research on the direct computational simulation of large-scale aerodynamic turbulent flow structure will be expanded using advances in large-scale scientific computers. This basic information forms the foundation for experiments and predictions to improve missile and aircraft performance. Structural Mechanics: Research efforts to improve the capability of predicting the structural response of submarines to shock loadings associated with underwater explosions will be continued and expanded to more complex and realistic structural geometries

and to the case of nonlinear deformations of permanent nature in the elasto-plastic regime. Efforts to improve the prediction of the acoustic energy radiation from submarine hull vibrations will be continued, including the reduction of vibration excitation through the development of improved machinery mounts. An investigation of anechoic coatings will be conducted in the context of reducing the acoustic energy reflection characteristics of submarine hulls. An effort to apply similar noise reduction techniques to torpedoes will also be undertaken. The dynamic analysis of ocean structures with appropriate soil support interactions and wave and current loadings will be continued. Real time assessment of failure of actual operating vehicle structures via limited number of sensors will be examined. The analysis of aircraft wing/store flutter problems will be extended to more complex cases and compared with laboratory experiments. In the case of the delamination failure of composite laminates special research emphasis will be given to the mechanics of crack arrestment and to the investigation of effective arresting techniques. Impact damage growth under combined compression/shear loading will be evaluated. Fatigue tests will be conducted to determine the effect of cycle rate and dwell time at load on graphite/epoxy laminates. These tasks are all directed towards improved durabilty, survivability and reliability for Navy vehicles.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 23	Mechanics	14,868	18,203	20,003	22,362	Continuing	Continuing

Subelement: 24 Title: Energy Conversion
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: 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; 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, photolysis and detonation relative to solid propellants, fuels, pyrotechnics and explosive systems; the Energy Utilization project encompasses investigations of new and improved power and propulsion concepts for application to naval aircraft, missiles and ships, through interdisciplinary fundamental and applied research on the physical and chemical phenomena associated with conversion, transmission, and utilization of energy into useful power and thrust.

(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 Enviornmental Protection Agency. The production of soot from gas turbine combustion, for example, is of interest to the Air Force and Navy primarily from the concerns for propulsion efficiency and aircraft detectability and of interest to the Environmental Protection Agency from the concern for environmental quality. Coordination of the efforts within the Energy Conversion subelement takes place through joint participation in program sponsorship and program progress reviews. For example, programs within this subelement are jointly sponsored with the Army Research Office on the synthesis and characterization of interhalogen oxiders at Rockwell International, on the abinitio quantum chemical calculation of explosive density and reaction pathways at John Hopkins University, and on new materials characterization for electric machine brushes at Ohio State 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 investiagations in tribology are closely coordinated with other agencies through the joint sponsorship and conferences of the Mechanical Failures 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 Symposia. The Energy Conversion subelement monitor regularly participates in Air Force Office of Scientific Research program reviews on combustion processes.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Silver Spring, MD; Naval Air Propulsion Center, Trenton, NJ; United States Naval Academy, Annapolis, MD; Lawrence Livermore Laboratories, Livermore, CA; Naval Weapons Center, China Lake, CA; (2) Industrial: Aerochem Research Laboratory, Inc.,

Subelement: 24 Title: Energy Conversion
Program Element: 61153N Title: Defense Research Sciences
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Princeton, NJ; General Atomics, Inc., San Diego, CA; United Technology Research Center, East Hartford, CT; Westinghouse Electric Corporation, Pittsburgh, PA; Mechanical Technology, Inc., Latham, NY; Aeronautical Research Associates of Princeton, Princeton, NJ; AIResearch Manufacturing Company, Torrance, CA; General Electric Company, Philadelphia, PA; General Electric Research Lab, Schenectady, NY; Calspan Corp., Buffalo, NY; (3) Non-Profit: SRI - International, Menlo Park, CA; Combustion Institute, Pittsburgh, PA; Battelle Columbus Laboratories, Columbus, OH; (4) Academic: Princeton University, Princeton, NJ; Yale University, New Haven, CT; Georgia Institute of Technology, Atlanta, GA; University of California, Berkeley, CA; Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; University of Akron, Akron, OH; Catholic University, Washington, DC; Arizona State University, Tempe, AZ; University of New Mexico, Albuquerque, NM; University of Minnesota, Minneapolis, MN.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Previous accomplishments follow: Advances in understanding of thermochemistry, ignition and combustion of boron and aluminum compounds, and of high-energy fuels and additives, have guided designs of ramjets, air-augmented rockets and extended burning ramjets now under development. Fluorine atom generation salts have been synthesized which promise to be superior candidates for chemical laser systems and for additives to increase the detonation pressure of explosives. An investigation of methane combustion chemistry was completed with important implications to alternate fuel technology. A theory of the effect of inlet distortion on non-steady operation of rotors has been formulated and the experimental measurement of the forces acting on rotor blades has been achieved. Advanced non-intrusive diagnostics have been developed for use in measuring temperature, velocity, and species concentrations in combustion environments. Feasibility investigations of the closed Brayton cycle, two-phase turbine, and liquid metal magnetohydrodynamic systems have been completed. Electric machine brush capabilities have been improved by a factor of ten, yielding current densities of 1000 amps/square inch with lifetimes exceeding 8000 hours. From investigations of advanced electric machines a new design concept evolved and is now being developed by the Naval Sea Systems Command, utilizing the improved brush capabilities. A theory and confirming experimental data were obtained which illustrate performance improvement of mechanical seals utilizing a controlled surface waviness. This seal has been incorporated into a Naval Sea Systems Command Development program.

2. (U) FY 1982 Program: In Electrical Power Generation, efforts to determine parameters governing the magnetohydrodynamic production of electrical power from high temperature/high pressure plasma will be emphasized. The appropriate equations of state will be determined and electrical conductivities will be calculated. A proof-of-principle test for a pulsed magnetohydrodynamic approach will be continued. In Chemical Propulsion and Armaments, research continues to synthesize new organic structures containing various oxidizing groups, high density polycyclic hydrocarbons and new energetic polymer binders. Dynamic fracture investigations of simulated composite propellant and explosive materials will be continued to improve the understanding of the deflagration and shock to detonation transitions. Work will continue to investigate the time-resolved decomposition of solid and

Subelement: 24 — Title: Energy Conversion
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

liquid energetic materials, to develop catalysts for denitrogenation of shale oil-derived jet fuel, and to provide materials for infrared decoys and for excitation of laser radiation. In Energy Utilization emphasis is on utilization of laser diagnostics for measurement of realistic flows typical of air augmented missiles and turbojet engines. Research will be continued on fundamental turbulent mixing and combustion, with emphasis on large scale turbulent structures and the state of mix. A joint academic-industrial program to determine the flow field and heat transfer in aircraft gas turbines has been initiated. Research in tribology will emphasize wear mechanisms, wear theory, and investigations of the new seal concept which utilizes a controlled surface waviness. The latter will include gas sealing phonomena and submarine shaft environmental considerations. Research efforts on electric machine brushes will be reduced. In marine propulsion investigations of heat transfer in complex flows will continue with increased emphasis on heat transfer augmentation techniques. Efforts in alternate improved fuel utilization will continue with emphasis on combustion/vaporization characteristics as related to fuel properties.

3. (U) FY 1983 and FY 1984 Planned Programs: In Electrical Power Generation, theoretical modeling will continue on extremely high temperature and pressure plasmas at magnetic Reynolds numbers greater than unity. High temperature/high pressure plasma sources will be used to characterize self-excited magnetohydrodynamic pulsed power generators for directed energy applications. In Chemical Propulsion and Armaments, investigations will continue on the dynamics of highly energetic chemical reactions to identify candidate visible and ultra-violet laser systems. Chemical processes responsible for toxic products and smoke in organic fuel oxidation will continue to be investigated in order to reduce casualties from fires aboard naval craft. New dense diamondlike nitramines and energetic thermoplastic elastomers will be synthesized to enhance the effectiveness of solid propellants and explosives. Biotechnology will be used to study fuel degradation. In Energy Utilization, research will continue in heat transfer relevant to obtaining higher thermodynamic efficiencies, more reliable heat exchanger design, and the kinds of fuels used and their efficiencies. Increased emphasis will be given to tribological research toward achieving more reliable, longer operational life machinery components. Improved reactive flow measurement and visualization techniques will continue to be sought that are applicable to investigations of advanced aircraft and missile power plant performance. Planning is underway to refine phenomenological models of soot formation in flames with advanced diagnostic techniques which will lead to better engine performance. Fundamental research on turbulent reacting flows and combustion will be extended from conventional turbojet conditions to subsonic and supersonic combustion ramjet flows for advanced tactical missiles.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 24	Energy Conversion	9,193	9,987	12,545	14,097	Continuing	Continuing

Subelement: 31 Title: Oceanography
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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, magnetics and gravity), analysis of the sound scatterers and bioluminescene 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.; and to pay transfer expenses of ships. 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.

(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 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 and the Geological Survey. Within the Department of Defense, research is coordinated with the Defense Mapping Agency, Defense Advanced Projects Research Agency, Office of the Under Secretary of Defense for Research and Engineering, Naval Systems Commands and the Office of the Chief of Naval Operations.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Research Laboratory, Washington, DC; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Postgraduate School, Monterey, CA; (2) Industrial: Magnavox, Fort Wayne, IN; (3) Non-Profit: National Academy of Sciences/Engineering, Washington, DC; (4) 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.

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

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A major result of oceanographic research of the last 10 years has been an increased knowledge of the variability and distribution of mesoscale (10 to 300 km) features including fronts, rings, eddies etc. and a transfer of this knowledge to the Fleet and to the modeling efforts in support of the Fleet Numerical Oceanography Center products. Oceanographic instrumentation and techniques for measuring ocean fine and microstructure, turbulence, shear currents and internal waves have given high quality data with good reliability, and are now being used by the Navy for evaluating non-acoustic anti-submarine warfare concepts. Facilities to analyze satellite remote sensing data have been established at three academic institutions and two Navy laboratories. Existing and recent data sets contribute to an understanding of water masses and circulation patterns of the Norwegian-Greenland Sea and its connection with the North Atlantic via the strategically important Greenland-Iceland-United Kingdom straits. Current meter moorings have been installed south of the Aleutians to measure, for a period of a year, the dynamic eastward and westward flowing boundary currents. Direct measurements of the Gulf Stream volume transport have been underway a year. Using acoustically tracked drop sondes, these measurements are acquiring cross-current profiles at two-month intervals. Current meter moorings were recovered after being in place for a year in the Kuroshio extension. These meters have been redeployed for a second year to produce a current profile data over a total time span of two years. Results of the Ocean Fronts Experiment in the North Central Pacific are providing detailed insight into the strong gradients of physical parameters (for example: temperature) which can exist across an ocean front as well as allowing description of currents near fronts. Such knowledge is important because of the potentially significant impact of fronts on acoustic propagation and short wavelength oceanographic phenomena such as the internal waves and horizontal sheer currents. Measurements of internal wave fields with orthogonally directed doppler sonars have been made. A direct relationship has been found between ocean depth, age of ocean crust, acoustic layering of the ocean lithosphere, and magnetic anomalies, which will make possible improvement of seafloor acoustic propagation predictions. A geophysical transect of the sea floor has been made from the mid-Atlantic ridge to the U.S. East Coast. This was made using two ships, each with air gun sources and a 36 channel, 3.6 kilometer long hydrophone array. A Global Positioning System satellite navigator has been acquired for use on various academic research vessels as the first step toward installation of Global Positioning System equipment on all such vessels. Experiments have measured the influence of fronts and eddies on long range acoustic propagation and shortscale oceanographic phenomena such as internal waves, fine structure, horizontal shear currents and turbulence. Improvements in chemical pre-concentration schemes and analytical chemical techniques allow measurement of true background levels of ocean trace elements. Collecting efficiencies have been experimentally defined for sediment traps that are used in measurement of the vertical flux of ocean particulates, and thereby the vertical flux of nutrients, trace elements and sediments. Such data also provides more accurate baseline information for assessment of optical systems of non-acoustic Anti-Submarine Warfare. Timelapse photography combined with current meters and temperature recorders have given the first understanding of episodic high current events in the ocean's bottom benthic boundary layer. An ocean bottom, seismic propagation experiment off Baja California, in January 1979, with unprecedented high density of instruments, enabled simultaneous determination for the first time of velocity anisotropy, absorption, lateral variability and scattering for both

compressional and shear waves. This will provide a unique contribution to understanding of sonar paths interacting with the sea floor. New effective acoustic reflection coefficients appropriate for wave theory have been used to investigate bottom effects. Theory for flow noise reduction in oil-filled towed arrays has been verified leading to future higher speed towed arrays of potential use for tactical sonar purposes. Acoustic tomography experiments have verified that the acoustic times are stable and can be identified so that acoustic tomography has great potential for remote sensing of internal ocean dynamics. Tomography combined with synoptic remote sensed satellite altimetry and sea surface temperature data, offer the possibility of continuous monitoring of the internal ocean density structure and therefore the sound velocity structure required for sonar predictions. Monte Carlo computer codes have been written for quantitative definition of optics of the sea surface and the upper ocean for various cloud covers, sea states and suspended matter in the sea water.

2. (U) FY 1982 Program: Physical Oceanography: One year current meter moorings installed south of the Aleutians will be recovered. The data will allow description of the boundary currents at 4000m and 5000m depths and comparison of these currents with presumed tranquil water mass at a depth of 3000 meters. Direct measurements of the Gulf Stream volume transport at two-month intervals will continue. The purpose is to understand better the downstream increase in Gulf Stream transport. Current meter moorings re-installed last year in the Kuroshiro extension will be recovered. Insight gained from results of the January 1980 Ocean Fronts Experiment in the Pacific has been used to plan additional measurements of fronts which will be conducted this year. Special emphasis will be placed on fine scale sampling near the front. Parameters to be measured include temperature, salinity (conductivity) and current. These significantly influence sound propagation as well as internal waves and shear currents. Mooring technology, hardware and instruments developed over the last two years will be used to establish several moorings at 34°N 70°W in a Long Term Upper Ocean Study. This planned two-year mooring will provide data to relate local meteorology with currents and temperature structure of the upper 500 m of the water column. Chemical Oceanography: Continued emphasis will be 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 evaluating various aspects of non-acoustic ASW. Marine Geology and Geophysics: Data from the Atlantic geophysical transect will be analyzed 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) has been installed on the academic research vessel RV Thomas Washington. Seabeams 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 will be analyzed to select a site for a major future experiment to investigate the high energy benthic boundary layer. Construction will continue on a deep towed geophysical array which is being built to provide a detailed measurement of the continuity of shallow seafloor sedimentary reflectors. Oceanic Biology: Emphasis will continue on integrated research on all aspects of biodeterioration including fouling, boring and related marine corrosion studies. Emphasis will continue to be 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 will also be emphasized. Work will continue in the application of recombinant DNA techniques to develop an understanding of the process by which surface-attaching marine bacteria foul fresh surfaces in the marine environment. Ocean Science Engineering: The ocean technology project will continue 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 Exploratory Development/Advance Development will begin. Data will be analyzed for sea tests of a high speed (10 knots) optical biological sampler. Magnetic bubble memory data recorder design and fabrication will continue. Basic research will continue in order to develop an understanding of natural processes causing shoaling and affecting flow in Navy harbors. A completed high data rate ocean bottom seismometer recorder description will be published. Ocean Acoustics: Analysis of data resulting from a major ocean acoustic tomography experiment will allow an evaluation of how well the acoustic transit 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 kilometer 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 are participating agencies. A major seafloor propagation experiment will be run along a 600 kilometer line in the Philippine Sea. This line will be orthogonal to the track of the 1981 Philippine Sea propagation experiment and will allow examination of velocity anisotropy. The measurements will also expand the work in lateral variability, attenuation vs depth and shear waves. Analyses of the high frequency (5 to 20 hertz) marine seismic earthquake phases will be 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 sofar channel. Theoretical computations of propagation in a random media will continue. Theoretical work has improved the performance of the parabolic equation solution to the wave equation making it possible to calculate high angle rays. Results will transition to exploratory development. Joint programs with the Oceanic Biology program in the Office of Naval Research will continue to investigate biological scattering in the frequency range from 40 kilohertz to 3 megahertz. Ocean Optics: A model for simulating the ocean optical properties in depth and time is being developed. Theoretical examinations and planning for field measurements will be conducted.

3. (U) FY 1983 and FY 1984 Planned Programs: Physical Oceanography: The major oceanographic mooring at 34°N 70°W will be serviced at three-month 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 and south of the Aleutians will be analyzed. Analysis and experiments will continue to develop relations between synoptic satellite sensed sea surface temperature data and the internal ocean investigation of the Antilles Current that flows to the northwest from the Windward Islands to the Bahamas will continue. The two long term program goals in physical oceanography are to determine the potential of physical oceanographic phenomena in the upper ocean for non-acoustic Anti-Submarine Warfare and to develop ocean

Subelement: 31 Title: Oceanography
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

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 Anti-Submarine Warfare. Evaluations will continue for electrochemical sensors (anodic stripping voltametry), atomic absorption spectroscopy, and gas chromotograph-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: The 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 centimeter to 100 meters above the seafloor, nepholometers 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. Oceanic 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: Transition of the open ocean air deployed oceanographic mooring system will continue. Field tests of the Arctic version will be conducted. Basic research on warship ports for domestic and overseas operations will continue with emphasis on natural processes 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 scientific tomography experiment will be conducted; such as an investigation of the Norwegian overflow, the Gulf Stream transport or equatorial trapped waves. This experiment will require major hardware developments including a broadband acoustic signal source, stiff moorings and satellite links for data relay. Ocean Optics: Field measurements will be made of optical propagation and scattering for the upper 100 meters of the water column. These results together with data describing solar irradiance, meteorological and physical oceanographic properties will be used in predictive model assesment.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 31	Oceanography	43,088	51,139	51,768	58,653	Continuing	Continuing

belement: 32 Title: Terrestrial Sciences
ogram Element: 61153N Title: Defense Research Sciences
D Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

) DETAILED BACKGROUND AND DESCRIPTION: The objective of this research is to provide improved understanding and prediction pability of environmental and geophysical conditions which affect Naval personnel, systems and operations in Arctic, inland, allow water, coastal, atmospheric and space environments. Research is conducted under the general headings of Coastal Sciences, ctic Research, Earth Physics, Environmental Factors, and Surface Wave Scattering.

) RELATED ACTIVITES: Programs within the subelement are formally coordinated with the Army, Air Force, and the Office of the ider Secretary of Defense for Research and Engineering by means of apportionment and technology base reviews held by Office of ie Undersecretary of Defense for Reseach and Engineering each year, by formal Subelement Reviews within the Navy, by wide-spread stribution of program reports and by discussions with the Navy Environmental Remote Sensing Coordination and Advisory Committee id the Interagency Geophysics Discussion Group. Government-wide coordination occurs through membership in several Interagency id National Academy of Sciences Committees concerned with environmental problems. Interchange of information on coastal iences, earth physics, and Arctic sciences is maintained with the Defense Intelligence Agency, Defense Mapping Agency, CIA, AVAIR, NAVSEA, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, Environmental otection Agency, U.S. Geological Survey, National Science Foundation, U.S. Army Corps of Engineers, and the Defense Research roup and the Military and Science Committees of the North Atlantic Treaty Organization. The Environmental Factors Project is ordinated with the Navy Ionospheric/Space Research Program Steering group, Nuclear Weapons Effects Planning group, Defense clear Agency, and Defense Advanced Research Projects Agency, as well as those listed above. The Surface Wave Scattering Program f the Naval Research Laboratory is coordinated with Exploratory and Advanced Development projects within the Department of efense, and with Naval Air Systems Command, Naval Material Command, Naval Electronic Systems Command, Defense Meteorological atellite Program, and the National Aeronautics and Space Administration.

J) WORK PERFORMED BY: (Representative) (1) In-House: Naval Ocean Systems Center, San Diego, CA; Naval Postgraduate School, onterey, CA; Naval Research Laboratory, Washington, DC; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval nderwater Systems Center, New London, CT; (2) Industrial: Environmental Research Institute of Michigan, Ann Arbor, MI; Phoenix orp., McLean, VA; Underwater Systems, Inc., Rockville, MD; Telecommunications Enterprises, Panama City, FL; Lockheed Corporation, unnyvale, CA; Applied Science Associates, Apen, NC; Applied Sciences Technology, Arlington, VA; U.S. Technology, Fort Lauderdale, L; (3) Academic: University of Alaska, Fairbanks, AK; University of Virginia, Charlottesville, VA; University of Texas, Austin, X; Colorado School of Mines, Golden, CO; Hawaii Institute of Geophysics, Honolulu, HI; University of Kansas, Lawrence, KS; ouisiana State University, Baton Rouge, LA; Oregon State University, Corvallis, OR; Pennsylvania State University, State College, A; University of Washington, Seattle, WA; Columbia University (Lamont-Doherty Geological Observatory), Palisades, NY; assachusetts Institute of Technology, Cambridge, MA; Scripps Institution of Oceanography, La Jolla, CA; Stanford University, Palo lto, CA.

Subelement: 32
Program Element: 61153N
DoD Mission Area: 510 - Defense Research

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

1. (U) FY 1981 and Prior Accomplishments: Previous accomplishments include: A self contained LORAN C/D location capability has been added to the low cost coastal-ocean data buoy. An analog model analysis capability has been added to the coastal data referral system now operational at the Naval Oceanographic Office. A laser/acoustic bathymetry and mine detection system aboard ship has been successfully demonstrated under field conditions. A multivariate prediction technique for a season-in-advance estimation of cyclone frequency and patterns in the North Atlantic has been developed for surface and ASW applications. A model has been developed that uses heat flux equations to predict water temperature in well mixed continental shelf waters, thus enabling better predictions of sound speed profile. An Arctic ice station (FRAM III) was established to develop an improved understanding of Arctic underwater acoustics and physical oceanographic dynamics; electromagnetic signature responses of sea ice at various frequencies; and to determine Arctic geophysical fabric of the ocean floor, and the linear relationship between ice stress dynamics gradients and ambient noise level under Arctic ice cap; all of which leads to an improved ASW capability in the Arctic. Development of accurate ocean tide prediction by means of sea floor/coastal gravity inversion, completion of low cost buoy system for measurement and transmission or wave, tide, surface temperature, and current data via over-the-horizon radar link for improved coastal and amphibious operations. Published compendium of Extremely Low Frequency electromagnetic fields produced in air by electric and magnetic dipoles under sea water in both vertical and horizontal positions; and of fields produced in seawater when the dipoles are in the air for electromagnetic communications through the air/water interface. Also demonstrated positive correlation between energetic particle precipitation and excessive attenuation of Extremely Low Frequency radio signals of mid- and high-latitudes which affect both tactical and strategic communications. Transition to Air Force/Defense Advanced Research Projects Agency of project to examine low range (low attenuation) seismic (pressure and shear waves) nuclear test detection; publication of key geomagnetic variational chaacteristics and indices for improved navigation and missile guidance. More recent accomplishments include: Completion design of wave packet refraction model for effects of distant storms on waves approaching coasts; and generation of new, efficient coastal data referral system and transfer of operational aspects to Naval Oceanographic Office for improved coastal and amphibious operation. Formulated and transferred ice distribution models to Naval Ocean Research and Development Activity to modify for operational evaluation and verification. Completed design, fabrication and testing of the Stimulated Emission of Energetic Particles (SEEP) Satellite Experimental package for measuring the effects of very low frequency radio waves on magnetosphere particles and the ionosphere, which may lead to better tactical and strategic communications; developed improved signal processing algorithm for seismic location of hostile artillery/vehicles; established characteristics of electromagnetic sea floor propagation by the lateral wave mode; and published signal-to-noise characteristics of seismic vs. acoustic detection as part of study to help overcome acoustic surveillance deficiencies in continental margin areas. Established transition project to determine mean low water reference level to meet Defense Mapping Agency requirement for accurate, worldwide coastal navigation charts. Development and evaluation of radar scattering models and theory and experiment in wave-wave interaction. Laboratory, tower, and aircraft radar measurements of wave spectra, currents, and winds using high frequency, X-band doppler, pulse-limited, and Delta-K radars. Development of millimeter-wave radiometric imaging systems and performance of first airborne measurements of sea, ice and coastal environments with millimeter-wave length electromagnetic imaging system which increases all weather operational capability.

Subelement: 32 Title: Terrestrial Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

2. (U) FY 1982 Program: Arctic Program: Continue acoustic experiments to investigate reverberation, ambient noise, propagation and sediment dynamics in the Barents Sea and eastern Arctic, as well as effects of the environment such as thermal fronts, ice and shallow water to improve Anti-Submarine Warfare operations in the Arctic. Continue buildup of special focus program in the Marginal Ice Zone to extend the horizon of knowledge of the sea-air-ice interaction and the geophysical dynamics, to increase capability to predict environmental effects on naval operations in and near ice covered oceans. The Marginal Ice Zone is a vital transition area from the temperate oceans to the ice-covered oceans. This new initiative is to provide hypotheses, models and experiments to develop a reasonable and accurate predictive capability for operating forces using this transition region. 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 operational capability in polar regions. Coastal Sciences: Continue basic research in coastal dynamic processes and responses as they relate to regional and local forcing functions and as they impact coastal and amphibious warfare. Emphasis will be placed on complementing research of strategic straits by developing an understanding of large epicontinental sea dynamics, physical structure, wave and current regimes, and sediment transport so that an integrated picture of the coastal environment can be developed. Continuing research on straits will include the hydrodynamic, acoustic, and geophysical conditions in strategic straits areas relying on participation in field expeditions to several key areas in cooperation with other Navy groups; the coastal data referral system will continue to be expanded with input from European and other interested NATO countries to enhance Naval operations in coastal areas worldwide. Remote sensing research will continue to emphasize electromagnetic and optical energy exchange with sea and land surfaces for measuring physical conditions at and beneath the surfaces which impact tactical and strategic operations; a project will begin on developing a covert, long-range communication system for ship-to-ship or -shore using the low cost disposable buoy system. Transition the television navigation/location system which improves navigation/location accuracy to exploratory development. Earth and Physics Program: Examine spatial and temporal geomagnetic field fluctuations and improve prediction methods for better missile guidance and navigation. Evaluate the potential of seismic detection as a complement to acoustic detection in shallow water by resolving energy partitioning, propagation properties, and signal-to-noise characteristics as a function of frequency, water depth, geologic structure, and bottom materials; to improve surveillance capability. Use coastal and sea floor tidal gravity measurements and available satellite altimetry data to improve worldwide tidal prediction. Conduct research on modeling of lateral electromagnetic waves to evaluate propagation along and in the sea floor for improved navigation and communication. Ionospheric Science Program: To improve tactical and strategic communications, complete launch and on-orbit phase for Stimulated Emission of Energetic Particles Satellite Experiment and start data analysis and modify Microwave Radiometer so that absorption and emission spectra of upper atmosphere water can be measured (monitor only) also continue ionosphere modeling; generation of long wave signals in the ionosphere, worldwide radio noise measurements, and theoretical investigation of cable antennas for submarine communications; continue theoretical research on

Subelement: 32 Title: Terrestrial Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

remote detection and classification of low altitude nuclear bursts at sea. Continue research on naval system vulnerability to nuclear burst effects. Surface-Wave-Scattering: To maximize use of remote sensing tool to support Naval operations, will accomplish: Analysis of wave, current and radar scattering data from Maritime Remote Sensing experiment. Analysis of Delta-K data wave measurement data from helicopter measurements. Development of 220 gigahertz imaging radiometer, measurements of ice, ocean targets, and terrain. Development of 90 gigahertz radar for precision measurement of land, ice and ocean scattering characteristics. Shipboard measurements of directional wave spectra with Remote Ocean Wave Spectrometer and Delta-K radar techniques.

3. (U) FY 1983 and FY 1984 Planned Programs: Arctic Research - 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 polar environment. Program will continue emphasis on the Eurasian Basin and East Greenland, Barents and Norwegian Seas using satellite, aircraft, surface and subsurface data gathering platforms, leading to improved measurement and forecasting of sea ice, acoustic, 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 affects on polar operations. Accelerate research in the marginal ice zone in the Greenland/Barents/Bering seas with major field program in FY 1983 in cooperation with other U.S. agencies and foreign countries (i.e., Norway). Continue research using a passive microwave imagery and radiometry radar to measure the properties and distribution of sea ice. Coastal Sciences - Continue interdisciplinary hydrodynamic-aerodynamic-morphodynamic research on highly variable estuarine, continental shelf/epicontinental sea environments to improve Navy and Marine Corps operations in coastal environments worldwide. Continue multidisciplinary research of strategic sea straits in conjunction with U.S. Naval Oceanographic Office cruises, other ships of opportunity, and foreign logistics support to increase data base. Continue research on electromagnetic and optical remote sensing capabilities for measuring coastal conditions to provide an all weather, remote, data gathering capability. Upgrading of coastal information referral system will continue along with airborne-acoustic and fluorescent remote sensing techniques to increase data base and widen geographic coverage. 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. Ionospheric Sciences Program - Analyze wave-particle interaction data from Stimulated Emission of Energetic Particles Satellite Experiment to determine impact on communications. Add water measuring capability to microwave radiometer for upper atmosphere water measurements which increases use of remote sensing to support Naval operations. Select either cable or peninsula antennas for experimental verification and planning of communication experiment for better tactical and strategic communications. Continue investigation of worldwide radio noise at long wavelengths; nuclear test detection at sea; ionosphere modeling and electromagnetic

wave generation and propagation research; and research on naval system vulnerability to nuclear burst effects. Surface-Wave Scattering Program - To optimize use of remote sensing tool to support Naval operations: Develop methods and techniques for determination of ocean parameters (orbital speed, wave spectra, currents, wind speed, and directional wave spectra). Complete millimeter-wave radiometric data acquisition, analysis, and system research for 90, 140, and 220 gigahertz. Initiate measurements, improve sensor performance model, and develop data processing system for measurement of ocean and terrestrial parameters with 94 gigahertz radar. Develop inversion algorithms for parameter retrieval from electromagnetic sensors. Emphasize development of methods and techniques for determination of terrestrial/coastal parameters to meet amphibious, U.S. Marine Corps, and mapping, charting and geodesy requirements.

4. (U) Resources

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 32	Terrestrial Sciences	12,706	14,415	17,536	19,272	Continuing	Continuing

Subelement: 33 Title: Atmospheric Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: Research relates to atmospheric problems 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 electro-optic systems; cloud physics and dynamics and lightning physics for improvement of flight safety, warning, and engineering design data for new aircraft control techniques; climate models in support of strategic planning; developing and testing general circulation and tropical cyclone prediction models; solar/terrestrial relationships as possible means for extending weather forecasts; study of solar dynamics by solar radiometry and imaging and high resolution spectroscopy; investigate relationships between geomagnetic response and variability of solar plasma and electromagnetic radiations; ionospheric plasma dynamics and solar control of the ionosphere including modeling of neutral and ionized atmospheres for improved prediction of conditions affecting naval communications, navigation, and surveillance systems; explore optical environment of earth; remote sensing of lower and upper atmosphere and interplanetary media for rapid measurement of environmental conditions and acquisition of wide-area data in support of naval operations; probes for rocket and satellite observations for ionosphere diagnostics.

(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 in cloud physics 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 chamber at University of Missouri; through New Mexico Institute of Mining and Technology and through coordination with Wright Patterson Air Force Base and the French Atomic Energy and Aerospace Establishment for research on triggered lighting; 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 with programs of Army and Air Force occurs through annual reviews by the Office of the Under Secretary of Defense for Research and Engineering. 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-Bioklimatische Forschungsstelle (Germany), and the University of Galway (Ireland), and the National Research Council (Canada).

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Research Laboratory, Washington, DC; Naval Postgraduate School, Monterey, CA; National Aeronautics and Space Administration, Huntsville, AL; (2) Industrial: Control Data Corporation, Minneapolis, MN; Atlantic Scientific Inc., Melbourne, FL; (3) Academic: New Mexico Institute of Mining and Technology, Socorro, NM; University of Miami, Miami, FL; University of Arizona, Tucson, AR; Massachusetts Institute of Technology, Boston, MA; University of Maryland, College Park, MD.

Subelement: 33 — Title: Atmospheric Sciences
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In Marine Boundary Layer area, tests of marine fog prediction models were prepared. Feasibility of multiple wavelength lidar for aerosol sensing examined. In Cloud Physics continue construction of advanced model cloud physics chamber at the University of Missouri (delivery promised from contractor by end of calender 1981); four parameter cloud rain-drop disdrometer for cloud rain-drop measurements for cloud physics and fog research programs almost completed; through evaluation of ultra long atmospheric waves attempted better understanding of stratospheric-tropospheric coupling (investigation proceeding); In Climate Model Research, examined seasonal succession of atmospheric flow in differentially heated precision rotating annulus by step changes in thermal Rossby Number (scientific results published showing succession depends on nonlinear dynamics and that analog weather situation are not applicable). In Solar-Terrestrial Research in preparation for Alternative Weather Forecasting Program conducted workshop to plan experimental program to test proposed mechanisms of solar reaction of atmosphere (proceedings in press). In Ionospheric and Atmospheric Modeling, expanded efforts to model neutral thermosphere including its composition, dynamics and thermodynamics (to continue with inclusion of magneto hydrodynamic factors) and extended model to include dynamic laminar ionosphere (completed); continued computer codes for calculating lower energy interaction of nuclei impinging on the atmosphere including effects of geomagnetic cutoff (accomplished). Use plasma probes to investigate equatorial electrojet (by rocket) and global ionospheric irregularity from a satellite (continuing with inclusion of polar effects); used Solar Wind Satellite coronagraphy data to study causes of magnetospheric/geomagnetic responses (In third year of data collection and continues). This approach will allow observing of coronal plasma irregularities as they develop and will allow following ejection of coronal clouds from the sun into the interplanetary medium and also toward the earth, with possible consequence of causing magnetic storms. It will be the only instrument of type operating during peak period of the solar cycle. A historic first for the Solar Wind Satellite was the observation of a comet entering the sun 30 August 1979. This event was unobserved from other satellites or ground observatories and opens new possibilities in reconaissance. Prepared Space Shuttle experiment to conduct extreme ultraviolet spectral survey of space environment. Planned for a joint program with Defense Nuclear Agency and National Aeronautics and Space Administration for observations with rocket and satellite instrumentation to be flown under Space Test Program and also a coordinated multi-instrument Low Altitude Satellite Study of Ionospheric Irregularities planned for Shuttle launch. Completed initial stages of a highly accurate lightning location net and transitioned it to Naval Air Systems Command.

2. (U) FY 1982 Programs: In Cloud Physics: Complete cloud physics chamber for experimental test of cloud models; develop models for genesis of severe storms at sea. In Climate Research: continue model scale experiments of global climate and seasonal succession; investigation on the formation and measurement of submicron particles and the global climatology of these particles. In Solar Terrestrial: continue effort on refinement of measurements to be taken during early Space Shuttle missions of solar images and spectra in the ultraviolet, to improve measurement of absolute solar output and its variability with wavelength in the far ultraviolet; investigate near-solar-maximum data on variability of solar plasma emission; continue efforts to characterize response of atmosphere to disturbances of solar wind, to map earth ultra-violet background, terrestrial helium distribution,

Subelement: 33 Title: Atmospheric Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

oxygen recombination at magnetic equator; prepare solar polar coronagraph mission (delayed by National Aeronautics and Space Administration funding); develop extreme ultraviolet monitoring techniques of state of disturbed ionosphere (going forward on the fiscal year 1983 Space Shuttle). In Ionospheric and Atmospheric dynamics and modeling: plan field program in alternative weather forecasting program to test theoretical concepts of solar-terrestrial reaction; extend theoretical work on modeling of artificial modification of ionospheric-magnetospheric system and on radio wave amplitude and phase scintillation during period of solar maximum (shifting emphasis from equatorial to high latitude effects). In the In-situ Probe area, continue investigation of Low Altitude Satellite Study of Ionospheric Irregularities and also rocket probe experiments of equatorial electrojet (combining with equatorial probing in calendar 1982). Prepare Space Shuttle environment and laboratory beam experiment (to continue for several years depending on shuttle schedule and collaborating with Air Force Geological Laboratory). Test wide band noise radar for ability to detect objects on ocean surface against wave clutter. Use available multiple aircraft to probe thunderstorm environment in connection with field program of induction of lightning strikes on demand. Begin preparation of detailed theoretical models of ice crystal formation and droplet nucleation and growth for test in experimental facility.

3. (U) FY 1983 and FY 1984 Planned Programs: Start planned experiments on cloud physics problems in cloud physics chamber. Start turbulence study in marine boundary layer; man cruise of USNS HAYES to Indian Ocean and Arabian Sea to study boundary layer processes and bioluminescence. Start development of single station forecasting technique. Begin program of desert meteorology to better understand sand storm situations and their forecasting. Begin study of scattering on nonspherical particles in the micron wave region. Extend studies to understand solar events and their interaction with the earths high atmosphere. Undertake effort to understand ionospheric irregularities, natural and disturbed and polar and equatorial, including effort toward model development. Attempt to fully understand induced ionospheric changes by heating, deposition or injection. Begin to develop imaging detectors with fast, full-readout capability.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 33	Atmospheric Sciences	6,221	6,446	6,805	7,469	Continuing	Continuing

Subelement: 34 — Title: Astronomy and Astrophysics
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: Scientific investigations are made of earth-space environment to determine characteristics of natural backgrounds, effects of energetic radiations 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; neutrino detection in the undersea radiation environment; characteristics of man-made disturbances; and supporting instrumentation and vehicle technology.

(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.

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Previous accomplishments include: A capability has been demonstrated for precise time determination and for increased accuracy for fundamental position reference systems by interferometer measurement of celestial radio sources. Initiated measurements of precise positions and radio emission regions of quasars and radio stars to determine reference sources. Collaborated with the Naval Observatory in implementation and evaluation of dedicated Navy radio interferometer for improvement in precise Universal Time determination for operational use. Constructed detectors used in: discovery and measurement of X-rays from the sun; establishing theoretical understanding of solar control of the ionosphere and shortwave radio fading; mapping and imaging X-ray sources including supernova remnants, pulsars, and as yet unexplained bursts which affect systems designed to detect nuclear explosions in space. Ultraviolet detection systems, culminating in the earth's electrographic camera, have provided data on stellar, cometary and atmospheric ultraviolet fluxes including discovery and imagery of the hydrogen geocorona at 1216 angstroms. Heavy ion studies resulted in the first reliable comparisons of rare elements and

Subelement: 34 Title: Astronomy and Astrophysics
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

isotopes notably lithium, beryllium, boron and helium-3 in space and the sun, and in reconstruction of nuclear transformation in space which revealed the source composition, and the breakup processes of heavy nuclei, thereby elucidating cosmic-ray propagation. Recent accomplishments include: The very large array has been used to chart the radio emission from the SS433 object, which is like a quasar but within the galaxy; hence, it is a key to the understanding of quasars. Radio star sources within the galaxy have been investigated to establish their relation to optical star positions. Conduct of very-long-baseline interferometry by satellite link has demonstrated the feasibility of a factor of ten increase in accuracy of time and position. Ground-based radio observations have been used to monitor the variation of ozone, and revealed a maximum of water vapor in the mesosphere. X-ray high emission sources studied from space included quasars, active galaxies, black hole candidates, neutron stars, pulsars, binary stellar systems, clusters of galaxies, and sources near the galactic center. A detailed catalog of the x-ray sky has been produced. A remarkable 30-second reverberating gamma-ray (x-ray) burst was observed and attributed to probable massive disruption of a neutron star. Gamma-ray data from the National Aeronautics and Space Administration-Solar Maximum Mission have yielded the first observation of gamma-radiation from the sun at energy greater than 10 million ergs, and also the first detection of neutrons from solar flares. New observations and interpretations have been made of ultraviolet day glow and aurorol emissions to infer the composition of, and physical processes in, the near-space atmosphere. Analysis of previous observations of celestial ultraviolet stellar and diffuse sources were made, and new observations conducted with improved instrumentation. New techniques of theoretical analysis of resonant light scattering in optically very thick media were applied to atmospheric studies. Development of cooperative balloon and cryogenic rocket experiments to observe celestial infrared sources continued for prospective flight in FY 1982. Flight hardware to detect heavy charged-particles from shuttle-launched spacecraft has been completed. An analytic model of all the sources of penetrating particle radiation in the near-earth environment has been developed. Cosmic ray composition has been found to differ from solar system composition. The first discovery of a comet from a spacecraft, from the first observation of a comet's collision with the sun, was made by a Naval Research Laboratory instrument aboard the DOD Space Test Program satellite P78-1. Debris was scattered outward over an entire solar hemisphere thus changing the coronal brightness for more than a full day.

2. (U) FY 1982 Program: In Extraterrestrial Radio Backgrounds and Techniques, precise time determination and transfer by interferometer of celestial radio sources will continue to be investigated and evaluated in collaboration with the Naval Observatory. Investigation of new time-transfer techniques will include United States-Europe operations in spring 1982 and employ both radio interferometry and satellite time transfer. Research on structure of radio sources and stars will continue. Investigation of celestial radio sources is to be pursued at wavelengths of 1 millimeter - 1 micrometer. Radio spectroscopy of mesospheric ozone moleculer oxygen, and water vapor will be conducted to attempt to elucidate the mechanisms of their variable behavior. Under Infrared Backgrounds, effort continues on joint Naval Research Laboratory/Air Force Geophysics Laboratory celestial background measurements program being engineered for the far infrared 30-120 micron region. The cryogenic telescope and a partial sensor array have been tested in this program and flight is scheduled to occur in winter of 1981. Under Gamma-Ray Backgrounds, detailed design for a high-sensitivity gamma-ray monitor for the National Aeronautics and Space Administration's

Subelement: 34
Program Element: 61153N
DoD Mission Area: 510 - Defense Research

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

Gamma-Ray Observatory will be carried forward with launch scheduled for 1988. In collaboration with University of New Hampshire, a solar gamma-ray monitor launched on 14 February 1980 will continue for some years (probable) to study energetic flare effects on National Aeronautics and Space Administration's Solar Maximum Mission Satellite. Under Ultraviolet and X-ray Backgrounds, two flights will be made with a new rocket payload with an X-ray telescope to provide high resolution images of X-ray sources and backgrounds. A flight is planned of a far ultraviolet stellar spectrograph and camera, with special emphasis on the 900-1200 angstrom wavelength region. Fundamental investigation of cosmic radiation will provide results for use in space of microeletronics and of man in space. In Supporting Instrumentation and Technology, effort is continuing to exploit rockets and superpressure balloons (utilized for gamma-ray observations) as low cost high-altitude test platforms for future instrumentation, including telemetry/control by satellite relay. Repackaged X-ray rocket system instrumentation will also be prepared for less-expensive adaptation to Shuttle flight under the National Aeronautics and Space Administration Experiment of Opportunity Payload program. Electrographic cameras are also being prepared for Shuttle flights under the DOD Space Test Program and the National Aeronautics and Space Administration Experiment of Opportunity Payload program.

3. (U) FY 1983 and FY 1984 Planned Programs: In Radio Backgrounds, development will continue of improved time and position determination, including satellite positions, and of improved basic astronomical position reference systems. Methods will be explored to relate radio and optical celestial reference systems through use of stars in the galaxy and asteroids. Observation of quasars and weaker sources will be made down to milliarcseconds resolution through participation in the full (MK III) very long baseline interferometric radio network of stations. Investigations of new natural sources of celestial radio radiation will be continued and extended to the submillimeter wavelength region. Mesospheric molecular constituent monitoring will continue in order to understand the full range of behavior of previously observed and additional species. Under Infrared Atmospheric and Celestial Background limits, reflight of the improved far-infrared telescope and sensor array is planned with Naval Research Laboratory/Air Force Geophysical Laboratory collaboration as before. This cooperative effort will also develop a large-angle infrared telescope system. Under Ultraviolet and X-ray Backgrounds, the analysis of data from ultraviolet instruments on three ultraviolet astronomy sounding rockets will be completed, to establish basis for interpreting space emissions. Effort will continue using new imaging and spectrographic instruments to measure space emissions. Ultraviolet instrumentation will be constructed for Shuttle/Spacelab, and charge-coupled device television readout of the Schmidt image converter will be designed for eventual satellite application. Flights are planned with ultraviolet instruments to measure the interstellar helium. Theoretical modeling of ultraviolet scattering in interplanetary space will be used to calculate tropospheric dissociation rates with greatly improved reliability. Continuing effort will extend the wavelength range of the Schmidt image converter from the far ultraviolet to include the middle ultraviolet and nearvisible, making it useful for ground-based and low-altitude, as well as space-borne, surveillance applications. Plans continue for implementation of an all-sky ultraviolet survey and ultraviolet surveillance tests. Under X-ray backgrounds, small Payload Ejection and Recovery experiments will be designed and built, for flight aboard the Shuttle, for X-ray mapping experiments. The new X-ray map will be expanded by special examinations of source-confused regions. A special survey will be carried out in the neighborhood surrounding the North

ecliptic pole. Large area X-ray position-readout proportional counters will be constructed for use with the ARIES rocket system for imaging studies of high energy sources. In Solar Phenomena, gamma radiation data processing and analysis will continue. A continuing program using extended balloon flights and (in the far future) a DOD Space Test Program Shuttle flight will measure gamma ray and hard x-ray background contributions from solar and celestial sources. In near-earth heavy ion fluxes, a means of estimating soft upsets to satellite-borne electronics will be developed. Also experiments will be conducted to characterize the near-earth and cosmic radiation effects on matter. In Supporting Technology effort will continue on a super pressure balloon with a float time of 50 days or more, and on the construction of instrumentation for satellite telemetry expanded for gamma ray measurements.

4. (U) Resources

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 34	Astronomy and Astrophysics	3,907	4,013	4,295	4,700	Continuing	Continuing

Subelement: 41 Title: Biological and Medical Sciences
Program Element: 61153N Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: The Biological and Medical Sciences Subelement provides knowledge of principles and mechanisms from which bioenvironmental and biomedical developments are derived. The research encompasses physiology, immunology and hematology, microbiology, biochemistry, biophysics, epidemiology, clinical medical sciences and naval biology. The work addresses problems related to Navy/Marine Corps operations, and emphasis is given to specific areas of: (a) Stress: such as pressure changes, temperature extremes, electromagnetic fields, toxic atmospheres and materials, isolation and fatigue, and human response to inertial forces; (b) Disease Prevention: related to specific diseases of potential naval importance in world wide sea control and amphibious operations; (c) Health Care: related to trauma, shock resuscitation, fluid and blood replacement, reconstructive surgery and wound healing in combat-wounded; (d) Bioecology: relates to biological processes as a means of controlling, preventing and understanding marine, terrestrial and atmospheric environmental effects related to naval operations.

(U) RELATED ACTIVITIES: This subelement is related to efforts of the Army, Air Force, Uniformed Services University of Health Sciences, National Aeronautics and Space Administration, National Institutes of Health, National Oceanic and Atmospheric Administration, 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 Services Biomedical Research Evaluation and Management (ASBREM) Committee, the Armed Forces Pest Management Board, the Armed Forces Epidemiology Board, the Department of State Federal Council for Science and Technology, the National Institutes of Health Office of International Health; and the North Atlantic Treaty Organization Advisory Group for Aerospace Research and Development Aerospace Medical Panel.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Naval Medical Research Institute, Bethesda, MD; Naval Aerospace Medical Research Laboratory, Pensacola, FL; Naval Biodynamics Laboratory, New Orleans, LA; Naval Health Research Center, San Diego, CA; Naval Submarine Medical Research Laboratory, Groton, CT; the overseas Naval Medical Research Units; Naval Air Development Center, Warminster, PA; the Armed Forces Radiobiology Institute, Bethesda, MD; and the Naval Biosciences Laboratory, Oakland, CA; (2) Industrial: QEI, Inc., Burlington, MA; Desmatic, Inc., State College, PA; (3) Non-Profit: American Institute of Biological Sciences, Arlington, VA; Undersea Medical Society, Rockwell, MD; Biomedical Research Institute, Rockwell, MD; (4) Universities: Georgetown University, Washington, DC; Harvard University, Cambridge, MA; University of Pennsylvania, Philadelphia, PA; University of Maryland, College Park, MD; University of Michigan, Ann Arbor, MI; University of California, Berkeley, CA; Baylor University, Houston, TX; Boston University Medical Center, Boston, MA; Stanford University, Palo Alto, CA; Johns Hopkins University, Baltimore, MD; University of Washington, Seattle, WA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Past accomplishments include major contributions to the area of diving physiology including decompression effects, breathing gas mixtures and inert gas narcosis; preservation and use of frozen blood components;

for treatment of battle casualties; prevention of loss of consciousness in aviators due to high-g accelerations and water impact; correlation of evoked brain potentials with sensory stimulation to determine potential performance; measurement of changes in brain magnetic fields for diagnosis of injury and tumors; microbial biodegradation of oil and pesticides in naval environments; producing universally transfusable red blood cells through enzymatic modification of the red blood cell membrane; to reduce the need for the storage of multiple blood types; development of vaccine for coccidioidomycosis; toxicity associated with shipboard fire gases; demonstrated effect of low-level microwaves on endothelial cells in cornea of eye; test for assessing the viability of preserved white blood cells; endotoxin effects in traumatic shock; sleep induction and post sleep performance; measurement of microwave induced biochemical and temperature changes; motion effects and impact injury prediction and modeling; post thaw viability and function of frozen blood platelets and white blood cells; oil pollution identification kit; vector/pest genetic control system. More recent accomplishments include demonstration of: microwave effects on cell-cell interactions and cell morphology; mechanism of shock reaction in relapsing fever therapy; mechanism of decay of enteric marine microorganisms; new method of polymerizing PGBX (a prostaglandin derivative); electrically stimulated organized regeneration of mammal bone and nerve tissue; simulated deep dive to 2132 feet; improved ultrasonic imaging of human tissue for identification/isolation of foreign bodies, e.g., shrapnel; improved laser surgery techniques; mechanism of preconcussive state following impact acceleration exposure.

2. (U) FY 1982 Program: In Stress, research on conservation of body heat in divers, inert gas narcosis, high pressure deafness, oxygen toxicity, high pressure nervous syndrome and inert gas isobaric counter-diffusion syndrome and modeling of motion effects will be continued. The electric, magnetic and physiological correlates of behavioral changes in response to stressful environments will continue to be investigated. The effects of electromagnetic fields will continue to be explored at the cellular and animal level with special attention to multiple simultaneous frequencies, biomedical applications and simultaneous effects with drugs. Studies on the physiology of sleep, the effects of sleep fragmentation, and/or the disruption of biological rhythms will be continued. Investigations of the chemical structure, assay methods and biochemical effects of a hormone-like chemical called PGBX will be continued. Research will commence on adaptation to cold exposure, and effects of cold on oxygen delivery and utilization by tissues and organs. In Disease Prevention, the application of anti-idiotypic antibodies effort will continue on immunological defense against disease. Work will be initiated utilizing recombinant DNA, monoclonal antibodies, and hybridoma technology and on mechanism of pathogenesis of diarrheal disease agents. In Health Care, the program on universal red blood cell donors will continue with emphasis on the effects of biochemical modification of red blood cell membrane on cellular function, specificity and feasibility of use in blood replacement therapy. Cellular interactions during wound healing will be studied. Investigation of biophysical aspects of regulation of cellular electrolytes and water in tissue cells will be continued in order to better understand the problem of resuscitation of traumatized personnel. Research will continue on immunology of preserved blood components and tissue grafts. Work will be initiated on synthetic oxygen-carrying resuscitative fluids. Expanded effort will relate to cold injury and rewarming. Bioecology Effort will continue on biological degradation of wood and metal, fouling of surfaces, control of pollutants, and the toxicity of wood preservatives and antifoulants in the marine environment. New emphasis

be given to microbiology of paint deterioration, the environmental impact of organotins, role of microorganisms in marine osion and alternative vector/pest control strategies.

(U) FY 1983 and FY 1984 Planned Programs: In Stress, research related to underwater physiology will continue to explore the owing: limitations imposed by pressure conditions approaching 3,500 feet of sea water; conservation of body heat, inert gas osis, high pressure deafness, oxygen toxicity, and inert gas isobaric counter-diffusion syndrome in divers. The work on lictive modeling for effects of ship's motion on crew performance will be continued with expanded effort on the effects of otation on crews. The investigation of electric, magnetic, and physiological correlates of behavioral change in response to ssful environments will be continued. Basic biomedical, biochemical, biophysical, and/or behavioral effects of different quencies of electromagnetic fields at the cellular level will continue to receive attention. Emphasis will continue to be n to the physiology of sleep, the effects of sleep fragmentation, and/or the disruption of biological rhythms. Research ociated with field operational medicine in extremely cold naval environments will be accelerated, with emphasis on techniques enhance cold adaptation and biochemical effects of cold during shock. Efforts are planned to access the effects of multiple ssors (e.g., fatigue, heat, noise, and g-forces) on the performance of Naval Aviators in high-speed aircraft. A program to stigate chemical-biological-radiation defense mechanisms of naval importance is in the early planning stage. Investigation of biochemistry of the hormone-like chemical PGBX will continue with expanded effort given to the physiological actions and nical applications. In research on Disease Prevention work on new or improved mechanisms of immunization against diseases of al importance will emphasize the investigation of anti-idotypic antibodies, monoclonal antibodies, hybridomas and the virulence liarrheal agents. In Health Care the program on development of universal red blood cell donors will continue to be expedited. utility of monoclonal antibodies for diagnosis and treatment of infection will be emphasized, as well as research on preserved od components and tissue grafts. Studies related to the medical uses of non-linear microscopy, and the electrical mediation of l growth will be initiated. New efforts are planned in the following areas: naturally occurring pain killers, biophysical trumentation, the toxic effects of chemicals, blood plasma proteins, and immunology. Increased emphasis will be placed on the stigation of wound healing by elecrtomagnetic fields and chemicals, non-toxic immunosuppression, and the effects of servation on peripheral blood and bone marrow cells. The potential of fibronectin, a naturally occurring blood protein, in the atment of wounds, burns and infections will be investigated. In Bioecology, increased emphasis will continue on mechanism of trolling or preventing marine, terrestrial, and atmospheric environmental effects on naval operations. Work in biodegration l be shifted toward corrosion of surfaces in seawater. Research will continue on vector/pest control with emphasis on oboard problems. Efforts will be expanded in bioluminescence, plants that produce oil and chemosensing. New efforts are ined in bioengineering for the production of biological materials and engineering of microorganisms and/or enzymes.

(U) Resources:

	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
lement 41	Biological and Medical Sciences	16,316	17,859	17,619	19,689	Continuing	Continuing

Subelement: 42 — Title: Behavioral and Social Sciences
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND 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: Organizational Effectiveness, focused on personnel characteristics, leadership and management techniques, and other factors that determine the productivity, morale, and retention of personnel; Personnel and Training, research on psychological measurement for selection and classification, human information-processing, training systems, learning and cognitive processes; and 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 to meet Navy and Marine Corps operational requirements.

(U) RELATED ACTIVITIES: The Office of Naval Research has efforts funded by Exploratory Development (Program Element 62763N, Personnel and Training Technology, and Program Element 62757N, Human Factors and Simulation Technology) which are closely coordinated with the Research-funded programs. Interdisciplinary research efforts are jointly funded with ONR's Information Systems, Operations Research and Physiology Programs. 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. Conferences and symposia in significant research areas, such as adaptive testing by computer, are cosponsored with appropriate Navy and Department of Defense activities.

(U) WORK PERFORMED BY: (Representative) (1) In-House: Navy Personnel Research and Development Center, San Diego, CA; (2) Industrial: Bolt, Beranek, Newman, Inc., Cambridge, MA; General Electric Co., Arlington, VA; Performance Measurement Associates, Inc., Vienna, VA; (3) Non-Profit: National Academy of Sciences, Washington, DC; (4) Academic: University of Illinois, Urbana, IL; University of Southern California, Los Angeles, CA; Yale University, New Haven, CT; Rice University, Houston, TX.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Previous accomplishments include: A comprehensive plan for research in support of Navy family programs; integrative review of maintenance training practices leading to specific recommendations for improved Navy training; application of intelligent computer-based instruction to tactics and electronic warfare training; research on computerized adaptive testing, leading to a joint-service program to test its feasibility for military selection. New diagnostic measures of exposure to stressors, now being used in research aimed at reducing Marine attrition. Verifying the power of that have formed the basis for specification of display requirements for instrumentation on underwater equipment and submersibles; a

theoretical model and experimental data on hypothesis generation, that provide an explanatory framework for the widespread trait of stubborn adherence to early hypotheses even in the face of contradictory data; theories and models of supervisory control, being applied to the design of underwater teleoperator systems. More recent accomplishments include: refinements in methods for predicting information processing workload and the identification of linkages between encoding, processing and response modalities; human performance models on which to base algorithms for use in sonar pre-processors and displays to enhance acoustic signal classification; conceptual models and advances in decision theory that contribute to understanding why human decision behavior so frequently deviates from logical and statistical norms; research on cognitive effects of aging with recommendations for Navy policy on retirement, medical standards, etc.; a method for detecting deliberate failure on military selection tests; determination of strategies underlying expert Marine land navigation practices; research on personnel turnover which culminated in a theory of the causes and consequences of turnover; creation and testing of a model of individual and job context variables, that provides for prediction of leaders' effectiveness under various circumstances; identification of factors accounting for the success (or failure) of job relevant communications between supervisors and subordinates. Research in neural science has shown that neuron selectivity for visual patterns does not develop in a pure noise environment, but requires repeated presentation of a patterned input.

2. (U) FY 1982 Program: Research in Organizational Effectiveness will complete survey research on sailors' decisions to stay in, or leave, the Navy after 20 years service. (This was delayed from FY 1981 due to difficulty in obtaining adequate numbers of respondents.) Research will be completed on new techniques to reduce Submarine School attrition. Research will be initiated to produce a theoretical model of factors influencing the acceptability and utilization of Navy training equipment. A field study will be conducted on factors that affect the success of personnel who change billets or jobs. Research in Personnel and Training seeks to extend model-based psychological testing procedures which simultaneously tap several abilities and to develop better methods for capitalizing on computerized test administration and scoring. Related research is concerned with the information-processing and cognitive demands of real-world tasks, particularly those that require spatial abilities and close coordination of concurrent mental processes. This work will produce selection guidelines and training methods for jobs in surface operations, aircraft piloting, etc. Other work seeks to discover the nature of advanced problem-solving skills such as those found in experienced boiler technicians and electronic technicians. Investigations of the organization and structure of instructions will seek to improve the efficacy of Navy training materials. Research in Engineering Psychology will investigate visual performance with advanced electronic display techniques including three-dimensional displays, to determine the unusual demands imposed on visual perception, and to explore new opportunities for information integration. Auditory reseach will focus on human capability to understand causal relationships among transient acoustic signals to determine the utility of these important cues for sonar target classification. Research on decision behavior will continue with increased attention to the process of problem formulation and the effects of various ways of organizing information on human judgment in various types of human tasks. An interdisciplinary program on user-computer interaction will investigate a dialogue management system, the effectiveness of data entry and retrieval techniques including graphics and interactive voice systems, human engineering aspects of software design and principles for

interactive computer displays. Neural science research will continue theoretical and experimental work on neuron selectivity in vision and other behavior.

3. (U) FY 1983 and FY 1984 Planned Programs: Expanded research in neural science will explore the internal and external factors which influence the organization of neural units involved in processing and storing information. In Organizational Effectiveness, leadership factors accounting for success of high-technology organizations will be investigated, research on new observational techniques for assessing leadership performance will be completed, and a new motivation and incentive model designed to improve prediction of worker productivity and morale will be tested. Personnel and Training research will include examination of little-explored opportunities for formatting and scoring test responses at a computer terminal, in richer, more sensitive ways, e.g. the use of response time and the scoring of solution paths in problem-solving exercises; research on technical training materials will explore multimedia, computerized systems for delivery of instructions; work on computer-based training will be oriented more towards microcomputers for distributed job-site training; research will be initiated on how to better motivate trainees, particularly as the recruit population and the set of possible training methods become more diverse. In the area of Engineering Psychology, models will be investigated to describe the performance effects of various work station designs and to predict task loadings on multiple operators; research on design for maintainability will verify performance models of fault isolation and investigate the potential of these models for predicting maintainability of alternate equipment configurations during the design process; during this period, research on supervisory control will explore human monitoring and fault detection functions in the control of dynamic plant processes representative of shipboard engineering systems; a new initiative will be pursued to integrate concepts and methods derived from human factors and artificial intelligence research, and to measure and quantify their potential for the enhancement of personnel performance and the reduction of skill demands in the operation and maintenance of Naval systems.

4. (U) Resources:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 42	Behavioral and Social Sciences	8,274	9,080	10,931	11,183	Continuing	Continuing

Subelement: 51 — Title: University Research Instrumentation
Program Element: 61153N — Title: Defense Research Sciences
DoD Mission Area: 510 - Defense Research — Budget Activity: 1-Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION: This subelement is being established to refurbish and upgrade research equipment in university laboratories that carry out Navy supported research programs. These university research programs are responsible for the flow of new ideas and results which provide much of the basis for the Navy'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 for the Navy.

(U) RELATED ACTIVITIES: A similar program is being established in the Army and the Air Force. These Department of Defense programs will be coordinated through the Office of the Under Secretary of Defense for Research and Engineering. It is not clear at this time how other Federal agencies will be responding to the special equipment needs of the research universities. As other programs are developed, coordination with these programs will take place.

(U) WORK PERFORMED BY: This is a university program. All universities doing research for the Navy will be eligible to compete for support of their equipment needs.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: New Project N/A

2. (U) FY 1982 Program: New Project N/A

3. (U) FY 1983 and 1984 Planned Programs: The emphasis of this program will be on the purchase of research equipment costing over $100,000 per item. These large purchases are poorly accommodated by limited resources in projects. University researchers supported by the Navy will be notified of this new program and given an opportunity to submit proposals for equipment purchases. These proposals will be rated based on the Navy'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

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

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

research, and artificial intelligence and robotics. It has been estimated that it would cost about $50,000,000 to bring the university laboratories doing Navy research up to industrial standards. Since this cannot be done in one year, this will be an ongoing program.

4. (U) RESOURCES:

	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Subelement 51	University Research Instrumentation	0	0	10,000	10,000	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62241N
Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

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

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	28,657	24,297	27,414	31,865	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

° Applies current technology advances, as listed in the projects above, to the changing performance requirements and environments of Navy aircraft operating from ships and of long endurance land based patrol aircraft

(U) BASIS FOR FY 1983 RDT&E REQUEST

° Develops technology to support Naval Aviation requirements in operating at sea where space is a premium, where toughness is a must, and where improved readiness is an absolute necessity. Specific technology areas include:

- Enhance aerodynamic performance of low aspect ratio winged, high speed aircraft configurations to minimize aircraft space requirements aboard ship
- Integrate flight sensor systems for improved durability

Program Element: 62241N
DoD Mission Area: 523 - Engineering Technology

Title: Aircraft Technology
Budget Activity: 1 - Technology Base

- Develop low cost structurally efficient airframes that are salt water corrosion resistant, reliable, repairable, and maintainable
- Improve flight control and display systems for all weather shipboard operations and weapon delivery
- Improve the life of aircraft engines to minimize 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
° Develops technology to support the Navy's mission to perform antisubmarine warfare with long endurance, land based patrol aircraft
° Provides the only source of funds for the development of Marine Corps Aviation technology for V/STOL exhaust plume thermal signature reduction, night angle rate bombing system, and USMC systems/concepts definition
° FY 1983 increase over FY 1982 funding results from initiating two major programs and focusing support on one major FY 1982 program; namely,

- Improved durability and damage tolerance of aircraft structures
- Development of components for 5,000 HP turboshaft engine for V/STOL and helicopter applications
- Continuation of a maneuvering flight path display guidance system

° As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work on development phases now planned or anticipated through 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands)

° The subprojects within the element have been regrouped for better definition and reporting of the work. Project WF41-400 has been eliminated, with the work appearing in Projects WF41-422, WF41-423, WF41-431, WF41-433, and WF41-451. Project WF41-461 has been divided into two Projects, WF41-461 and WF41-462. Project WF41-454, Electromagnetic Compatibility, was added in late FY 1981. Large changes in funding level among the projects between FY 1982 and FY 1983 are from regrouping of projects and not from changes in technical thrust, i.e., WF41-423. The decreases in P.E. funding for FY 1982 (-$6,361) and FY 1983 (-$6,208) are due to a change of Navy priorities for FY 1983 and Congressional action for FY 1982. The increase of $323K in FY 1981 is the result of extra support for the tilt-nacelle V/STOL program.

Program Element: 62241N
DoD Mission Area: 523 - Engineering Technology

Title: Aircraft Technology
Budget Activity: 1 - Technology Base

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	30,739	28,334	30,658	33,622	Continuing	Continuing
F41-400	Naval Aircraft Technology	8,268	9,647	10,582	11,599	Continuing	Continuing
F41-401	Air-Breathing Propulsion System Technology	5,404	4,602	4,990	5,499	Continuing	Continuing
F41-411	Systems Investigations	9,070	5,199	6,177	6,760	Continuing	Continuing
F41-421	Fluid Dynamics	3,884	3,580	3,890	4,263	Continuing	Continuing
F41-422	Structural Design and Test	965	1,466	1,595	1,748	Continuing	Continuing
F41-423	Vehicle Control	242	275	0	0	Continuing	Continuing
F41-451	Habitability/Personnel Protection/Damage Control	384	565	624	684	Continuing	Continuing
F41-461	Vehicle Handling/Servicing	2,522	3,000	2,800	3,069	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62241N
Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Aircraft are defined as those self-propelled, boosted, or towed airborne vehicles used for the strategic and tactical deployment of forces, weapons, materials, and supplies in support of naval warfare
- Projects within this program element are those whose principal objective is to provide the necessary understanding and application of current advances in technology to future aircraft of the U.S. Navy and Marine Corps

(U) RELATED ACTIVITIES

- Related to and coordinated with the advanced aircraft developments of the Army, Air Force, the National Aeronautics and Space Administration and the Defense Advanced Research Project Agency:

  - 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 multifunction control panel
  - Air Force/NASA/Navy will evaluate Navy developed light emitting diode multifunction 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
  - Navy/NASA development of a F404 engine composite outer duct panel
  - Navy/Army development of components for advanced technology 5000 HP turboprop engine
  - Navy developed transpiration cooled combustor to be incorporated in next TF-41 engine buy

(U) WORK PERFORMED BY

- *In-House* - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Air Development Center, Warminster, PA; Naval Air Engineering Center, Lakehurst, NJ; Naval Air Propulsion Center, Trenton, NJ; Naval Weapons Center, China Lake, CA

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62241N
DoD Mission Area: 523 - Engineering Technology

Title: Aircraft Technology
Budget Activity: 1 - Technology Base

- 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
- Academic - Lehigh University, Bethlehem, PA; Purdue University, Lafayette, IN; University of Dayton Research Institute, Dayton, OH; Stanford Research Institute, Stanford, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Defined flow field for reduction of exhaust plume thermal signature on Marine Corps V/STOL aircraft
1.2 Conducted a joined wing subsonic wind tunnel evaluation to verify reductions in drag levels
1.3 Completed technology applications associated with the Navy's trainer program, (VTXTS), the Marine Corps medium assault helo (V/HXM) and the Navy's electronics communications program (ECX) which have transitioned to the Acquisition Phase of procurement
1.4 Completed static, full scale testing of the circulation control wing with upper surface blowing using the NASA Quiet STOL Research Aircraft (QSRA) to demonstrate lift augmentation under real gas temperature conditions and verify small scale results
1.5 Completed design development of a composite structure wing capable of high strain levels with a potential 25 percent structural weight savings
1.6 Demonstrated a multifunction programmable keyboard utilizing light emitting diodes to provide a substantial equipment cost savings in the cockpit with improved reliability
1.7 Developed a 270 volt DC, 400 AMP line and bus contactor and a three phase inverter (270V DC to 115V, 400 cycle) as an interim step to the all 270V DC aircraft
1.8 Completed development of an advanced engine compressor with 50 percent fewer stages than current compressors at comparable pressure ratios
1.9 Completed shipboard trials of a display system for transmitting information to the pilot during carrier approach thereby improving recovery operations

2. (U) FY 1982 Program

2.1 Quantify potential reduction levels of a V/STOL exhaust plume thermal signature through analytical flow mixing techniques
2.2 Design and initiate fabrication of a joined wing transonic wind tunnel model to identify performance gains

2.3 Identify technology applications and designs for future attack/strike aircraft
2.4 Conduct a subsonic wind tunnel test of a full span circulation control wing with upper surface blowing to establish total aircraft high lift potential
2.5 Extend high strain wing composite technology to include high load transfer joints and verification testing
2.6 Demonstrate the multifunction keyboard with a liquid crystal flat panel advisory display to provide total cockpit integration
2.7 Demonstrate a 270V DC, 45 Kilowatt samarium cobalt generator with an expected efficiency of 90 percent
2.8 Complete the determination of the effects alternative/broad specification fuels have on the performance and operation of engines and their components
2.9 Select dry lubricants for replacing greased catapult systems to eliminate flight deck slipperiness and reduce loss of aircraft sliding overboard
2.10 Design a detailed Remotely Piloted Vehicle (RPV) airframe for a long endurance, at high altitudes to provide ocean surveillance

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Complete exhaust plume program through wind tunnel verification and transition to the AV-8B Program Office
3.2 Complete transonic wind tunnel testing and performance validation of the joined wing concept
3.3 Fabricate and flight test a Remotely Piloted Vehicle aircraft to verify aerodynamic design control capability and propulsion performance
3.4 Complete the technical assessment of circulation control wing with upper surface blowing for transition opportunity to advanced development
3.5 Initiate a major thrust to demonstrate improvements in structural durability and damage tolerance leading to improvements in aircraft survivability
3.6 Flight demonstrate a computer graphics generated maneuvering flight path guidance system on a head-up display
3.7 Apply a 270V DC power system to an all electric environmental control system
3.8 Initiate a new technology thrust to develop critical components for turboshaft engines with a goal of 30 to 50 percent fuel improvement for V/STOL and helo applications
3.9 Complete dry lubricants capapult program for transition to advanced or engineering development

Changes from FY 1982 to FY 1983

3.10 The increase in P.E. funding from FY 1982 to FY 1983 is due to a Congressional $5.2 million reduction in FY 1982, and the initiating of two major programs in FY 1983 and focusing support on one major FY 1982 program; namely:

- Improved durability and damage tolerance of aircraft structures

I. *Program Element: 62241N
DoD Mission Area: 523 - Engineering Technology

Title: Aircraft Technology
Budget Activity: 1 - Technology Base

- Development of components for 5000 HP turboshaft engine for V/STOL and helicopter applications
- Continuation of a maneuvering flight path display guidance system

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

5. (U) Milestones: Not applicable

II. Project: F41-423 Title: Vehicle Control
Program Element: 62241N Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports the development of vehicle control technology for advanced missions and improved sea based operations as applicable to naval aircraft, including Vertical/Short Take-off and Landing (V/STOL) aircraft
- Major objectives are to develop:
  - Functionally integrated control systems using advanced digital data processing technology for safe shipboard landing under adverse conditions with improved mission capability
  - Distributed sensor and system architectures adaptable to fiber-optic data links for improved survivability considering the severe deck environment and the enemy electromagnetic and ballistics weapons threat
  - Advanced flying qualities and stability and control design criteria for Navy unique improved sea based aircraft controllability
  - Head-up, helmet and multifunction displays and controls for reduced pilot workload and improved information transfer for controlling aircraft operating from sea based platforms and, as required, for advanced missions while realizing a reduction in training time and cost
  - Hardware technology including flat panel displays, modular sensors, and direct drive and electrically powered actuators to reduce complexity and deck support and maintenance problems

(U) RELATED ACTIVITIES

- Coordinated with other Navy Centers as well as the industrial technology base
- Uses ongoing developments by other military services and the National Aeronautics and Space Administration
- Participation in Tri-service working groups for coordinated developments:
  - Navy/NASA joint development and evaluation of liquid crystal multifunction control panel
  - Navy/NASA/Army joint development and evaluation of a direct view multifunction electroluminescent display panel
  - Navy/Army/Air Force jointly developed a high resolution (300 lines per inch) liquid crystal projection display panel
  - Air Force/NASA will procure and evaluate Navy developed Light Emitting Diode Multifunction control panel
  - Navy/Army joint participation on upgrading 15 year old flying quality specification for helicopters (MIL-8501A)

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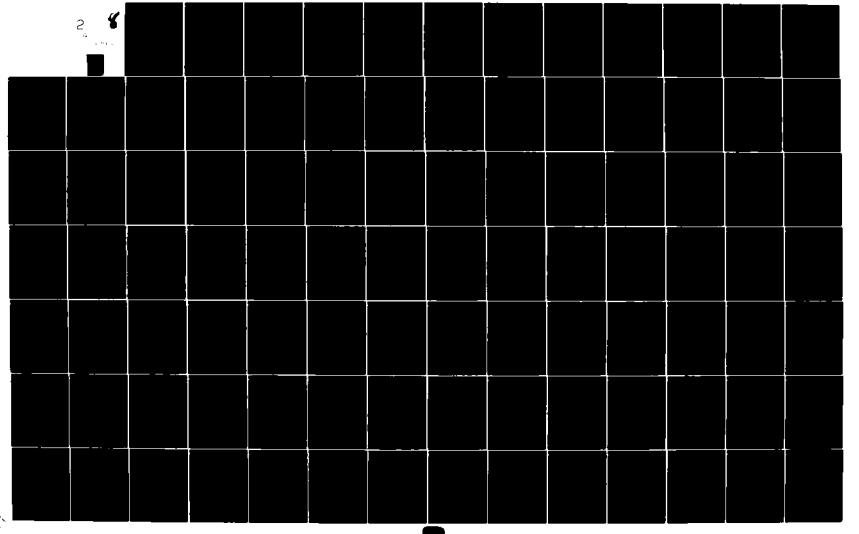

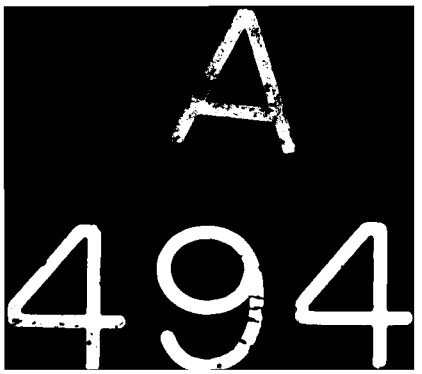
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II. Project: F41-423 Title: Vehicle Control
Program Element: 62241N Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) WORK PERFORMED BY

- In-House - Naval Air Development Center, Warminster, PA; Navy Ocean System Center, San Diego, CA; Naval Air Test Center, Patuxent River, MD; Naval Weapons Center, China Lake, CA
- Industrial - Hughes Aircraft Company, El Segundo, CA; Rockwell International, Thousand Oaks, CA; Hycom Inc., Irvine, CA; Honeywell Inc., Minneapolis, MN; General Electric, Utica, NY; Intermetrics Inc., Cambridge, MA; Bell Helicopter Textron, Fort Worth, TX; Grumman Aerospace, Bethpage, NY; Rockwell International, Columbus, OH; Systems Technology Inc., Hawthorne, CA; Sperry Flight Systems, Phoenix, AZ
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Display Systems

1.1 Developed a multifunction programmable keyboard utilizing light emitting diode display technology
1.2 Demonstrated a liquid crystal display with 3:1 resolution improvement

Flight Control

1.3 Successfully demonstrated the feasibility of skewing sensors thus requiring fewer components
1.4 Demonstrated a parallel fly-by-wire flight control actuator system for automatic landing of helicopters aboard ships at sea
1.5 Completed design for an electromechanical rudder actuator for demonstration in an F-14 testbed

Flight Dynamics

1.6 Published a comprehensive design handbook for estimating V/STOL aerodynamics/stability and control
1.7 Completed a flight research program on the X-22A aircraft designed to validate V/STOL translational rate control flying qualities criteria and published design guides suitable for future navy aircraft development
1.8 Completed a preliminary, but crucial, assessment of the helicopter flying qualities specification for Navy unique missions

II. Project: F41-423 Title: Vehicle Control
Program Element: 62241N Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: I - Technology Base

1.9 Accomplished flight investigations of Conventional Takeoff and Landing (CTOL) aircraft equivalent systems flight qualities criteria

2. (U) FY 1982 Program

Display Systems

2.1 Laboratory demonstration of beam-index color cathode ray tube breadboard
2.2 Laboratory demonstration of flat panel advisory display and multifunction programmable keyboard using light emitting diode and liquid crystal technology integrated with voice interaction technology

Flight Control

2.3 Investigate the application of advanced data processing technology to reduce the cost and weight of the flight control system
2.4 Study integrated propulsion and flight control system to enhance carrier approach characteristics
2.5 Develop control electronics for an electrically powered flight control actuator
2.6 Laboratory evaluate direct drive flight control actuator rotary valve

Flight Dynamics

2.7 Develop flying qualities design criteria for helicopters and advanced Short Takeoff and Landing (STOL) aircraft in shipboard recovery environment
2.8 Continue development of advanced fighter/attack and V/STOL flying qualities design criteria

Maneuvering Flight Path Guidance

2.9 Development of flight information required for optimum mission performance as well as shipboard landing

3. (U) FY 1983 and FY 1984 Planned Programs

Display Systems

3.1 Laboratory demonstration of a binocular-visor helmet mounted display breadboard

II. Project: F41-423 Title: Vehicle Control
Program Element: 62241N Title: Aircraft Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.2 Feasibility assessment/demonstration of multicolor thin film electroluminescent display technology
3.3 Laboratory demonstration of a video bus concept

Flight Control Systems

3.4 Provide feasibility demonstration of a flight control system using distributed microprocessing, and integrated avionics
3.5 Iron bird demonstration of an all-electric Rudder Actuator for an F-14 testbed
3.6 Flight demonstrate Modular Integrated Actuator using direct drive valve
3.7 Integrate inertial component sensor assembly with radio navigation aids

Flight Dynamics

3.8 Apply new technology base in flying qualities to ensure safer shipboard aircraft recovery and extend combat maneuverability through control-departure-resistant design guidelines

Maneuvering Flight Path Guidance

3.9 Flight demonstration and evaluation of simple path guidance concept

Comparison with FY 1982 Program:

3.10 The increase in FY 1983 funding over that for FY 1982 is due to additional support for the maneuvering flight path guidance system program

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated
F41-423	Vehicle Control	3,733	3,944	5,378	6,884	Continuing	g

FY 1983 RDT&E DESCRIPTIVE SUMMARY

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

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

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Develop advanced technology for solid and liquid-fuel, air-breathing and rocket propulsion systems for air, surface, and subsurface-launched guided and unguided missiles, and gun systems.

(U) BASIS FOR FY 1983 RDT&E REQUEST

- 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
- Improve guided and unguided 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
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

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

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

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-$132 in FY 1981, -$945 in FY 1982, and -$1,356 in FY 1983) are the result of budgetary readjustments and reductions as well as refined estimates of cost including escalation which are characteristic of research and exploratory development efforts

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9,633	9,481	10,192	10,972	Continuing	Continuing
F31-300	Air-Launched Guided Missile Propulsion	5,479	5,264	5,606	6,034	Continuing	Continuing
F31-332	Surface/Submarine-Launched Solid Missile Propulsion	1,845	2,055	2,242	2,414	Continuing	Continuing
F31-334	Surface/Submarine-Launched Airbreathing Missile Propulsion	2,309	2,162	2,344	2,524	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

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

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

(U) DETAILED BACKGROUND AND DESCRIPTION

° Air-Launched Guided Missile Propulsion

- Develops the necessary propulsion technology to solve present day deficiencies in current air-to-air and air-to-surface missiles and develops the technology for future long range missiles

° Surface/Submarine-Launched Solid Missile Propulsion Technology

- 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

° Surface/Submarine-Launched Airbreathing Missile Propulsion Technology

- Develops the technology for and evaluates components for 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

(U) RELATED ACTIVITIES

° Research efforts (P.E. 61153N) ongoing in high energy/low sensitivity synthesis work for propellant formulation and characterization

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62331N Title: Missile Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Related work in Strike Warfare (P.E. 62332N) in wide area defense, self-defense, and standoff jammer application as well as in the utilization of low vulnerability propellants (LOVA) for the 5"/54 ammunition improvement program (LOVA propellant development is done in this program element)
- Related work in Aircraft (P.E. 62241N) in materials and structures data for engine components and airframe designs
- National coordination of missile propulsion programs is accomplished via the Joint Army, Navy, NASA, and Air Force Interagency Propulsion Committee (JANNAF) 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 (TTCP) panel W-4 for Propulsion Technology
- International coordination is also accomplished through Data Exchange Agreements on Rocket and Ramjet technologies with France and Germany
- Propulsion technology for the Advanced Common Intercept Missile Demonstration (ACIM-D) is coordinated with P.E. 63308N, Air-to-Air Missile Technology Demonstration

(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, Alexandria, VA; Convair Dynamics, San Diego, CA; Hercules/ABL, Cumberland, MD; Marquardt Company, Van Nuys, CA; Martin Marietta, Orlando, FL; and McDonnell-Douglas Corporation, St. Louis, MO
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Air-Launched Guided Missile Propulsion

1.1 Successfully tested liquid fuel/solid fuel ramjet engines and their components
1.2 Technology developed for certain components of the Advanced Common Intercept Missile for fleet air defense
1.3 Successful completion of the joint Navy/USAF side dump Solid Fuel Ramjet Technology Demonstration Program

I. *Program Element: 62331N
Title: Missile Propulsion Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

Surface/Submarine-Launched Solid Missile Propulsion

1.4 A jet vane thrust vector control system with a cross-linked double-based propellant motor incorporating a low-cost strip laminate case and pneumatic actuator was successfully static fired
1.5 Analysis of Infrared and ultraviolet exhaust plume measurements of several tactical missiles indicates that static firings provide adequate information
1.6 Initial safety and fragment vulnerability testing has verified several low vulnerability (LOVA) gun propellants
1.7 Developed and demonstrated modular booster concept that allows, for example, vertical launch without major modifications to the basic missile system

Surface/Submarine-Launched Airbreathing Missile Propulsion

1.8 Proof-of-concept for Hypersonic Dual Combustion Ramjet combustion process has been demonstrated over a wide range of simulated flight conditions
1.9 Composite design of a tactical Hypersonic Air-breathing vehicle completed which demonstrates compatability with the weight and volume constraints of the Vertical Launcher
1.10 Wind tunnel testing of chin inlets for candidate multiple launch platform/anti-ship missile (MLP/ASM) configurations successfully completed and data incorporated in engine simulations
1.11 Successfully demonstrated rocket to ramjet transition with a flight-weight combustor and a high energy solid booster propellant for an integral-rocket-ramjet missile

2. (U) FY 1982 Program

Air-Launched Guided Missile Propulsion

2.1 Complete the additional component technology development for the Advanced Common Intercept Missile (ACIM)
2.2 Demonstrate a more reproducible, lower cost, castable gas generator propellant for air-launched weapons

Surface/Submarine-Launched Solid Missile Propulsion

2.3 Evaluate candidate compounds for propellant ingredients for Low-Hazard High Performance propellants
2.4 Initiate design trade-off studies of an anti-air warfare area defense restartable rocket propulsion system
2.5 Complete analysis of plume signature interference with ship's search and detection, and fire control system, and its effect on defensive capability
2.6 Initiate design and demonstration of an integral booster for the rocket Dual Combustion Hypersonic Ramjet concept

2.7 Continue evaluation of the effects of non-obtainable propellant ingredients
2.8 Select initial Low Vulnerability (LOVA) gun propellant candidates for Navy application

Surface/Submarine-Launched Airbreathing Missile Propulsion

2.9 Complete evaluation of the utility of hypersonic ramjets and rockets for the Wide Area Defense mission
2.10 Test the Hypersonic Dual Combustion Ramjet combustor at low Mach numbers
2.11 Apply an inlet flow analysis to the design of an inlet model for the Wide Area Defense missile and evaluate a nose entry inlet for the Area Defense missile
2.12 Modify combustor hardware to simulate the multiple launch platform, anti-ship missile (MLP/ASM) configuration with a shorter length and different exit nozzle size and initiate testing

3. (U) FY 1983 and FY 1984 Planned Programs

Air-Launched Guided Missile Propulsion

3.1 Perform semi-free jet ground testing of the inlet/combustor/fuel control, in flight weight hardware, for the Advanced Common Intercept Missile (ACIM-D)
3.2 Demonstrate an advanced technology, fire-safe rocket motor case which would be lighter and less voluminous than existing cases
3.3 Demonstrate a more reproducible, lower cost propellant for unguided rockets and JATO's

Surface/Submarine-Launched Solid Missile Propulsion

3.4 Select most promising high energy compounds for propellant ingredients
3.5 Complete component testing for the restartable rocket motor and initiate test of all-up system
3.6 Complete development of motor/signature design requirements to surface-launched motors based upon results of plume signature analysis
3.7 Complete baseline design of booster and development of critical components for the Hypersonic Dual Combustion Ramjet
3.8 Complete evaluation of the effect on changing manufacturing technology upon propellant ingredient availability
3.9 Complete safety and mechanical property characterization of gun propellant for selected Navy gun systems

Surface/Submarine-Launched Airbreathing Missile Propulsion

3.10 Design and fabricate high Mach number combustor for the Hypersonic Dual Combustion Ramjet

I. *Program Element: 62331N Title: Missile Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.11 Initiate high Mach number tests for the Wide Area Defense Missile inlet
3.12 Complete tests of combustor for multiple launch platform, anti-ship missile (MLP/ASM) and conduct analyses to optimize engine performance capabilities

Changes from FY 1982 to FY 1983

3.13 No significant changes in major thrusts

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

5. (U) Milestones: Not applicable

II. Project: F31-330
Program Element: 62331N
DoD Mission Area: 523 - Engineering Technology

Title: Air-Launched Guided Missile Propulsion
Title: Missile Propulsion Technology
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Pursues increased range, increased average velocity, and reduced plume signature in propulsion capabilities and improves reliability, storability, service life, operational safety, and decreased costs for Air-Launched missiles
- Develops the necessary propulsion technology to solve present day deficiencies in current Air-to-Air and Air-to-Surface missiles and develops the technology for future long range missiles
- Defines future propulsion requirements and develops the predictive tools needed in the analysis, design, and assessment of propulsion concepts
- Incorporates advances in thermal and structural materials, solid propellant density-impulse, and ramjet combustion efficiency into integral rocket/ramjet engine concepts for air launched application

(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 (ONR) as potential ingredients for an insensitive minimum smoke rocket propellant
- 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
- Propulsion technology for the Advanced Common Intercept Missile Demonstation (ACIM-D) is coordinated with P.E. 63308N, Air-to-Air Missile Technology Demonstration
- National coordination of missile propulsion programs of the Navy, Air Force, Army, and NASA is through the JANNAF Interagency Propulsion Committee with OUSDR&E as an ex-officio member. Information is disseminated through the Chemical Propulsion Information Agency (CPIA)
- International coordination of programs is accomplished through The Technical Cooperation Program (TTCP, W-4) and through Data Exchange Agreements

(U) WORK PERFORMED BY

- In-House - Naval Air Propulsion Center, Trenton, NJ; Naval Ordnance Station, Indian Head, MD; Naval Surface Weapons Center, White Oak Laboratory, White Oak, MD; and Naval Weapons Center, China Lake, CA
- Industrial - Atlantic Research Corporation, Gainesville, VA; Brunswick Corporation, Lincoln, NB; Chemical Systems Division of United Technologies, Sunnyvale, CA; Ford Aerospace, Newport Beach, CA; Futurecraft Corporation, City of Industry, CA;

II. Project: F31-330 Title: Air-Launched Guided Missile Propulsion
Program Element: 62331N Title: Missile Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Hercules/ARL, Cumberland, MD; Hercules, Magna, UT; The Marquardt Company, Van Nuys, CA; Thiokol Chemical Corporation, Huntsville, AL; and United Technology Research Center, Hartford, CT

° Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Successfully tested Liquid fuel/Solid fuel ramjet engines and their components in a free jet demonstration in the NASA-Lewis Tunnel
1.2 Technology developed for certain components of the Advanced Common Intercept Missile for fleet air defense including an advanced liquid ramjet and an integrated electronic fuel controller
1.3 Initial demonstration of the technology for a pulsed thrust rocket motor with a 20 to 1 thrust magnitude control
1.4 Completion of the joint Navy/USAF side dump, solid fuel ramjet technology demonstration program which verified angle-of-attack performance and excellent fuel utilization for small diameter air to surface motors
1.5 Demonstration of the technology necessary for development of high pressure (25,000 psi) stored gas systems for air-launched weapons and completed testing of a family of low cost castable gas generator propellants
1.6 Ceramic roller bearing technology completed for low cost turbojet engines
1.7 Formulations for high volumetric performance propellants were developed and tested, and shown to provide 7 to 10 percent increase in density-impulse over state-of-the-art propellants
1.8 Small scale tests of newly formulated metallized fuels for solid fuel ramjets resulted in performance gains of up to 57 percent over baseline fuels
1.9 Amorphous metals evaluated to reduce weight and increase strength in strip laminate motor cases

2. (U) FY 1982 Program

2.1 Complete development of a high performance, stably burning combustor, and the design of a stable high angle-of-attack inlet for the Advanced Common Intercept Missile
2.2 Demonstrate a more reproducible, lower cost, castable gas generator propellant for Air-launched weapons
2.3 Demonstrate near term rocket case technology which will provide increased carrier operational safety under shipboard damage control environments
2.4 Demonstrate side dump solid fuel ramjet technology suitable for mid-sized (10 inch diameter) air-to-surface missiles

ject: F31-330 Title: Air-Launched Guided Missile Propulsion
Element: 62331N Title: Missile Propulsion Technology
sion Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

FY 1983 and FY 1984 Planned Programs

3.1 Perform semi-freejet ground testing of the inlet/combustor/fuel control in flight weight hardware for the Advanced Common Intercept Missile demonstration (ACIM-D)
3.2 Demonstrate booster energy/safety/ballistic reliability for ACIM-D
3.3 Perform final flight-weight hardware demonstration for ACIM with booster to ramjet transition in FY 1984
3.4 Demonstrate an advanced technology rocket motor case which would be lighter and less voluminous than existing ones and would yield in a fire to prevent pressure build up leading to explosions
3.5 Exploit the technology developed for pulsed thrust rockets in the design of a mid-range air-to-air missile
3.6 Demonstrate the side-dump solid fuel ramjet technology with full-scale 15 inch diameter hardware
3.7 Develop an advanced rocket booster for the integral rocket-ramjet with increased specific impulse/density and perform static testing

Comparison with FY 1982 Program:

3.8 No significant changes in major thrusts

Program to Completion: This is a continuing program

Milestones: Not applicable

Resources (Dollars in Thousands)

Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Air-Launched Guided Missile Propulsion	5,183	5,045	5,410	5,490	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

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

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	**	**	**		
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 ($5,916M), was combined into Surface-to-Air Warfare Technology, Project F32-399, in FY 1981 ($2,453M)

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Addresses weaponry technology needs in Air-to-Air, Surface-to-Air, Air-to-Surface, Surface-to-Surface, Unique Marine Corps, and Theater Nuclear Weapon Warfare Areas
- Identifies weaponry technology needs and transition opportunities in each warfare area cited above
- Develops system design concepts for near and far-term needs
- Assesses state-of-the-art and risk of critical technologies associated with each system design concept
- Directs resources to critical technologies with good payoff potential versus investment

Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Investigate critical issues related to targeting/weapon control, medium/long range intercepts, and short-range weapon technology for air-to-air warfare
- Exploit emerging technology in radar dome materials, automatic target classification, and IR focal plane arrays for use in the design of electro-optical weaponry under adverse environments
- Develop advanced radar guidance/targeting components and concepts
- Collect and analyze data for design and evaluation of advanced electro-optical/electromagnetic frequency targeting and guidance sensor concepts
- Investigate missile guidance and control techniques, airframe configurations, and ordnance technologies to address
- Develop and evaluate missile concepts and hardware suitable for surface launched point defense and Marine Corps air defense needs
- Develop vulnerability data, fuzing, and warhead concepts to counter air defense threat targets at very high closing velocities
- Develop techniques to increase and assure effective standoff air-to-surface capability for attacking and destroying sea and land targets
- Develop techniques for transfer into standoff tactical missile programs such as HARPOON/Medium Range Air-to-Surface Missile (MRASM) product improvements and advanced anti-shipping missile developments
- Increase safety/reliability and reduce cost for guns, ammunition, bombs, projectile/bomb fuzing, and low vulnerability gun propelling charges
- Complete guided and unguided weapon effectiveness assessments against threat class CGN and AOR ships
- Maintain data bases and modeling techniques for target vulnerability, aerodynamic prediction, low vulnerability propellants, and target IR and RF signatures
- Develop Marine Corps unique weaponry improvements in helicopter transportable artillery, advanced vehicle armament, infantry weapons, and air defense
- Investigate weapon concepts for use in urban terrain environments and security/riot control assignments
- Support the development of a new generation of more effective and safe theater nuclear weapons for Navy and Marine Corps needs
- Increased funding for FY 1983 ($9,408K) allows reinitiation of planned essential technological efforts in air-to-air targeting, standoff tactical air-to-surface missiles, conventional air delivered ordnance, surface-to-surface missiles, naval gunnery, and theater nuclear weapons projects that were either eliminated or reduced to sub-critical levels by the Congressional budget cut in FY 1982. Examples of reinitiated efforts include:

- Initiate contract for Air-to-Air Fighter/Attack Avionics Targeting Demonstration hardware
- Rebuild technical expertise in fuel air explosive ordnance, binary chemical weapons, and aircraft guns
- Reinitiate projects in advanced Forward Looking Infrared (FLIR), and low cost guidance components
- Initiate efforts in surface-to-surface missile seekers
- Restore efforts to investigate submunition payloads, ship plate breeching mechanisms, aerodynamic shape improvements, and penetration performance of Naval projectiles
- Complete testing and evaluation of laser radar hardware for multi-target fire control
- Restore investigations to address
- Evaluate the Improved HAWK missile air defense system concept for Marine Corps application

° The funding increase will restore inhouse expertise in Navy/Marine Corps unique technology to efficacious program levels in the following areas:

- Low altitude over the water fuzing
- Directional ordnance systems
- Air and ship target vulnerability
- Lightweight infantry weapons and mobile air defense systems
- Target and aimpoint selective guidance
- Countermeasure resistant guidance and radar
- Aerodynamic prediction codes
- Low vulnerability propelling charges for Naval gunnery
- data bases for ships and aircraft
- IR focal plane array devices

° Funding profile for this continuing program includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

° The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Sumary are:

- The major change (-$548 in FY 1981, -$11,358 in FY 1982, and -$3,975 in FY 1983) results from reductions by Congressional action in FY 1982 and realignment to higher priority programs

Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

- Additional restructuring resulted from initiating projects F32-375, F32-390 and F32-396, combining project F32-392 into F32-399, and placing increased emphasis on Air-to-Air Warfare Technology

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	31,020	31,678	31,758	33,783	Continuing	Continuing
F32-300	Marine Corps Weaponry Technology	4,495	4,010	4,780	4,900	Continuing	Continuing
F32-389	Pulse Power Technology	0	2,900	*	*		
F32-391	Ship-Launched Anti-Surface Warfare Technology	2,568	2,608	3,188	3,375	Continuing	Continuing
F32-392	Medium/Long Range Surface-to-Air Technology	7,586	7,421	9,190	9,800	Continuing	Continuing
F32-393	High-Powered Radiation Technology	3,917	2,485	*	*		
F32-394	Air-to-Air Warfare Technology	4,872	4,225	5,000	5,308	Continuing	Continuing
F32-395	Air-to-Surface Warfare Technology	4,775	5,211	6,500	7,100	Continuirg	Continuing
F32-399	Point Defense Against Air Targets Technology	2,807	2,818	3,100	3,300	Continuing	Continuing

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

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

(U) DETAILED BACKGROUND AND DESCRIPTION

- Responsible for addressing weaponry technology needs in Air-to-Air, Air-to-Surface, Surface-to-Air, Surface-to-Surface, unique Marine Corps, and Theater Nuclear Warfare areas
- Identifies technology needs and transition opportunities and addresses critical technologies for both near- and far-term weaponry applications
- Develops advanced air and surface weaponry system concepts and technology for missiles, rockets, guns, launchers, free-fall weapons, and components
- Includes the technology areas of aerodynamics and structures, guidance and control, warheads and fuzes, missile launchers, gun mounts and propulsion, and electro-optics

  - Aerodynamics and structures technology interface the airframe or vehicle flight dynamics to internal subsystems and launchers
  - Guidance, control, and weapon-related targeting technology includes sensors, both electro-optical and radio frequency, signal and data processors, and autopilots
  - Fuzing technology is related to guidance technology in the development of sensors and signal and data processors
  - Warhead technology includes target damage mechanics, warhead mechanization, and weapon dynamics
  - Missile launcher and gun mount work includes application and integration of thermodynamic, kinematic, and structural technologies

(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 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)

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- 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 PEs 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)
° Efforts in this program are also coordinated with technology demonstration efforts under PE 63303N, 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 re also coordinated through the Tripartite Technical Coordination Program (TTCP)

(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
° Industrial - Aerojet Corporation, Azuza, CA; Ball 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
° Academic - California Institute of Technology, Pasadena, CA; Johns Hopkins University, Applied Physics Laboratory, Silver Spring, MD; Naval Postgraduate School, Monterey, CA; Georgia Institute of Technology, Atlanta, GA

1. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Marine Corps Weaponry Technology

1.1 Successful out-of-battery firing of 8" lightweight gun/howitzer carriage assembly allowed continuation of lightweight howitzer development
1.2 Successfully mounted and instrumented a large caliber gun on a lightweight, armored, full tracked vehicle
1.3 Model to predict vehicular dynamic response when subjected to large caliber gun recoil forces was developed and validated
1.4 A simple, low cost range control device was successfully tested for the Field Artillery Rocket System which will transition to Advanced Development under P.E. 63635M in FY 1982
1.5 The High Explosive (HE) equivalence of Fuel Air Explosive (FAE) has been established through testing against frame and concrete structures to provide a baseline for optimizing a man-portable system
1.6 Performance of Vibrating Beam Gyro (VYRO) increased by a factor of four offering potential breakthrough of low cost, no maintenance/calibration device for a variety of weapon applications
1.7 A concept for the application of technology for the evolutionary improvement of the Improved HAWK (IHAWK) missile system was formulated and anechoic chamber testing began
1.8 Brassboard Seeker Design for a Fire and Forget Anti-Tank Weapon was completed and fabrication of a feasibility demonstration model was initiated
1.9 Technology Assessment on chemical, electromagnetic, acoustic and mechanical systems as riot control devices was nearly completed
1.10 Feasibility of several concepts for breaching interior walls of buildings in urban environments was established
1.11 Use of aqueous foam as a sound pressure level reduction (blast hazard) technique was unsatisfactory and the work unit was terminated

Automatic Infrared Target Classification

1.12 New start in FY 1982.

Pulse Power Technology

1.13 Transferred to Directed Energy Technology (P.E. 62768N) in FY 1982 and reported therein

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

Advanced Weapon Concepts

1.14 New start planned for FY 1984

Ship Launched Anti-Surface Warfare Technology

1.15 Preliminary experiments identified practical techniques of obtaining starting material powders for fabricating infrared domes for use in high Mach number, high temperature environments
1.16 Tomahawk weaponeering estimates were completed against combatant ship classes
1.17 Weaponeering for surface platform weapons, 5" guns and Standard Missile (SM-1), was completed versus
1.18 Ballistic tests of a concept in 5"/54 gun showed equal muzzle velocity performance to that provided by M26 propellant with exceptionally smooth pressure time curves and much lower flame temperature
1.19 Phase I safety and vulnerability testing of the initial Low Vulnerability (LOVA) propellant charge candidates was completed (supporting work in gun propellants was provided by PE 62331N, Missile Propulsion Technology)
1.20 Specification for the programmable multi-option fuze target detecting device was completed and offers improved performance and reduced logistic cost
1.21 Lethality tests of projectile delivered M46 Submunitions against simulated missiles in topside launchers were completed
1.22 Three system concepts oriented toward upgrading in-service gun systems and one system concept for a long range surface-to-surface missile were defined and the associated critical technologies were identified to allow sharper focus of program efforts
1.23 Analytical model for predicting rocket motor exhaust blast effects on surrounding structures was completed and experimental results were documented

Medium/Long Range Surface-to-Air Technology

1.24 Combined with Point Defense Against Air Targets Technology into a project entitled Surface-to-Air Warfare Technology in FY 1982 and reported therein

High Powered Radiation Technology

1.25 Transferred to Directed Energy Technology (P.E. 62768N) in FY 1982 and reported therein

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

Air-to-Air Warfare Technology

1.26 Jammer permitting quick determination

1.27 Demonstrated the concept of a modular digital guidance and control system suitable for application to a range of missions and changing threat situations

1.28 concept was demonstrated by arena firings of several performance parameter modifications of an 8-inch diameter, 65 pound design

1.29 Simulated aerodynamic heating tests have shown superior performance of hot-pressed Spindel Sidewinder infrared domes

1.30 Catalog of representative scenes of several terrain and sky cloud backgrounds has been assembled from measurement data to provide standardized data for defining sensor sensitivity goals

1.31 Triservice standard plume modeling effort has been established which will reduce proliferation of models

Air-to-Surface Warfare Technology

1.32 Development and verification of data base was completed and classification using Fourier coefficients and moment features has been demonstrated (coordination is maintained with PE 62712N, Surface and Aerospace Target Surveillance)

1.33 Advanced anti-surface seeker competitive study efforts resulted in selection of a radar, using a technique to achieve required range and azimuth resolution for technology feasibility demonstration

1.34 Testing was initiated to measure the internal blast performance of material in comparison with other materials

1.35 Logic requirements have been determined and algorithms have been identified.

1.36 A demonstration model hybrid target acquisition system has been built which combines a radar and transceiver for detecting moving targets and flight test measurements have been made on target background and signatures

1.37 The Advanced Tactical Inertial Guidance System (ATIGS) and a Synthetic Aperture Radar have been selected for integration and feasibility demonstration of improved navigation and weapon delivery capability in PE 63306N, Advanced Air-Launched Air-to-Surface Missile Systems

1.38 Small-scale tests have indicated that burster tube material is critical to fuel air explosive distribution without preburn

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

Theater Nuclear Warfare

1.39 New start planned for FY 1982

Surface-to-Air Warfare Technology

1.40 Evaluation of countermeasures and sea state effects on correlation home-on-jam concept shows potential for

1.41 Completed evaluation of coherent on receive transmitter concept and concluded that with wide area defense missile trajectory constraints it is not competitive in performance with coherent sources for power levels greater than because of clutter cancellation problems

1.42 Developed and validated a very high velocity fragment plate penetration model accounting for the fragment shatter effect which occurs at very high impact velocity

1.43 Completed evaluation of alternative guidance modes for an advanced point defense missile showing command or command inertial to active terminal as the most viable guidance alternative for self defense needs

1.44 Integrated signal generator and receiver components into Radio Frequency (RF) subsystem breadboard of active seeker

1.45 Completed definition of solid rocket alternative for advanced point defense system

1.46 Tested and established characterization of an SM-2 with safe and arm and warhead initiation system

1.47 Completed laser radar flow system, signal processing electronics design, and tracker mount mechanical fabrication and initiated component installation in a trailer

1.48 A first model of the drive mechanism for a mirror track antenna system was demonstrated and preliminary design of the mirror, and twist reflector antenna was completed (coordination was maintained with PE 62712N, Surface and Aerospace Target Surveillance)

1.49 Completed failure mode effects analysis for incorporation in air target vulnerability data base

1.50 Extended axisymmetric non-airbreathing configuration code to MACH 8 and completed users guide

1.51 Published the FY 1982 Surface-Launched Weaponry Task Area Objectives Document to summarize the results of the Naval Sea Systems Command's top down approach in technology planning for surface-to-air and surface-to-surface systems

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

2. (U) FY 1982 Program

Marine Corps Weaponry Technology

2.1 Establish effect of muzzle brake on accuracy of vehicle mounted gun weapons
2.2 Determine practicality of improved flame weapon
2.3 Evaluate brassboard for a man-portable Fire and Forget Anti-Tank Weapon
2.4 Conduct missile on launcher evaluation of the Improved HAWK (IHAWK) missile using a multi-function/fire control radar
2.5 Establish feasibility of a small (hand grenade size) fuel-air explosive weapon for urban warfare
2.6 Expand the Vehicle Dynamic Response Model to include LVTP-7 and LVT(X) class vehicles
2.7 Initiate a feasibility investigation for employing DARPA developed, advanced shaped charge technology into the existing DRAGON Anti-Tank Missile
2.8 Examine the feasibility of employing to defeat enemy armor and material
2.9 Initiate family of weapon stations investigation for integration into advanced light armored/amphibian vehicles

Automatic Infrared Target Classification

2.10 Format data for computer input and examine the data for feature extraction

Advanced Weapon Concepts

2.11 Project F32-390 is a new start planned for FY 1984

Ship Launched Anti-Surface Warfare Technology

2.12 Investigate processing techniques for producing high fracture strength, tough and optical quality materials for thorough mechanical and optical testing (transitioned from Category 6.1 Research materials programs)
2.13 Complete physical and functional description.
2.14 Initiate physical and functional description and develop damage criteria and vulnerability data
2.15 Computerize Descriptive Data and initiate weaponeering efforts
2.16 Complete performance evaluation of stick propellent charges in 5"/54 guns
2.17 Complete trade-offs of most promising technology improvements to Close-In Weapon System concept and establish technology requirements and goals

I. *Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.18 Complete obturator band design handbook for ballistic projectiles
2.19 Demonstrate selected multi-option fuze target detecting device candidate
2.20 Establish baseline design and fabricate baseline model of surface-to-surface
2.21 Perform experimental rocket motor firings with Navy missiles to validate analytical models and evaluate thermal protection materials for surrounding shipboard structures and launchers
2.22 Initiate seeker concepts capable of providing [redacted] for surface-to-surface missiles

Air-to-Air Warfare Technology

2.23 Conduct rooftop tests of targeting
2.24 Complete signature measurement of special airborne target
2.25 Complete testing of low cost accelerometers and gyros for midcourse guidance
2.26 Develop Infrared Focal Plane Array (IRFPA) Camera for a mosaic seeker
2.27 Complete air-to-air system configuration definition for fighter/attack avionics targeting demonstration
2.28 Coordinate the following Advanced Common Interceptor Missile (ACIM) concept demonstration efforts with the Naval Sea Systems Command and MARCORPS:

- Assemble breadboard seeker and test
- Procure breadboard Inertial Measurement Unit (IMU) for initial evaluation
- Complete initial assessment of surface launch capability
- Continue vehicle and ordnance system design
- Propulsion efforts to be coordinated with PE 62331N, Missile Propulsion Technology and PE 63308N, Air-to-Air Missile Technology Demonstration

2.29 Evaluate aerodynamic prediction codes for airbreathing missiles and document efforts on axisymmetric body code
2.30 Continue development and evaluation of high speed, high temperature airframe and materials including radomes

Air-to-Surface Warfare Technology

2.31 Complete design of [redacted] fuze concepts
2.32 Fabricate and test brassboard active optical standoff (proximity) fuze concept
2.33 Fabricate and perform preliminary roof-top tests of brassboard Dual Mode Seeker
2.34 Complete upgraded design of Hybrid [redacted] Target Acquisition System (HYTAS) Concept

I. *Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.35 Demonstrate the feasibility of an inertial navigation aided high resolution synthetic aperture radar (SAR) for improved land weapon delivery by light attack aircraft
2.36 Design warhead for fabrication and testing
2.37 Initiate chamber/projectile design definition for a high performance gun concept
2.38 Complete design of low observable airbreathing propulsion airframe

Theater Nuclear Warfare

2.39 Establish project support team; initiate liaison with related groups in Navy systems offices as well as those in Department of Energy, SANDIA, Army, and Air Force; and prepare program plan
2.40 Initiate a Phase I study and investigate power sources for permissive action links

Surface-to-Air Warfare Technology

2.41 Complete evaluation of contractor efforts in rocket/ramjet comparison for wide area defense missiles
2.42 Complete integration tests and a comparative analysis quantifying the advantages of ordnance for Standard Missile, and document results
2.43 Initiate captive flight test efforts to demonstrate correlation home-on-jam guidance and control for wide area defense
2.44 Develop improved Lift/Drag ratio airframe design concept for a hypersonic wide area defense missile
2.45 Continue fabrication of antenna/gimbal/control and development of high power transmitter for active seeker

2.46 Complete evaluation of super federated modular digital missile concepts and initiate a point design for the RIM-7/AIM-7 system
2.47 Complete and test second generation mirror track antenna drive mechanism
2.48 Complete integration and laboratory tests of laser radar system and initiate limited tracking tests
2.49 Develop a baseline very high velocity staged warhead concept
2.50 Continue to maintain and update air target vulnerability data base by performing kill criteria analysis and preparing a vulnerability assessment

3. (U) FY 1983 and FY 1984 Planned Programs

*Program Element: 62332N
Mission Area: 523 - Engineering Technology

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

Marine Corps Weaponry Technology

3.1 Complete feasibility demonstration of enhancing mobility and firepower of the Improved HAWK (IHAWK) missile system for transition to PE 63318N
3.2 Complete feasibility investigation of concept for defeating enemy armor and material
3.3 Demonstrate the feasibility of a DARPA developed, advanced technology shaped charge warhead on existing DRAGON Anti-Tank Missile
3.4 Characterize and demonstrate advanced rate sensor (Vibrating Beam Gyro) weapon application
3.5 Transition man-portable fire and forget anti-tank weapon to Advanced Development
3.6 Demonstrate Lightweight 155 mm Howitzer
3.7 Demonstrate Wall Breaching Kit for military operations in urban terrain
3.8 Demonstrate LVTP vehicle armament enhancement
3.9 Design and evaluate a family of stabilized weapon stations capable of accepting a wide range of future weapons on light armored/amphibian vehicles

Automatic Infrared Target Classification

3.10 Complete development of signal processing concepts and algorithms for classification of ship targets

Advanced Weapon Concepts

3.11 Initiate development of advanced electro-optical (EO) technology for follow-on electro-optical weapons, sensors, and countermeasures

Ship Launched Anti-Surface Warfare Technology

3.12 Identify practical fabrication routes for manufacturing desired missile domes and transfer to manufacturing technology project in FY 1984
3.13 Develop physical and functional descriptions
3.14 Complete weaponeering efforts against ship classes
3.15 Complete Phase II safety, vulnerability, and performance testing of low vulnerability propelling charge configurations
3.16 Complete evaluation of multi-option fuze target detection device
3.17 Complete laboratory and functional evaluation of baseline surface-to-surface adaptive contact fuze model

I. *Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.18 Complete revised missile exhaust handbook to include guidelines and criteria for protecting shipboard structures and missile launchers

Air-to-Air Warfare Technology

3.19 Complete feasibility demonstration of Coherent Frequency Multiplexed Radars (CFMR) for targeting
3.20 Evaluate differential canard controlled low-drag airframe modifications to improve maneuverability and reduce roll torques as an AIM-9M product improvement
3.21 Assemble Infrared Mosaic brassboard seeker and develop signal processing techniques
3.22 Conduct laboratory demonstration of improved angular resolution home-on-jam seeker
3.23 Begin testing of midcourse and terminal guidance hardware for the Advanced Common Interceptor Missile concept
3.24 Conduct roof-top tests of air-to-air targeting system for Fighter/Attack Avionics Targeting Demonstration
3.25 Complete air-to-surface system configuration definition for Fighter/Attack Avionics Targeting Demonstration
3.26 Characterize target signatures for target/background discrimination
3.27 Perform captive flight tests of advanced Radio Frequency (RF) Solid State Semi-active/Active Mid Course and Termina Guidance components

Air-to-Surface Warfare Technology

3.28 Develop from a missile platform for transfer to HARPOON/Medium Range Air to Surface Missile (MRASM) product improvements
3.29 Fabricate brassboard and test Hybrid Target Acquisition System (HYTAS) concept
3.30 Develop and test advanced bomb fuzing components such as terrain sensors, and electric bomb fuze aircraft system improvements
3.31 Initiate integration and demonstration of high performance gun concept
3.32 Perform captive flight tests of
3.33 Fabricate and test warhead
3.34 Integrate circuit components and test
3.35 Fabricate and test models of Active Optical Standoff (Proximity) and Passive Radio Frequency Anti-Radiation Missile (RF ARM) (Proximity) Fuze Concepts with potential transfer to PE 63303N, Electromagnetic Radiation Source Elimination System Technology

I. *Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

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

Theater Nuclear Warfare

3.36 Complete Phase I Study
3.37 Perform a 155 mm projectile study

Surface-to-Air Warfare Technology

3.38 Modify a Unified Radome Limits (URLIM) Computer Code to include rain damage and infrared domes, define Infrared (IR) material and rain damage limits, and complete radome configuration design requirements for a hypersonic missile
3.39 Identify most promising candidates to provide improved maneuverablity, reduced time constant missile concept and verify performance with six degree-of-freedom model to assess impact on miss distance performance
3.40 Develop computer codes for predicting aerodynamic coefficients for non-axisymmetric airbreathing missiles
3.41 Fabricate and test a beam-steerable antenna subsystem on a full scale 360 degree roll missile mock-up for application to very high velocity intercept air defense encounters
3.42 Design, fabricate, test, and evaluate a full-scale very high velocity staged warhead
3.43 Complete home-on-jam midcourse guidance efforts and captive flight tests of a correlation home-on-jam guidance concept
3.44 Integrate low power components into seeker and complete tests
3.45 Complete evaluation of modular digital guidance for RIM-7/AIM-7 application
3.46 Integrate low power mirror track radar components into a test bed, complete development of active components, and perform field tests
3.47 Complete Laser Radar field testing to demonstrate
3.48 Development and maintenance of approximate and numerical aeroprediction codes and air target vulnerability data bases will continue

Changes from FY 1982 to FY 1983

3.49 Increase in funding for FY 1983 (+$9,408 thousand) allows reinitiation of planned essential technological efforts in air-to-air targeting, standoff tactical air-to-surface missiles, conventional air delivered ordnance, surface-to-surface missiles, naval gunnery, theater nuclear weapons, and mobile air defense projects that were either eliminated or reduced to sub-critical levels as a result of the Congressional budget cut in FY 1982. Examples of reinitiated efforts include:

- Initiate contract for Air-to-Air Fighter/Attack Avionics Targeting Demonstration hardware
- Rebuild technical expertise in fuel air explosive ordnance, binary chemical weapons, and aircraft guns

I. *Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Reinitiate projects in warheads, advanced Forward Looking Infrared, and low cost guidance components
- Initiate efforts in surface-to-surface seekers
- Restore efforts to investigate submunition payloads, ship plate breeching mechanisms, aerodynamic shape improvements, and penetration performance of Naval projectiles
- Complete testing and evaluation of laser radar hardware for multi-target fire control
- Restore investigations to address
- Evaluate the missile HAWK air defense system for Marine Corps application

° The funding increase will restore Navy/Marine Corps unique technology to efficacious program levels in the following areas:

- Low altitude over the water fuzing
- Directional ordnance systems
- Air and ship target vulnerability
- Lightweight infantry weapons
- Target and aimpoint selective guidance
- Countermeasure resistant guidance and radar
- Aerodynamic prediction codes
- Low vulnerability propelling charges for Naval gunnery
- data bases for ships and aircraft
- Infrared focal plane array devices

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

5. (U) Milestones: Not applicable

11. Project: F32-394 Title: Air-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports the development and maintenance of technology for air-launched air-to-air warfare systems in the areas of guidance and control, weapon-related targeting, aerodynamics, structures, launchers, warheads, and fuzes
- Investigates critical issues related to targeting/weapon control, medium/long range intercepts, and short-range weapon technology for air-to-air warfare
- Develops and maintains techniques/data bases necessary for the development of future weapon systems
- Technology improvements supporting maneuvering air combat are directed at improved heads-up targeting and high lethality short time-to-target missiles with an increased off-axis, all-quadrant engagement capability
- Driving threat parameters include aircraft and missiles with operational flight capabilities,
- Specific thrusts being addressed include:

  - Demonstration of technology applicable to an advanced air-to-air interceptor missile concept
  - Development of mosaic Infrared (IR) Focal plane arrays for advanced seekers
  - Development of Coherent Frequency Multiplex Radar (CFMR) to improve weapon targeting in jamming environments
  - Evaluation of radar technology
  - Measurement of Infrared/Radio Frequency (IR/RF) signatures of airborne targets and backgrounds
  - Evaluation of advanced aerodynamic configurations and control concepts for missiles
  - Development and evaluation of high speed, high temperature airframe materials including radomes
  - Demonstration of technology applicable to fighter/attack avionics for targeting
  - Development of semi-active/active midcourse and terminal guidance components
  - fuzes for improved burst point control
  - Evaluation of low-cost accelerometers and gyros

(U) RELATED ACTIVITIES

- Work is coordinated through the Joint Logistics Commanders Joint Technical Coordinating Groups for Munitions Effectiveness; the joint Army, Navy, and Air Force Propulsion Committee; the Joint Logistics Commanders Fuze Management Organization; the Joint Services Guidance and Control Committee; and Navy Aeroballistics Committee
- Further coordination is effected through the Weapon Technology Coordinating Paper, exchanges of planning documents and interservice meetings, and the Tripartite Technical Coordination Program (TTCP)

II. Project: F32-394
Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

Title: Air-to-Air Warfare Technology
Title: Strike Warfare Weaponry Technology
Budget Activity: 1 - Technology Base

- Efforts in this program are closely coordinated with ongoing technology efforts under PE 62331N, Missile Propulsion Technology; PE 62633N, Undersea Warfare Weaponry Technology (explosives development, effects, and safety); and PE 62761N, Materials Technology
- Efforts are also coordinated with technology demonstration efforts under P.E. 63308N, Air-to-Air Missile Technology Demonstration

(U) WORK PERFORMED BY

- In-House - Naval Weapons Center, China Lake, CA; Naval Ordnance Station, Indian Head, MD; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA and White Oak Laboratory, Silver Spring, MD; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD
- Industrial - Denver Research Institute, Denver, CO; Grumman, Bethpage, Long Island, NY; Hughes Aircraft, Culver City, CA; McDonnell-Douglas Astronautics, St. Louis, MO; Texas Instruments, Dallas, TX
- Academic - Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; Georgia Institute of Technology, Atlanta, GA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Developed a jammer permitting quick determination

1.2 Demonstrated a modular digital guidance and control system suitable for application to a range of missions
1.3 Arena tested concepts to evaluate design parameter modifications in 8-inch diameter, 65-pound size design
1.4 Performed simulated aerodynamic heating tests of materials offering superior performance
1.5 Assembled a catalog of representative scenes of several terrain and sky cloud backgrounds from infrared and radio frequency measurement data
1.6 A baseline missile concept, the Advanced Common Interceptor Missile (ACIM), was proposed for a joint technology demonstration to demonstrate utility in both the air and surface launched roles
1.7 Transitioned Charge Coupled Device (CCD) Seeker for Air-to-Air missiles to P.E. 63308N
1.8 Developed signal processing techniques for F-14/AWG-9
1.9 Developed techniques used in AIM-7M SPARROW and AIM-54C PHOENIX missiles

II. Project: F32-394 Title: Air-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.10 Demonstrated Controlled Pattern Warhead used in AIM-7M SPARROW and AIM-9M SIDEWINDER missiles respectively
1.11 Demonstrated Active Optical fuzing, high response signal processor, and gimbal control tracking loop used in SIDEWINDER missile
1.12 Demonstrated for AIM-9M SIDEWINDER missile

2. (U) FY 1982 Program

Technology for Short Range Air-to-Air Missiles

2.1 Initiate evaluation of differential canard control configurations as a means of improving missile maneuverability and reducing roll torques and drag
2.2 Develop/evaluate Infrared Mosaic Seeker Technology
2.3 Initiate evaluation of Infrared Charge Coupled Device and advanced hybrid arrays matched to nonuniformity correction electronics
2.4 Design and begin fabrication of Active Optical (CO_2 Laser) Heterodyne Detection Seekers
2.5 Design transceiver brassboard for Scanning Coherent Optical Fuze
2.6 Perform high angle of attack aerodynamics measurements for air breathing missile configurations

Technology for Medium to Long Range Air-to-Air Missiles

2.7 Evaluate a solid state transmitter to provide a multi-target capability
2.8 Develop a Cassegrain radio frequency antenna for small diameter missiles
2.9 Investigate super federated modular digital missile technology for reduced cost and manufacturing complexity
2.10 Pursue multi-jammer counter countermeasures
2.11 Perform evaluation and end-game analysis of aimable ordnance for providing improved lethality
2.12 Design fuzes for improved burst point control
2.13 Evaluate thermal structural materials for long range high speed missiles
2.14 Evaluate advanced aerodynamic configurations and control concepts for airbreathing missiles
2.15 Develop lightweight materials and structures for long range, high speed airbreathing intercept missile
2.16 Continue efforts for the Advanced Common Interceptor Missile (ACIM) concept demonstration

- Assemble and test breadboard seeker
- Procure breadboard Inertial Measurement Unit (IMU) for initial evaluation
- Continue vehicle and ordnance system design

- Coordinate propulsion efforts being conducted under PE 62331N, Missile Propulsion Technology and PE 63308N, Air-to-Air Missile Technology Demonstration

Long Range and Countermeasure Resistant Targeting Radar Technology

2.17 Perform rooftop testing of transmitter/receiver
2.18 Initiate brassboard fabrication of coherent frequency modulated radar
2.19 Design Transmit/Receive modules
2.20 Develop multi-sensor techniques
2.21 Complete air-to-air system configuration definition for Fighter/Attack Avionics Targeting demonstration

3. (U) FY 1983 and FY 1984 Planned Programs

Technology for Short Range Air-to-Air Missiles

3.1 Complete feasibility demonstration of the differential canard configuration and control concept
3.2 Complete and document the high angle of attack aerodynamics measurement program
3.3 Continue effort on IR Focal Plane Array seeker technology development
3.4 Effort will continue on Scanning Coherent Optical Fuze technology development including counter countermeasures techniques

Technology for Medium to Long Range Air-to-Air Missiles

3.5 Complete super federated modular digital missile efforts and transition technology
3.6 Complete Cassegrain antenna feasibility demonstration and transition technology
3.7 Thermal structural evaluation will be completed
3.8 Multi-jammer counter countermeasure technology efforts will be completed
3.9 Complete fuze technology efforts
3.10 Complete evaluation of metal matrix tail structural properties
3.11 Complete and document advanced aerodynamics configuration control concept evaluation for future applications
3.12 Initiate efforts on technology development for advanced RF guidance
3.13 Initiate efforts to develop transmitter technology for air-to-air seekers
3.14 Initiate efforts on advanced multi-mode dome technology
3.15 Conduct midcourse and terminal guidance testing of Advanced Common Interceptor Missile (ACIM) demonstration hardware

II. Project: F32-394 Title: Air-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Long Range Countermeasure Resistant Targeting Radar Technology

3.16 Technology development for [redacted] will be completed and ready to transition to the F-14/AWG-9 Radar Improvement Program
3.17 Effort on [redacted] Coherent Frequency Multiplex Radar (CFMR) transmit/receive modules will be complete and technology will be ready for transition
3.18 Modify test-bed aircraft for installation of Fighter/Attack Avionics Targeting demonstration air-to-air system hardware
3.19 Conduct roof-top tests of Fighter/Attack Avionics Targeting air-to-air system
3.20 Complete air-to-surface system configuration definition for Fighter/Attack Avionics Targeting demonstration

Comparison with FY 1982 Program:

3.21 The funding increase for FY 1983 over FY 1982 (+$2,623 thousand) allows reinitiation of planned essential technology efforts in air-to-air targeting, guidance, IR focal plane array, missile airframe aerodynamics evaluation, and fuzing projects that were eliminated or reduced to sub-critical levels as a result of the Congressional budget cut of FY 1982. Examples of reinitiated efforts include:

- Initiate contract for air-to-air Fighter/Attack Avionics Targeting Demonstration hardware
- Reinitiate projects in low cost guidance components
- Reinitiate multi-sensor targeting investigations and counter countermesure guidance technique
- Initiate aerodynamic codes development and evaluation of airbreathing missile configurations
- Pursue optical scanning fuze technology for air-to-air applications

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F32-394	Air-to-Air Warfare Technology	6,195	6,040	8,663	9,053	Continuing	Continuing

III. Project: F32-395 Title: Air-to-Surface Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports the development and maintenance of technology for air-launched anti-surface weapons in the areas of guidance, control, weapon-related targeting, aerodynamics, structures, launchers, warheads, and fuzes
- Addresses improvement of conventional free-fall munitions as well as precision guided direct and standoff weapons that can be delivered with a high probability of aircraft survival
- Pursues technologies to provide high utility, cost effective conventional munitions which can be delivered more accurately and with positive forward air control for close air support
- Lethality against large or hardened targets is addressed through improvements in ordnance and through investigations of more accurate guidance systems with both target and aimpoint selectivity
- Stresses all-weather attack technology with major emphasis on higher utility weapon system concepts which can attack both sea and land targets, including air defense sites
- Addresses weapon associated targeting/weapon control avionics which can effectively support tactical standoff missiles or conventional ordnance
- Driving threat parameters include land and sea targets that are intensely protected

- Specific thrusts being addressed include:

  - Demonstrate feasibility of an inertial laser navigation aided high resolution synthetic aperture radar for improved land and sea weapon delivery by light attack aircraft
  - Investigation of a Hybrid Target Acquisition System (HYTAS) Concept
  - Evaluation of survivable concepts
  - Design and evaluation of Ship Target Recognition RF and IR Guidance Seekers
  - Development of Dual Mode Seekers
  - Design, fabrication, and testing of Active Optical and Passive RF Anti-Radiation Missile Proximity Fuze Concepts
  - Design, fabricate, and test IR Focal Plane Array for Targeting
  - Design, fabricate, and test warhead
  - Investigate high performance gun and advanced free fall ordnance fuze concepts

(U) RELATED ACTIVITIES

- Work is coordinated through the Joint Logistics Commanders Joint Technical Coordinating Groups for Munitions Development; the Joint Service Fuze Management Committee; and the Navy Aeroballistics Committee

III. Project: F32-395 Title: Air-to-Surface Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Further coordination is effected through the DOD Mission Area Summary Technical Coordinating Papers on weapon technology, exchange of planning documents, informal interface meetings with other service commands and laboratories, and the Tripartite Technical Coordination Program (TTCP)
- Efforts in this program are closely coordinated with ongoing technology efforts under PE 62712N, Surface and Aerospace Target Surveillance; PE 62633N, Undersea Warfare Weaponry Technology (explosives development, safety, and effects); and PE 62761N, Materials Technology (tactical portions)
- Efforts in the program are also coordinated with technology demonstration efforts under PE 63303N, Electromagnetic Radiation Source Elimination System Technology; and PE 63306N, Advanced Air-Launched Air-to-Surface Missile Systems

(U) WORK PERFORMED BY

- In-House - Naval Weapons Center, China Lake, CA; Naval Avionics Center, Indianapolis, IN; Pacific Missile Test Center, Pt. Mugu, CA; Naval Surface Weapons Center, Dahlgren, Va and White Oak Laboratory, Silver Spring, MD
- Industrial - Bendix, Phoenix, AZ; Emerson Electric, St. Louis, MO; Nielson Engineering and Research, Palo Alto, CA
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (C) FY 1981 and Prior Accomplishments

1.1 Classification has been demonstrated using Fourier coefficients and moment features
1.2 Internal blast model was expanded to include metals as fuels
1.3 Combined targeting sensors demonstrated that ground targets could be acquired in both Radio Frequency (RF) and Infrared (IR) at ranges
1.4 Survivable fuze modules performed successfully in four moderate hard target penetration tests
1.5 technology transitioned to Medium Range Air-to-Surface Missile (MRASM)/TOMAHAWK
1.6 transitioned to TOMAHAWK
1.7 Advanced Tactical Inertial Guidance System (ATIGS) ring laser gyro technology transitioned to MRASM
1.8 warhead design was transferred to TOMAHAWK as a backup warhead
1.9 Air burst fuze technology was demonstrated for the Fuel Air Explosive (FAE-II) ordnance system
1.10 warhead and fuze technology transferred to CBU-59 (Anti-Personnel Anti-Material) ordnance

III. Project: F32-395 Title: Air-to-Surface Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.11 transitioned to the A-6E Target Recognition Attack Multisensor (TRAM) Forward Looking Infrared (FLIR)
1.12 transitioned into the guidance seeker for AGM-65D (MAVERICK)
1.13 transferred to the A-6E Conversion in lieu of procurement (CILOP) All-Weather Standoff Attack Control System (AWSACS)
1.14 Micrad all weather land and sea seeker technology transitioned to P.E. 63306N
1.15 Ship and land target warhead for standoff Air-to-Surface missiles transitioned to P.E. 63306N

2. (U) FY 1982 Program

Technology for Standoff Air-to-Surface Missiles

2.1 Investigate infrared (IR) and radio frequency (RF) missile seekers capable of
2.2 Establish warhead design
2.3 Design high-shock-survivable modules
2.4 Fabricate and test a Land/Sea Optical Standoff Fuze brassboard model
2.5 Fabricate and test low observable airframe models
2.6 Investigate Passive RF Anti-Radiation Missile fuze concepts
2.7 Develop improved midcourse guidance components

Technology for Freefall Ordnance

2.8 Investigate Bi-Modal Fuel Air Explosive Weapon Concepts for high utility ordnance
2.9 Define improved bomb fuzing concepts for improved reliability, safety, and utility
2.10 Upgrade aircraft/weapon interface launch dynamic codes to predict separation trajectories and captive air loads
2.11 Investigate improved safe and arm device concepts
2.12 Initiate chamber/projectile design definition for a high performance gun concept

Air-to-Surface Targeting Technology

2.13 Investigate advanced Focal Plane Array Forward Looking Infrared (FLIR) technology for targeting
2.14 Continue to pursue targeting technology and concepts
2.15 Initiate development efforts
2.16 Complete Synthetic Aperture Radar (SAR) updated inertial guidance feasibility demonstration

III. Project: F32-395 Title: Air-to-Surface Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Technology for Standoff Air-to-Surface Missiles

3.1 Complete efforts for transition to Medium Range Anti-Snip Missile (MRASM) and HARPOON respectively
3.2 Complete the fabrication and testing of warheads
3.3 Fabricate and perform component testing of modules
3.4 Design, fabricate, and test a feasibility model of an active optical standoff (PROXIMITY) fuze concept
3.5 Design, fabricate and test breadboard models of a passive RF anti-radiation fuze concept
3.6 Perform captive flight tests of advanced guidance system components
3.7 Initiate a new effort to measure and define Airbreathing Missile Aerodynamics for non-circular cross section airframes
3.8 Initiate technology development for an advanced high utility warhead

Technology for Freefall Ordnance

3.9 Complete design, fabrication, and testing of bimodal fuel air explosive concepts for transition to engineering development
3.10 Complete the design, fabrication, and evaluation of improved bomb fuzing components and ready for transition to engineering development
3.11 Develop aircraft stores launch dynamics codes for the transonic speed regime
3.12 Incorporate improved safe and arm components and technology into bomb, projectile, and missile fuzes
3.13 Initiate integration and demonstration of a high performance gun concept
3.14 Fabricate and test warhead

Air-to-Surface Targeting Technology

3.15 Design, fabricate, and initiate testing of Focal Plane Array Forward Looking Infrared (FLIR)
3.16 Complete the technology development and ready for transition
3.17 Fabricate and perform initial testing of a Hybrid Target Acquisition System (HYTAS) Concept
3.18 Initiate efforts to develop Synthetic Aperture Radar (SAR) techniques
3.19 Initiate development of algorithms

III. Project: F32-395 Title: Air-to-Surface Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.20 The funding increase for FY 1983 over FY 1982 (+$2,161 thousand) allows reinitiation of planned essential technology efforts in Standoff Tactical Air-to-Surface Missiles and air delivered conventional ordnance. Examples of projects to be reinitiated include:

- Rebuild technical expertise in fuel air explosive ordnance, binary chemical weapons, and aircraft guns
- Reinitiate projects in warheads and advanced Forward Looking Infrared (FLIR)
- Evaluate low cost improvements to bomb fuzing

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F32-395	Air-to-Surface Warfare Technology	4,953	3,171	5,332	5,325	Continuing	Continuing

Project: F32-399 Title: Surface-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

DETAILED BACKGROUND AND DESCRIPTION

° Supports the development and maintenance of technology for surface-launched Anti-Air Warfare (AAW) systems in the areas of Guidance and Control, Missile Fire Control, Aerodynamics and Structures, Fuzes, Warheads, and Target Vulnerability
° Investigates critical technology issues related to specific generic system design concepts for new and improved surface-launched Anti-Air Warfare (AAW) systems
° Develops and maintains techniques/data bases necessary for the development of future weapon systems
° Driving threat parameters include the multiplicity of launch platforms,

°

Self Defense

- An assessment of the cost, risk, and performance compromises of employing the Advanced Common Intercept Missile (ACIM) concept versus a surface Navy unique solid rocket concept in a surface launched point defense role
- Demonstration of technology for a mirror track radar multiple target fire control concept
- Demonstration of technology for an active seeker which would be immune to standoff countermeasures

Area Defense

- Development of multi-mode guidance options for a STANDARD Missile in conjunction with the Multimode Guidance Program, P.E. 63318N
- Investigation and demonstration of concepts to reduce STANDARD Missile time constant and increase maneuverability at altitude
- Demonstration of a a candidate for the next STANDARD Missile (SM-2) upgrade

Wide Area Defense

- Development of midcourse and terminal guidance for a far term hypersonic missile
- Development of high lift to drag ratio airframe concepts for hypersonic missile

IV. Project: F32-399 Title: Surface-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Development of fuze, warhead, and target vulnerability concepts to address problems associated with very high velocity intercepts

Generic Efforts

- Development of a Surface-Launched Weaponry Task Area Objectives document which provides a top down approach in technology planning
- Demonstrate a Laser Radar fire control system capable of very accurate target tracking
- Development and maintenance of aerodynamics prediction codes and Air Target Vulnerability data

(U) RELATED ACTIVITIES

- Related work is carried out by the U.S. Army and Air Force under P.E. 62303A and 62602F
- Work is coordinated through the Joint Logistics Commanders Joint Technical Coordinating Groups for Munitions Development and Munitions Effectiveness; the Joint Army, Navy, NASA and Air Force Committee on Propulsion; the Joint Logistics Commanders Fuze Management Organization; and the Joint Services Guidance and Control Committee
- Further Coordination is effected through the Weapon Technology Coordinating Paper, exchanges of planning documents, interservice meetings, and the Tripartite Technical Coordination Program (TTCP)
- Efforts in this project are also closely coordinated with other projects within P.E. 62332N, Strike Warfare Weaponry Technology and with ongoing technology efforts under P.E. 62331N, Missile Propulsion Technology; P.E. 62712N, Surface and Aerospace Target Surveillance; P.E. 62633N, Undersea Warfare Weaponry Technology (explosives development, effects and safety), and P.E. 62761N, Materials Technology (tactical portions) as well as with those programs currently in advanced and engineering development in the surface-launched anti-air warfare weapons areas

(U) WORK PERFORMED BY

- In-House - Naval Surface Weapons Center, Dahlgren, VA and White Oak Laboratory, Silver Spring, MD; Naval Weapons Center, China Lake, CA; and Pacific Missile Test Center, Point Mugu, CA
- Industrial - None
- Academic - Johns Hopkins University/Applied Physics Laboratory, Laurel, MD; New Mexico Institute of Mining and Technology, Socorro, NM

IV. Project: F32-399
Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

Title: Surface-to-Air Warfare Technology
Title: Strike Warfare Weaponry Technology
Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Self Defense

1.1 Developed and documented a generic self defense missile system design concept with command or command inertial midcourse and active terminal homing and defined the trajectories which such a missile would have to fly to avoid mainbeam jamming
1.2 A baseline missile concept for the generic surface launched self defense role was identified as the Advanced Common Interceptor Missile (ACIM), and has resulted in a proposal for a joint technology demonstration of the Advanced Common Interceptor Missile concept in air and surface launched roles
1.3 Developed a generic system design concept for a system capable of defending the Fleet from the high angle threat
1.4 The first model of the drive system for a mirror track radar was tested and found to have less rigidity than required; a redesign was performed to provide greater structural rigidity
1.5 Tested an experimental [redacted] for an active seeker
1.6 Fabricated memory and input/output modules and conducted a hardware in the loop simulation of a federated modular digital missile guidance concept
1.7 Assessed the required airframe characteristics for an advanced surface launched self defense missile and defined a solid rocket alternative to the Advanced Common Interceptor Missile concept

Area Defense

1.8 Performed system level tradeoffs and identified dual mode [redacted] guidance, pulsed rocket motors and discarding radomes as areas holding promise for improved high altitude performance
1.9 Performed tests and characterized a baseline design [redacted] in a STANDARD Missile size and completed models necessary for conducting sensitivity and comparative tradeoff studies

Wide Area Defense

1.10 Performed mission evaluation showing need for hypersonic missile interceptor velocities to counter threats in the year 2000 and beyond
1.11 Performed and documented multimode compatibility measurements of a [redacted] multimode seeker

IV. Project: F32-399 Title: Surface-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.12 Developed a closed loop simulation and defined performance limits of home-on-jam midcourse and defined the performance requirements
1.13 Evaluated countermeasures and sea state effects on Correlation Home-on-Jam concept showing that the system has the potential to provide
1.14 Completed wind tunnel tests and analyzed and published results of integral rocket supersonic ramjet investigations
1.15 Tested staged velocity enhancement warhead concepts showing a potential 20-25% fragment velocity enhancement
1.16 Designed and tested an analog phase shifter for a beam steering antenna and identified candidate fuze waveforms capable of performing over a broad range of target-interceptor closing velocities
1.17 Developed and validated a very high velocity plate penetration model which accounts for fragment shatter
1.18 Conducted full-scale tests of annular warheads which would be compatible

Generic Program

1.19 Developed and published an FY 1982 Surface-Launched Weaponry Technology Task Area Objectives document summarizing the Naval Sea Systems Command's top down approach in technology planning for surface-launched weapons systems
1.20 Completed laser radar flow system, signal processing electronics design and tracker mount mechanical fabrication
1.21 Extended axisymmetric non-airbreathing configuration approximate aerodynamics code to Mach 8 and completed users guide.
1.22 Maintained and updated air target vulnerability data base by performing a flight simulation and kill criteria definition and a detailed failure mode effectiveness analysis

2. (U) FY 1982 Program

Self-Defense

2.1 Validate the need for advanced self defense system and quantify the cost/performance tradeoffs of commonal.ty for Advanced Common Intercept Missile (ACIM) concept and a solid rocket alternative (efforts are coordinated with PE 62331N, Missile Propulsion Technology and PE 63308N, Air-to-Air Missile Technology Demonstration)
2.2 Continue fabrication of antenna/gimbal/control and development of high power transmitter for active seeker
2.3 Complete evaluation of super federated modular digital missile concept and initiate a point design for the RIM-7/AIM-7 system

IV. Project: F32-399 Title: Surface-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.4 Complete and test second generation mirror track antenna drive mechanism and initiate counter-countermeasures (CCM) analysis of the mirror track system
2.5 Collect target signatures at the encounter simulation laboratory and verify fuze air target analogs

Area Defense

2.6 Update area defense system design concepts and coordinate efforts addressing discarding radomes and pulsed motors to quantify the overall system impact of these concepts
2.7 Coordinate with multimode guidance program and initiate effort looking at long term options to integrate for advanced area defense missiles
2.8 Initiate effort to identify and explore alternative concepts to provide improved maneuverability and reduced missile time constant at altitude for advanced area defense missiles
2.9 Complete integration tests and a comparative analysis quantifying the advantages of the for STANDARD Missile

Wide Area Defense

2.10 Initiate investigation of infrared (IR) seeker feasibility for a hypersonic wide area defense missile
2.11 Initiate definition of home on jam midcourse algorithms for a hypersonic wide area defense missile concept
2.12 Initiate captive flight test effort to demonstrate correlation home on jam concept
2.13 Develop improved Length/Diameter (L/D) airframe design concept for a hypersonic Wide Area Defense Missile
2.14 Complete baseline very high velocity (VHV) vulnerability assessment model
2.15 Complete component development for a beam steerable fuze antenna

Generic Program

2.16 Complete integration and laboratory tests of laser radar system and perform limited tracking tests to conclude the program
2.17 Continue development of nonaxisymmetric airbreathing approximate aerodynamics prediction code
2.18 Prepare a vulnerability assessment and perform a kill criteria analysis

IV. Project: F32-399
Program Element: 62332N
DoD Mission Area: 523 - Engineering Technology

Title: Surface-to-Air Warfare Technology
Title: Strike Warfare Weaponry Technology
Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Self Defense

3.1 Integrate low power components into seeker [redacted] and complete development and testing of [redacted]
3.2 Complete evaluation of modular digital missile guidance for RIM-7/AIM-7 application
3.3 Integrate low power mirror track radar components into a test bed and complete development and testing [redacted]
3.4 Complete development of kill assessment algorithms
3.5 Pursue technology demonstration of Advanced Common Interceptor Missile addressing a surface-launched version in conjunction with the Naval Air Systems Command
3.6 Perform at-sea tests to verify fuze target clutter prediction models

Area Defense

3.7 Continue investigation of critical technology issues for an advanced dual mode guidance area defense seeker
3.8 Identify most promising candidates to provide improved maneuverability, reduced time constant concept and verify performance with 6 degree of freedom model to assess impact on miss distance performance

Wide Area Defense

3.9 Complete infrared feasibility performance analysis and evaluate cooling techniques for an infrared seeker for a hypersonic Wide Area Defense Missile
3.10 Complete Home-on-Jam (HOJ) midcourse efforts and [redacted] definition for a hypersonic missile
3.11 Complete captive flight tests of correlation Home-on-Jam concept
3.12 Complete radome rain damage code and preliminary configuration design for a hypersonic Wide Area Defense Missile
3.13 Conduct large scale tests of baseline Staged Very High Velocity warhead and conduct warhead tests at elevated temperatures

Generic Program

3.14 Update and publish Surface-Launched Weaponry Technology Task Area Objectives document as guidance for planning FY 1984 programs

IV. Project: F32-399 Title: Surface-to-Air Warfare Technology
Program Element: 62332N Title: Strike Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.15 Development and maintenance of the approximate and numerical aeroprediction codes and air target vulnerabilty data base will continue

Comparison with FY 1982 Program:

3.16 Increase in funding for FY 1983 ($+1,195 thousand) allows reinitiation of planned essential technology efforts in wide-area defense, area defense, and point defense projects that were either eliminated or reduced to sub-critical levels by the Congressional budget cut in FY 1982. Examples of projects to be reinitiated or restored to efficacious program levels include:

- Complete the evaluation of laser radar and mirror track radar multi-target fire control hardware
- Initiate counter countermeasure investigations of wide area defense terminal seekers and long range data links
- Initiate investigation of ordnance systems compatible with airbreathing ordnance
- Initiate waveform optimization for very high velocity intercept fuzing

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F32-399	Surface-to-Air Warfare Technology	8,369*	5,728	6,923	7,119	Continuing	Continuing

* Includes $5,916 in Project F32-392, Medium/Long Range Surface-to-Air Technology, that was combined with this project in FY 1981.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

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

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	44,639	47,576	53,624	58,735	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Element funds a comprehensive research and development program directed toward the development and application of advanced technologies for potential use in naval nuclear propulsion plants.
- Program's objectives include applying advanced technology to improve performance of the propulsion plant and its components; while also providing greater plant simplicity, standardization and operating life.
- Other objectives include increasing the reliability of the plant and its components while developing reactor plant equipment which is easy to maintain with reduced operating noise, space and weight requirements.

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Research and development efforts will include work in reactor plant material development and testing, reactor plant refueling and servicing technology, radiation control, shielding design and fabrication, steam generator technology and development of advanced design reactor instrumentation and control systems.
- Reactor plant mechanical components will be designed and tested in order to achieve better performance, extend the service life, and reduce detectable radiated noises.
- Work on improved steam plant water chemistry control methods will be conducted while work on advanced design instrumentation and control equipment with improved accuracy, reliability, reduced space, weight requirements and increased resistance to noise will continue.
- The increase in funds in FY 1983 over FY 1982 is required as result of inflation and increased efforts in equipment development and component testing
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes in funding as shown in the FY 1983 Descriptive Summary from the funding shown in tne FY 1982 Descriptive Summary (-57 in FY 1982 and -1,968 in FY 1983) are the result of escalation changes and refinement of cost estimates

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	41,976	44,639	47,633	55,592	Continuing	Continuing
F42-441	Submarine Nuclear Propulsion	12,400	14,400	15,200	19,000	Continuing	Continuing
F42-442	Surface Ship Nuclear Propulsion	11,900	10,000	8,200	9,000	Continuing	Continuing
F42-443	Multipurpose Nuclear Propulsion	17,676	20,239	24,233	27,592	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) DETAILED BACKGROUND AND DESCRIPTION

- Element funds a comprehensive research and development program directed toward the development and application of advanced technologies to naval nuclear propulsion plants.
- Investigates problems in specific technical areas including: improved propulsion plant and component performance, greater plant simplicity and standardization, longer ship life, reducing operating noise to preclude detectability from component generated radiated noise sources while decreasing space and weight requirements and increasing reliability and maintainability.
- Operational data from existing naval nuclear powered vessels and land based prototypes is continuously evaluated and factored into the program.
- Research and development efforts cover the entire spectrum of technologies involved in naval nuclear propulsion.

(U) RELATED ACTIVITIES

- Work conducted under this program is closely coordinated with the Department of Energy's Office of the Deputy Assistant Secretary for Naval Reactors' research and development work on nuclear reactor plants and cores.
- The Naval Nuclear Propulsion Program is an integrated research and development program which encompasses both Navy and Department of Energy (DOE) research and development funds, with the bulk of the funds provided by the DOE.
- Navy research and development portion includes exploratory development, advanced development, and operational development funds.
- Overall research and development program is dedicated to the continued development of safe, reliable, and advanced nuclear propulsion plants and related components.

(U) WORK PERFORMED BY

- In-House - None
- Industrial - Westinghouse Electric Corporation, Bettis 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (C) FY 1981 and Prior Accomplishments

1.1 Efforts under this program have provided for the continuous upgrading and improvement of naval nuclear propulsion plants of various power ratings and designs
1.2 Materials development and analysis has continued to be an area of extensive effort to ensure that reactor materials will withstand the harsh reactor environment over long periods
1.3 Continued materials development and analysis in order to qualify alternate materials having improved corrosion of mechanical properties for reactor plant applications in addition to testing of current reactor plant materials

1.4

1.5 The test program was continued

1.6 Continued investigations into the cause and prevention of

1.7 Completed development of manufacturing techniques which can produce pipings and fittings

1.8 The need to ensure safe and reliable reactivity control has mandated continued development
1.9 The functional evaluation of the has resulted in development and installation of improved bearings
1.10 Continued life testing of and testing of this testing provides valuable information on the mechanism
1.11 Testing was continued on the effects of mechanism performance
1.12 Continued development of advanced design reactor instrumentation and control equipment for submarine and surface ship applications
1.13 Advanced designs for instrumentation and control equipment will utilize microprocessors, miniature integrated circuits and digital techniques to replace existing magnetic amplifier and discrete transistorized equipment
1.14 New equipment being designed will provide improved accuracy, stability and reliability, and simplified operation and maintenance
1.15 Initiated development of advanced design reactor monitoring and protection equipment

1. *Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.16 The chemical treatment of reactor plant coolant can greatly affect the life and performance of reactor plant components and systems
1.17

1.18

1.19 Evaluated non-destructive test methods for improved detection

1.20 Updated technology and fleet requirements have necessitated constant review and development of reactor servicing equipment and procedures
1.21 Data obtained from a review of submarine and surface ship refueling equipment and procedures have been factored into the effort to reduce cost and time required for fuelings/refuelings
1.22 Continued research and development efforts to improve valve performance and reliability
1.23 Initiated preliminary testing to better define the operating environment

1.24

1.25 Initiated testing to redesign flow regulating check valves to improve their performance and stability
1.26 Developed design improvements to reduce the amount of radiated noise emanating from them
1.27
1.28 Continued work on shield design concepts and shield design analysis

2. (U) FY 1982 Program

2.1 The general development of both submarine and surface ship nuclear propulsion plant systems and components will continue
2.2 Continuing engineering effort and long term testing will explore the feasibility of extending the operating life of major reactor plant components
2.3 Data will be obtained from operating nuclear submarines and surface ships on reactor plant performance; data is evaluated and provides important information regarding plant performance over a number of years of operation; this information is applied to improve the design of reactor plant systems and components

2.4 Continue development efforts to apply advanced technology to naval nuclear instrumentation and control equipment and systems; effort is needed to produce equipment and systems having the greater accuracy, reliability, safety and maintainability that is required for compatibility with future generations of nuclear propulsion plants
2.5 Continue work on advanced design reactor instrumentation and control equipment for submarine and surface ship applications using microprocessors, miniature integrated circuits and digital techniques
2.6 Conduct technical evaluations as needed for nuclear surface ship and submarine instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility and installation suitability
2.7 Continue work to develop designs and methods which will improve performance and reliability in consonance with the design and operation of longer life cores
2.8 Conduct testing to obtain needed operational data
2.9 Continue life testing of and complete testing testing is necessary to determine whether as they are presently designed and manufactured are capable of performing well in future longer life reactors
2.10 Continue development of improved materials and material heat treatments for reactor plant application and testing of current materials to determine their long term corrosion resistance
2.11 Continue the effort to improve the performance of key reactor plant metals under long term conditions
2.12 *Initiate testing on the use of*
2.13 Determine methods for arresting or preventing performance and reliability
2.14 Initiate development of ultrasonic equipment to nondestructively examine
2.15 Continue tests and inspections to provide information to improve steam generator designs
2.16 Begin a program to qualify tubing for steam generator fabrication
2.17 Analyze and test alternate water chemistries to determine their usefulnesss
2.18
2.19
2.20 Operate land based prototype nuclear propulsion plants in order to provide information on advanced concepts and improved designs for potential shipboard application
2.21 Continue efforts to develop and improve reactor servicing in order to support surface ship and submarine refuelings on a regular or emergency basis
2.22 Continue work to improve valve performance and reliability

2.23 Design and test advanced main coolant pumps for surface ship and submarine applications
2.24 Improve noise source localization capabilities in order to prevent excessive noise and vibration in reactor systems and develop technology

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue development of improved materials for reactor plant applications and testing of current materials to improve their corrosion resistance
3.2 Initiate wear testing of materials
3.3 Continue the effort to develop advanced design reactor instrumentation and control equipment for nuclear powered surface ships and submarines using microprocessors, miniature integrated circuits and digital techniques
3.4 Undertake development of new design reactor plant instrument system detector and signal transmission and power distribution techniques to provide components having longer life, improved accuracy, stability and reduced susceptibility to noise
3.5 Continue technical evaluations as needed of instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility and installation suitability
3.6 Continue development of designs and methods which will improve performance and reliability in support of longer life reactors
3.7 Continue life testing of
3.8 Develop an improved individual rod position indicator to achieve improved core performance
3.9 Perform analysis for possible use with mechanisms which exhibit high rotational friction during operation
3.10 Qualify computer programs to be used in the analysis of steam generators
3.11 Continue tests and inspections to improve steam generator designs and to improve
3.12 Continue evaluation of new methods for water chemistry control i. steam generators and steam plant components
3.13 Complete development and qualification of non-destructive inspection methods and equipment
3.14 Qualify and implement methods
3.15 Continue tests to identify noise reduction methods while evaluating methods to reduce noise and improve performance, reliability and integrity of other components
3.16 Design and modification of reactor servicing equipment will continue

*Program Element: 62542N Title: Nuclear Propulsion Technology
Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.17 Continue to perform design and shipping safety analyses of shipping containers
3.18 Develop valve inspection and diagnostic methods in addition to new valve design and analysis methods

Changes from FY 1982 to FY 1983

3.19 The increase in funds in FY 1983 over FY 1982 is required as a result of inflation and increased efforts i equipment development and component testing

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

(U) Milestones: Not applicable.

11. Project: F42-441 Title: Submarine Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Submarine Nuclear Propulsion research and development work supports the continued development of advanced technology to improve nuclear propulsion plants for submarines
- The objectives of the program include improving propulsion plant and component performance in the areas of greater plant simplicity and standardization, longer life, reduced operating noise, reduced space and weight requirements and better reliability, safety assurance and maintainability
- Work under this project has provided the technical base required for the initiation of advanced submarine projects
- The effort of long-term operations is thoroughly evaluated as experience is gained from the increasing number of operating submarine plants
- Advances in materials development, component design, reactor control and instrumentation equipment design, and plant technology developed under this project have been incorporated in submarine propulsion plant systems to provide simple, more reliable high performance plants

(U) RELATED ACTIVITIES

- Work conducted under this program is closely coordinated with the Department of Energy's Office of the Deputy Assistant Secretary for Naval Reactors' research and development work on nuclear plants and cores
- The Naval Nuclear Propulsion Program is an integrated research and development program which encompasses both Navy and Department of Energy (DOE) research and development funds, with the bulk of the funds provided by the DOE
- The Navy research and development portion includes exploratory development, advanced development, and operational systems development funds
- This overall research and development program is dedicated to the continued development of safe, reliable, and advanced nuclear propulsion plants and related components

(U) WORK PERFORMED BY

- In-House - None
- Industrial - Westinghouse Electric Corporation, Bettis 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

II. Project: F42-441
Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Initiated development of advanced design reactor monitoring and protection equipment which will use microprocessor based circuitry to improve accuracy, simplify maintenance and increase reliability
1.2 Continue to develop other advanced design reactor instrumentation and control equipment for submarine applications which will utilize microprocessors, miniature integrated circuits and digital techniques
1.3 The new design equipment will provide improved accuracy, stability, and reliability, and simplified operation and maintenance
1.4 The need to ensure safe and reliable
1.5 The functional evaluation of the has resulted in development and installation of improved bearings
1.6 Continued life testing of and testing of this testing provides the Navy valuable information on
1.7 Testing was continued on the effects of defective conditions on mechanism performance
1.8 The chemical treatment of reactor plant coolant can greatly affect the life and performance of reactor plant components and systems
1.9
1.10
1.11 Developed design improvements to reduce the amount of radiated noise emanating from them
1.12 Updated technology and fleet requirements have necessitated constant review and development of reactor servicing equipment and procedures
1.13 Data obtained from a review of submarine refueling equipment and procedures have been factored into the effort to reduce the cost and time required for fuelings/refuelings
1.14 Continued research and development efforts to improve valve performance and reliability
1.15

II. Project: F42-441 Title: Submarine Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.16 Initiated testing to redesign flow regulating check valves to improve their performance and stability

2. (U) FY 1982 Program

2.1 The general development of submarine nuclear propulsion plant systems and components will continue
2.2 Continuing engineering effort and long term testing will explore the feasibility of extending the operating life of major reactor plant components
2.3 Obtain data from operating nuclear submarines on reactor plant performance; when evaluated, this data provides important information regarding plant performance over a number of years of operation and is applied to improve the design of reactor plant systems and components
2.4 Development efforts will continue to apply advanced technology to naval nuclear instrumentation and control equipment and systems; this effort is needed to produce equipment and systems having the greater accuracy, reliability, safety and maintainability required for compatibility with future generations of nuclear propulsion plants
2.5 Continue work on advanced design microprocessor based reactor protection and monitoring equipment as well as advanced design reactor instrumentation and control equipment for submarine applications using microprocessors, miniature integrated circuits and digital techniques
2.6 Technical evaluation will be conducted as needed for nuclear submarine instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility and installation suitability
2.7 Work will continue to develop designs and methods which will improve performance and reliability in consonance with the design and operation of longer life cores
2.8 Conduct testing to obtain needed operational data
2.9 Continue life testing of and complete testing testing is necessary to determine whether as they are presently designed and manufactured, are capable of performing well in future longer life reactors.
2.10 Continue valve research and development efforts in order to improve valve performance and reliability
2.11 Proceed with testing to develop new designs for flow regulating check valves to improve their durability perform valve failure analyses as required
2.12 Effort will be expended to determine methods for arresting or preventing and to improve steam generator performance and reliability
2.13 Continue testing of new design features in order to identify additional methods to reduce noise
2.14 Develop technology and continue to improve noise source localization capabilities in order to prevent excessive noise and vibration in reactor systems

II. Project: F42-441 Title: Submarine Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.15

2.16 Efforts to develop and improve reactor servicing equipment and techniques will continue in order to support submarine refuelings on a regular or emergency basis
2.17 Continue design and shipping safety analyses of shipping containers

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue effort to develop advanced design reactor instrumentation and control equipment for nuclear powered submarines using miniature integrated circuits and digital techniques
3.2 Continue technical evaluation as needed for nuclear powered submarine instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility, and installation suitability
3.3 Undertake development of new design reactor plant instrument system detectors and signal transmission and power distribution techniques to provide components having longer life, improved accuracy, stability

3.4 Continue development of designs and methods which will improve performance and reliability in support of longer life reactors
3.5 Continue life testing of
3.6 Develop an improved individual rod position indicator to achieve improved core performance

3.7 Evaluate alternate improved designs and hardware development to improve mechanism performance margins
3.8 Perform analysis for possible use with mechanisms which exhibit high rotational friction during operation
3.9 Continue development of technology while improving noise source localization methods in order to prevent excessive noise and vibration in reactor systems
3.10 Qualify and implement methods of

3.11 Develop computer programs to aid in the analysis of steam generator design and conduct testing

3.12 Continue tests to identify noise reduction methods while evaluating methods to reduce noise and improve performance, reliability and integrity of other components
3.13 Design modification of reactor servicing equipment will continue
3.14 Design and shipping safety analysis of shipping containers will continue to be performed

II. Project: F42-441 Title: Submarine Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.15 Pursue investigations of improved valve related materials and materials processing
3.16 Develop valve inspection and diagnostic methods in addition to new valve design and analysis methods

Comparison with FY 1982 Program:

3.17 The increase in funds in FY 1983 over FY 1982 is required as a result of inflation and increased efforts in equipment development and component testing

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F42-441	Submarine Nuclear Propulsion	14,400	15,183	19,000	19,000	Continuing	Continuing

III. Project: F42-442 Title: Surface Ship Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- This project is directed toward the 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 the continued development of advanced nuclear propulsion plant and system concepts and designs, and improving propulsion plant and component performance in the areas of greater plant simplicity and standardization, longer life, and better reliability, safety assurance and maintainability
- Special areas of interest encompass the design and development of systems, equipment and procedures necessary for the installation and servicing of advanced reactor cores in surface ship nuclear propulsion plants, and the analysis of plant performance data from nuclear powered surface ships and land based prototypes

(U) RELATED ACTIVITIES

- Work conducted under this program is closely coordinated with the Department of Energy's Office of the Deputy Assistant Secretary for Naval Reactors' research and development work on nuclear plants and cores
- The Naval Nuclear Propulsion Program is an integrated research and development program which encompasses both Navy and Department of Energy (DOE) research and development funds, with the bulk of the funds provided by the DOE
- The Navy research and development portion includes exploratory development, advanced development, and operational systems development funds
- This overall research and development program is dedicated to the continued development of safe, reliable, and advanced nuclear propulsion plants and related components

(U) WORK PERFORMED BY

- In-House - None
- Industrial - Westinghouse Electric Corporation, Bettis 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

III. Project: F42-442
Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Continued development of advanced design reactor instrumentation and control equipment for surface ship application
1.2 Advanced designs will utilize microprocessors, miniature integrated circuits and digital techniques
1.3 New design equipment will provide improved accuracy, stability and reliability, and simplified operation and maintenance
1.4 Updated technology and fleet requirements have necessitated constant review and development of reactor servicing equipment and procedures
1.5 Data obtained from a review of surface ship refueling equipment and procedures have been factored into the effort to reduce the cost and time required for fuelings/refuelings
1.6 Continued research and development efforts to improve valve performance and reliability
1.7 Initiated preliminary testing to better define the operating environment
1.8 Evaluated non-destructive test methods for improved detection
1.9

2. (U) FY 1982 Program

2.1 Continue development efforts to apply advanced technology to naval nuclear instrumentation and control equipment and systems having greater accuracy, reliability, safety and maintainability that is required for compatibility with future generations of nuclear propulsion plants
2.2 Continue work on advanced design reactor instrumentation and control equipment for surface ship applications using microprocessors, miniature integrated circuits and digital techniques
2.3 Conduct technical evaluations as needed for nuclear surface ship instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility, and installation suitability
2.4 Continue efforts to develop and improve reactor servicing in order to support surface ship refuelings on a regular or emergency basis
2.5 Continue work to improve valve performance and reliability

III. Project: F42-442 Title: Surface Ship Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.6

2.7

2.8 Continue analysis, design, and test programs to improve steam generator performance and reliability

2.9 Design and test advanced main coolant pumps with surface ship applications

2.10 Initiate development of ultrasonic equipment to non-destructively examine

2.11

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue the effort to develop advanced design reactor instrumentation and control equipment for nuclear powered surface ships using microprocessors, miniature integrated circuits and digital techniques

3.2 Continue technical evaluations as needed for nuclear powered surface ship instrumentation and control systems in the areas of system design, system performance, reliability and safety features, compatibility, and installation suitability; further develop advanced safety assurance systems for surface ships to enhance reliability

3.3 Undertake development of new design reactor plant instrument system detectors, signal transmission and power distribution techniques to provide components having longer useful lives, improved accuracy, stability,

3.4 Pursue investigations of improved valve related materials and materials processing while continuing to develop valve inspection and valve diagnostic methods

3.5 Develop new valve design and analysis methods

3.6 Continue analysis, design and test programs to improve steam generator and other components performance and reliability

3.7 Continue testing of advanced main coolant pumps which have surface ship applications

3.8 Complete development and qualification of non-destructive inspection methods and equipment to examine

3.9 Design and modification of reactor servicing equipment will continue, including design and shipping safety analyses of shipping containers

Comparison with FY 1982 Program:

3.10 The FY 1983 program increase over FY 1982 reflects refinement of costs including inflation

III. Project: F42-442 Title: Surface Ship Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F42-442	Surface Ship Nuclear Propulsion	10,000	8,190	9,000	9,000	Continuing	Continuing

IV. Project: F42-443
Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) DETAILED BACKGROUND AND DESCRIPTION

- The Multipurpose Nuclear Propulsion Technology Program provides for the development of technology to continuously upgrade and improve a broad range of propulsion plant systems and component designs
- This program incorporates areas of nuclear propulsion technology that are not primarily directed toward either submarine or surface ship propulsion plants
- Of primary concern is the advancement of nuclear technology and the application of this technology to the naval nuclear propulsion program; areas of effort include: primary and secondary plant chemistry, steam generator chemical cleaning, improved steam generator thermal and hydraulic tests and refinement of analytical techniques and corrections, materials application and analysis, radiation control, shielding design, advanced design reactor plant chemical components, reactor plant and nuclear instrument detectors, advanced instrument and control system concepts, and refined analytical methods to evaluate operational data from ships and land prototypes

(U) RELATED ACTIVITIES

- Work conducted under this program is closely coordinated with the Department of Energy's Office of the Deputy Assistant Secretary for Naval Reactors' research and development work on nuclear plants and cores
- The Naval Nuclear Propulsion Program is an integrated research and development program which encompasses both Navy and Department of Energy (DOE) research and development funds, with the bulk of the funds provided by the DOE
- The Navy research and development portion includes exploratory development, advanced development, and operational systems development funds
- This overall research and development program is dedicated to the continued development of safe, reliable, and advanced nuclear propulsion plants and related components

(U) WORK PERFORMED BY

- In-House - None
- Industrial - Westinghouse Electric Corporation, Bettis 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

IV. Project: F42-443
Program Element: 62542N
DoD Mission Area: 523 - Engineering Technology

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Efforts in this program have included work on concepts and techniques in the areas of pressurized water reactor technology, materials development and application as well as shielding design and fabrication
1.2 Continued materials development and analysis in order to qualify alternate materials having improved corrosion or mechanical properties for reactor plant applications; this was in addition to other testing of current reactor plant materials
1.3
1.4 The test program was continued
1.5 Continued investigations into the cause and prevention of
1.6 Completed development of manufacturing techniques which can produce pipings and fittings
1.7 Continued qualification and implementation of an improved steam generator chemical cleaning process designed to maximize sludge removal
1.8 Implemented methods to improve steam generator chemistry control with the purpose of reducing sludge buildup
1.9 Continued studies on the corrosive effects of primary coolant on reactor plant components
1.10
1.11 Continued work on shield design concepts and shield design analysis

2. (U) FY 1982 Program

2.1 Continue development of improved materials and material heat treatments for reactor plant application and testing of current materials to determine their long time corrosion resistance
2.2 Continue the effort to improve the performance of key reactor plant metals under long term conditions
2.3 Initiate testing on the use of

2.4 Initiate development and qualification of computer programs to analyze steam generators
2.5 Continue tests and inspections to provide information to improve steam generator designs
2.6 Start a program to qualify tubing for steam generator fabrication
2.7 Analyze and test alternate water chemistries to determine their usefulness in steam generator applications
2.8
2.9 Continue work on shielding design and analysis as well as engineering analyses and evaluations for naval ships in the areas of environmental monitoring and radioactive waste processing
2.10 Operation of the land based prototype nuclear propulsion plants, including extensive testing programs, will provide information on advanced concepts and improved designs for potential shipboard application

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue development of improved materials for reactor plant applications and testing of current materials to improve their corrosion resistance
3.2 Initiate extensive testing to determine the
3.3 Initiate wear testing of materials
3.4 Continue qualification of computer programs to be used in the analysis of steam generators
3.5 Continue tests and inspections to improve steam generator designs
3.6 Evaluation of new methods for water chemistry control in steam generators and steam plant components will continue
3.7 Continue to analyze the chemical and radiochemical behavior of the reactor plant primary coolant
3.8 Continue efforts to reduce sludge buildup which can alter normal plant conditions and operations
3.9 Continue shielding design and analysis for all types of nuclear powered vessels; work in this area includes conducting shield surveys, design of new refueling equipment to minimize radiation exposure, while providing support for the decommissioning of reactor plants which have ended their commissioned service; disposal work consists of choosing a method and location for disposal of the radioactive decommissioned nuclear propulsion plants
3.10 Experience gained in the operation of land-based prototype nuclear propulsion plants will provide information useful in nuclear powered naval ships and submarines
3.11 Continue test programs performed in the land based prototype reactor plants to provide information useful in plant system design, component design and plant operation of commissioned naval ships and submarines

IV. Project: F42-443 Title: Multipurpose Nuclear Propulsion
Program Element: 62542N Title: Nuclear Propulsion Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.12 The FY 1983 program increase over FY 1982 reflects refinement of costs including inflation

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F42-443	Multipurpose Nuclear Propulsion	20,239	24,203	25,624	30,735	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

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

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

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

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	35,016	38,251	44,156	46,501	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Develops the basic technology necessary to achieve significant advances in the military performance of naval ships, submarines, and boats, and in reducing their acquisition and support costs
- Seeks performance improvements through better combat capability, reduced vulnerability, enhanced survivability, and greater endurance
- Aims for cost reductions in ship design, construction, operation, and logistic support
- The basic technology includes advanced vehicle concepts, hydrodynamics, and ship structures; propulsion, electrical, and auxiliary machinery systems; ship survivability and acoustic silencing; electromagnetic compatibility and magnetic silencing; and Marine Corps amphibious vehicles

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

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

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Reduce surface ship size and acquisition cost by developing highly integrated, compact electrical propulsion systems; advanced structural designs, materials, and fabrication processes; innovative electrical generation and distribution systems; and new concepts for efficient, lightweight auxiliary machinery
- Develop analytical models to identify major cost areas and assess the potential impact of emerging technologies on reducing acquisition and life cycle costs
- Establish basis for reduced manning in surface ships through improved design and application of emerging technologies
- Continue development and assessment of advanced vehicle concepts for cost reduction and performance improvement
- Reduce life cycle maintenance and personnel costs through advancing the technology of highly reliable, automated propulsion and auxiliary machinery, and reduce fuel costs through more efficient heat engines, waste heat recovery systems, and improved propulsors and hull forms
- Reduce design and experimental costs by developing improved analytical tools to predict hydrodynamic and structural performance
- Enhance surface ship survivability by reducing detectability by external sensors, improving armor and other measures to resist explosive effects, improving shock resistance, and developing new methods of fire detection, prevention, and control
- Ennance surface ship performance by improving capabilities for analysis of combat system performance versus multiple threats, and improving the compatibility of electronic systems
- Increase of $5,905K in FY 1983 over FY 1982 supports new ship/systems initiatives development under F43-411, Titanium and composite structures development under F43-422, Compound Air Masker development under F43-452, and increased emphasis on Marine Corps surface mobility under F43-455
- Advance submarine performance by the use of high strength hull materials and components for greater depth capability, with new life support systems, reduced hydrodynamic resistance for greater speed, reduced radiated noise and detectability by sonar, and improved shock resistance
- Develop basic technology for Marine Corps next generation amphibious assault vehicles and increase the reliability of present and future vehicle systems
- As this is a continuing program, the above funding includes outyear escalation and encompasses all work on development phases now planned or anticipated through FY 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-$418 in FY 1981, -$3,372 in FY 1982 and -$5,887 in FY 1983) are the result of overall budget reductions in FY 1982 resulting in cancellations and reprogramming of outyear efforts and cost refinements in FY 1981

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

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

- Projects which support the principal thrust relating to the integrated machinery system design, F43-431 and F43-432, were allowed to retain their budget with the other projects in the program showing a substantial reduction in their budgets
- In FY 1982, the principal change between projects involves a substantially increased contribution to project F43-452 to support the Compound Air Masker (CAMS) feasibility evaluation for major combatant applications; other projects have been adjusted accordingly to fund this effort
- The Marine Corps has made the effort in Project F43-455 (formerly Project F43-401) one of their highest priorities, and has accelerated the development of amphibious vehicle related items; this acceleration of development has been funded accordingly with increases in FY 1982 and FY 1983 (+508 and +424 respectively)
- Project F43-422 funding increase in FY 1981 (+370) is for the development of new structural design capabilities required for titanium and composite materials
- New project F43-454, Ship Electromagnetic Compatibility, initiated in FY 1983; previously supported under F43-453, Surface Ship Magnetic Silencing
- Other minor changes are the result of refined estimates of costs, including inflation

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

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

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	32,241	35,434	41,623	50,043	Continuing	Continuing
F43-401	Marine Corps Surface Mobility	3,425	2,500	3,000	3,700	Continuing	Continuing
F43-411	Systems Investigations	4,350	3,780	3,800	6,300	Continuing	Continuing
F43-419	Navy Science Assistance Program	500	*	*	*	*	*
F43-421	Fluid Dynamics	3,552	3,531	3,700	4,643	Continuing	Continuing
F43-422	Structural Design and Test	4,880	4,632	5,100	6,500	Continuing	Continuing
F43-431	Electrical Energy Conversion and Distribution	2,022	5,883	7,223	5,000	Continuing	Continuing
F43-432	Main Propulsion Engines/Turbines/Related Technology	2,349	3,118	4,200	5,000	Continuing	Continuing
F43-433	Auxiliary Machinery/Equipment	2,423	2,025	3,200	5,000	Continuing	Continuing
F43-451	Survivability/Habitability/Personnel Protection/ Damage Control	2,680	4,110	4,500	6,000	Continuing	Continuing
F43-452	Acoustic Silencing	5,000	4,955	5,500	6,500	Continuing	Continuing
F43-453	Magnetic and Electromagnetic Silencing	1,060	900	1,400	1,400	Continuing	Continuing

* Transferred to Program Element 62711N.

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62543N
Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- The basic technology effort has been assigned as an integrated program to the David W. Taylor Naval Ship Research and Development Center; other efforts, including special interest projects, are direct managed by the Naval Sea Systems Command (NAVSEA)
- This arrangement provides stronger management and increased flexibility to ensure meeting the program goals and technical objectives approved by the program sponsor, the Naval Sea Systems Command (NAVSEA)
- Provides the basic technology for specific improvements in vehicle design, systems, and components which will provide improved performance at a reasonable cost
- Assesses the potential cost and performance impact of emerging technology on conventional ships
- Establishes the feasibility and potential payoff of advanced vehicles
- Evaluates combat system capabilities in light of emerging threats, system architecture options and operational complexities
- Improves vehicle hydrodynamic performance and design methods in the areas of resistance, propulsors, stability, control, hull form, seakeeping, and maneuverability
- Develops basic technology and design concepts for more compact, efficient, and less costly structure and structural design methods for the basic hull, appendages, and superstructures
- Develops basic technology and design concepts for more compact, efficient, and less costly machinery systems and components for propulsion, electric power and auxiliary functions
- Develops basic concepts and techniques to protect vehicles from nonacoustic detection, hostile action, and the effects of damage
- Provides means to reduce self-noise and avoid detection by both active and passive acoustic devices
- Provides the technology to ensure maximum effectiveness of electronic sensors and communications equipment by reducing interference between them, and technology for cost reduction and performance improvement of Marine Corps amphibious vehicles

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

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

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

(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)
  - 63514N - Shipboard Damage Control
  - 63531N - HY-130 Steel
  - 63553N - S0229 - Surface Ship Silencing
  - 63561N - S0207 - Advanced Submarine Control Program (ASCOP)
  - 63562N - Submarine Tactical Warfare Systems (Advanced)
  - 63564N - Ship Concept Formulation

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Carderock and Annapolis, MD; 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 Laboratory, White Oak, MD; Naval Underwater Systems Center, Newport, RI; Naval Weapons Center, China Lake, CA
- Industrial - Bath Iron Works, Bath, ME; Battelle Memorial Institute, Columbus, OH; Boeing Aircraft Corporation, Seattle, WA; Bolt, Beranek, and Newman, Cambridge, MA; 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
- Academic - Arizona State University, Tucson, AZ; Duke University, Durham, NC; MIT, 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; U.S. Naval Postgraduate School, Monterey, CA; Webb Institute, Glen Cove, NY

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

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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Established feasibility of basic extended performance hydrofoil, high length to beam surface effect ships and Small Waterplane Area Twin Hull (SWATH) ships, air cushion assault craft, and other high performance vehicles
1.2 Developed Combat Capability Assessment (CCA) models for single and multiple threats versus single and multiple weapons systems, including phased array radars
1.3 Assessed multiple propulsion alternatives leading to the integrated machinery concept
1.4 Established fundamental hydrodynamic characteristics and design methods for advanced vehicles
1.5 Provided analysis techniques for superior seakeeping and maneuvering performance with resultant improved ship and weapon effectiveness
1.6 Provided design methods for advanced propulsors and improved designs for submarine control and powering
1.7 Developed basic technology and design methods for ultrahigh strength steel and titanium structures for deep submergence vessels
1.8 Developed improved designs of TRIDENT missile compartment and hatches, surface ship midsection structures, and helicopter landing platforms; developed computer-aided structural design capability and acoustic techniques for submarine hull integrity monitoring
1.9 Determined feasibility and ship impact of advanced propulsion system concepts and components; provided supporting technology for longer life gas turbines, lightweight condensers, superconducting and contrarotating machinery, improved waste heat recovery systems, lightweight shafting, bi-phase engines, and compact gears
1.10 Construction and initial testing of components for 3,000 HP advanced electrical plant
1.11 Established basic concept and feasibility of compact propulsion derived ship's electric power, standard controller for machinery, high energy density submarine batteries, and improved roll stabilization
1.12 Developed technology for improved submarine life support systems, components for increased submarine depth, advanced air compressors, oil pumps, water pumps, distilling plants, bearing monitors, and shaft seals
1.13 Developed basic technology for new firefighting agents and techniques, improved submarine shock and damage resistance, improved ship armor and topside protection, and improved models for damage prediction and ship detection by various sensors
1.14 Provided technology for quiet pumps, valves and fans, multivane impellers, sound isolation devices, quiet propulsors, and noise masking methods
1.15 Developed analytical techniques for improved ship antenna arrangements now being adopted by NATO navies and for establishing electromagnetic interference margins for sonar systems; developed electromagnetic sensors for surface ship signature measurements

1.16 Established technology of improved track/suspension systems, hydraulic drives, hatches, bow flaps, exhaust eductors, clear armor inserts, and articulated vehicles for amphibious vehicle development

2. (U) FY 1982 Program

Reduced Costs of Ship Acquisition

2.1 To reduce ship size, cost, and fuel consumption, develop an integrated machinery concept for surface ships embodying contrarotating and superconducting electric propulsion and propulsion derived ship service power with improved electrical auxiliaries, distribution, and control
2.2 Complete initial performance evaluations of 3,000 HP candidate advanced electric propulsion systems and components; transition to Advanced Development in FY 1983
2.3 Continue development of alternate motor seal and collector concepts for advanced electric propulsion components
2.4 Assess potential of advanced vehicle and propulsion system options to reduce acquisition costs
2.5 Develop critical components for high performance compressors, pumps, and evaporators with extended life and reduced weight and space
2.6 Extend combat capability assessment methods for optimum design of hull and electronics in multi-threat and total combat system modes
2.7 Simplify structural design, fabrication, and inspection methods
2.8 Develop cost models to identify cost drivers and cost reduction potential of robotics and other emerging technologies
2.9 Develop concepts for support of propulsion components by marine hull members and for major improvements in surface ship topside structure
2.10 Complete conceptual design assessments of alternative electrical power generation and distribution systems

Life Cycle Support and Design

2.11 Develop advanced pumps, compressors, and other auxiliary machinery
2.12 Improve reliability and reduce maintenance manpower for frequency converters, hull and deck machinery, hydraulic systems, and gas turbine blading
2.13 Develop methods to identify problem areas in ship manning and potential reductions through emerging technologies
2.14 Reduce fuel costs through the integrated machinery effort, feasibility demonstration of better waste heat use from gas turbines, and evaluation of two-phase heat engines
2.15 Reduce design costs through the development and application of improved predictive methods for structural and hydrodynmamic performance

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

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

Surface Ship Performance and Mission Effectiveness

2.16 Extend technology of advanced catamaran hulls and Small Waterplane Area Twin Hull (SWATH) ships
2.17 Improve methods of predicting seakeeping and resistance performance, designing lower resistance, higher efficiency propellers, hulls, and appendages, and designing hulls for optimum seakeeping
2.18 Develop improved roll stabilization concepts and supporting technology
2.19 Improve antenna arrangements for electromagnetic compatibility and optimum performance
2.20 Improve maneuvering performance of surface ships

Submarine Performance and Mission Effectiveness

2.21 Develop new design procedures for highly efficient, quiet propulsors, reduced hull and appendage resistance, and component and hull designs for deep diving, using high strength materials
2.22 Develop technology to support secondary machinery concepts for reduced weight, greater reliability, and longer life
2.23 Develop higher energy density batteries
2.24 Develop new concepts and technology for improved life support systems
2.25 Expand the speed and depth operating envelope for submarines

Surface Ship Survivability

2.26 Develop technology to reduce radar and infrared signatures
2.27 Develop lightweight armor systems and materials
2.28 Develop tradeoff theory and defensive concepts for air blast and fragment resistant structures
2.29 Develop new agents and techniques for fire detection, extinguishing, and fire damage recovery
2.30 Develop concepts for resistance to underbottom explosive attack
2.31 Complete concept formulation and develop technology of
2.32 Complete measurements of ships' electromagnetic signatures and analyze data

Submarine Survivability

2.33 Improve life support, gas management, and emergency ballast tank blow systems
2.34 Improve shock effects analysis and hardening techniques
2.35 Improve hull strength and failure mode calculation methods
2.36 Evaluate
2.37 Develop technology for quiet propulsor concepts

2.38 Evaluate
2.39 Develop

2.40 Develop new techniques to measure energy transmission paths on hull structures

Marine Corps Vehicle Capabilities

2.41 Develop, construct, and test improved waterjets for propulsion
2.42 Construct and test breadboard of an advanced hydraulic drive train to reduce system weight
2.43 Construct and test the feasibility of composite components for lightweight cargo doors, stern ramp, and hull structure
2.44 Construct and test components for a reliable, lightweight retractable suspension
2.45 Construct and test metal matrix and laser glazed track blocks for a lightweight track

3. (U) FY 1983 and FY 1984 Planned Programs

Reduced Costs of Ship Acquisition and Life Cycle Support

3.1 Apply cost and technology impact models developed in 1983 to the identification and quantification of principal ship cost drivers and evaluation of the potential payoff of evolving technologies toward reducing ship acquisition and life cycle costs and enhancing military performance
3.2 Develop analytical tools to assess the potential for ship manning reductions through the application of emerging technology and changes in ship arrangements and operational doctrine
3.3 Assess combat capability and technology shortfalls of surface action groups based on updated threats, operational situations, and technology projections
3.4 Evaluate integrated machinery, advanced propulsors and contrarotation, and alternative structural designs and materials for potential cost reductions
3.5 Revise gas turbine blade specification for longer life
3.6 Complete test and evaluation of advanced auxiliary machinery concepts, lubricants, and hydraulic fluids

Surface Ship Performance and Mission Effectiveness

3.7 Complete all testing and evaluation of presently contracted 3,000 HP Segmented Magnet and superconducting machinery to support Advanced Development program starting in FY 1983
3.8 Complete design and transition the development of an advanced propulsion-derived ship service power system

I. *Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.9 Complete development of design methods for contrarotation propellors
3.10 Demonstrate a gas turbine recuperator and other waste recovery methods
3.11 Complete and transition the development of machinery control and monitoring systems
3.12 Establish the feasibility of a two-phase propulsion engine
3.13 Develop technology for improved prediction of resistance and vibrations, and improved seakeeping and maneuvering
3.14 Develop concepts for modular construction techniques and alternative structural arrangements and deckhouse concepts to reduce construction costs
3.15 Complete design methods for control, seakeeping, and resistance of Small Waterplane Area Twin Hull (SWATH) ships
3.16 Verify the design theory of contrarotating propellers
3.17 Perform rudder roll stabilization trials and report on potential for Navy application

Submarine Performance and Mission Effectiveness

3.18 Improve design criteria for submarine hulls and develop in-service monitoring techniques for hull integrity
3.19 Evaluate concepts and materials for higher energy density batteries
3.20 Test titanium structural models
3.21 Evaluate titanium pipe fittings and condensers for deep diving application
3.22 Develop improved shaft seals and improved life support systems
3.23 Develop technology for improved stability, control, wake prediction and resistance calculations
3.24 Complete evaluation of alternate submarine oxygen system concept

Surface Ship Survivability

3.25 Develop and test new armor for shaped charges and armor piercing projectiles
3.26 Improve protection of fire vulnerable systems, extinguishing agents for multi-class fires, and infrared signature reduction methods
3.27 Assess vulnerability to magnetic detection, define countermeasures, and identify advanced development requirements
3.28 Develop and evaluate new quiet propulsor concepts
3.29 Complete design, installation, test, and evaluation
3.30 Develop improved electromagnetic compatibility (EMC) measurement techniques and design capabilities

Submarine Survivability

3.31 Improve design methods for shock resistance, vulnerability assessment, and explosive effects prediction

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

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

3.32 Develop acoustic silencing technology

3.33 Determine effects of

Marine Corps Vehicle Capabilties

3.34 Develop and test critical technology and components for an Advanced Light Armored/Amphibian Vehicle System (ALAAVS)
3.35 Construct and test components for high performance vehicles including a low silhouette retractable track suspension, a complete metal matrix track assembly, a composite high strength track pin, and a hydraulic drive train for improved vehicle layout

Changes from FY 1982 to FY 1983

3.36 Significantly increased emphasis in Titanium Submarine Structures (F43-422)
3.37 Completion of laboratory evaluation of 3000 HP advanced electric motors in FY 1982 accounts for significant decrease in FY 1983 funds for Electrical Energy Conversion and Distribution (F43-431)

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

5. (U) Milestones: Not applicable

II. Project: F43-411 Title: Concept Assessment of Platforms and Systems
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Addresses problems of identifying technology needs for future ship concepts; the impact of emerging technologies on existing ships and near term designs; the reduction of costs and manning for future ships; the integration of combat systems with the ship platform; and the evaluation of new ship/vehicle concepts for their potential contribution to the fleet
- The above descriptions include developments of supporting technology for ships and concepts as contributors to fleet battle groups, amphibious assault groups, surface action groups, and sea lanes of communication

(U) RELATED ACTIVITIES

- Technology developed under this project supports other advanced developments in the following:
  - P.E. 63564N, Project 010, New Concepts
  - P.E. 63564N, Project 069, Surface Ship Concept Formulation

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Ocean Systems Center, San Diego, CA; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Air Development Center, Warminster, PA
- Industrial - Boeing Computer Systems, Inc., McLean, VA; American Computer and Electronics Inc., Gaithersburg, MD
- Academic - Davidson Laboratories, Stevens Institute of Technology, Hoboken, NJ; Navy Postgraduate School, Monterey, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Completed initial version and installed in-house capability to use an advanced surface ship evaluation model (ASSET) -- currently being used to assess impact of emerging technologies on total ship concepts relative to size, cost, and performance

1.2 Developed means to integrate effects of ship motions on missile and gun fire control systems, and measured relative effectiveness -- Integrated results with Combatant Capability Assessment Project, which is an integrated special focus effort under this project

II. Project: F43-411 Title: Concept Assessment of Platforms and Systems
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.3 Completed feasibility and design requirements for an Extended Performance Hydrofoil (EPH) to permit extended endurance and enhanced mine neutralization capability
1.4 Completed preliminary evaluation of a new catamaran surface effect ship (SECAT) concept
1.5 Completed feasibility analysis of tactical data correlation for a battle group; multi-threat anti-air warfare (AAW) engagement model; detection/tracking model, and ship motion model for combatant capability assessment (CCA) special focus effort (SFP 3107)

2. (U) FY 1982 Program

Ship/Systems Initiative Development (SIDS)

2.1 Develop conceptual alternatives (performance, size, cost) for next generation CV by assessing projected ship/vehicle capabilities against the future threat, identifying shortfalls, and prioritizing exploratory development needs to fulfill those shortfalls

Reduce Naval Ship Operational and Acquisition Costs

2.2 Assess the impact of emerging technology on the cost and performance of future ships by use of newly developed Advanced Surface Ship Evaluation Technology Model (ASSET)
2.3 Develop alternative pricing methods, and analyze current cost drivers to permit the possible application of emerging technology to those high cost areas
2.4 Investigate shipboard operational and maintenance manning alternatives to current (high skill rate and numbers) requirements, by applying new technology to these areas

Combatant Capability Assessment (CCA)

2.5 Develop system saturation conditions for anti-air-warfare (AAW) point defense, through feasible designs for modeling
2.6 Develop dynamic error budget re-optimization of existing class designs versus battle group track file synthesis criteria

New Vehicle Concepts

2.7 Develop model, conduct dynamic tests, and evaluate new catamaran surface effect ship (SECAT) concept

Project: F43-411
am Element: 62543N
lission Area: 523 - Engineering Technology

Title: Concept Assessment of Platforms and Systems
Title: Ships, Submarines, and Boats Technology
Budget Activity: 1 - Technology Base

U) FY 1983 and FY 1984 Planned Programs

Ship/Systems Initiatives Development (SIDS)

3.1 Develop conceptual alternatives (performance, size and costs) for next generation ships of an amphibious assault group (AAG) assessing projected ship/vehicle capabilities against the future threat, identifying shortfalls, and prioritizing exploratory development needs to fulfill those shortfalls
3.2 Start similar development as above on surface action group

Reduce Naval Ship Operational and Acquisition Costs

3.3 Update the Advanced Surface Ship Evaluation Technology model (ASSET) to include improved structures, cost modules and include a vulnerability analysis model -- Extend use of Advanced Surface Ship Evaluation Technology to all Ships, Submarines, and Boats technology program managers
3.4 Summarize technology assessment results and incorporate in Ships, Submarines, and Boats Program Element Strategic Plan
3.5 Develop next generation cost evaluation model (using results of previous accomplishments) to permit cost/warfare capability relationships
3.6 Develop analytical tools and data base to assess technology impact on reduced manning

Combatant Capability Assessment (CCA)

3.7 Develop system saturation conditions for anti-air-warfare (AAW) area defense through feasible design for modeling
3.8 Develop system availability model for each shipboard primary warfare area with use of, or revision to, currently available models

New Vehicle Concepts

3.9 Transition catamaran surface effect ship (SECAT) to separate programs -- No new concept developments planned

Comparison with FY 1982 Program:

3.10 Increase in FY 1983 over FY 1982 is to support an anticipated increase in the Ship's Initiative Development (SIDS) and an expansion of the Advanced Surface Ship Evaluation Technology (ASSET) development efforts

II. Project: F43-411 Title: Concept Assessment of Platforms and Systems
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F43-411	Concept Assessment of Platforms and Systems	2,464	3,734	5,476	5,270	Continuing	Continuing

III. Project: F43-422 Title: Vehicle Structures
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Develops technology aimed at achieving improvements in structural subsystems of combatant submarines and surface ships
- Addresses areas such as the hull, foundations, superstructures, and appendages
- Develops and demonstrates structural concepts, new structural materials applications and analytical procedures which will reduce design, construction, and maintenance costs, assure safety and reliability of future ships, improve ship performance, and/or permit the timely evolution of new ship types into the Fleet
- Develop analytical methods to address realistic and complex structures allowing better weight and volume utilization
- Reduce the construction/maintenance costs of submarines and surface ships through the development of improved structural arrangements and details and structural integrity based weld strength and repair/surveillance requirements
- Develop quantitative methods to determine submarine hull toughness requirements which will facilitate the introduction of new hull materials and balanced designs
- Demonstrate titanium pressure hull concepts and design procedures for application to future deeper diving submarines
- Demonstrate feasibility and develop confidence in the application of fibrous composites to a variety of Naval ship hulls and component structures
- Evaluate structural concepts to accommodate advanced propulsion systems to reduce the size and cost of surface combatants

(U) RELATED ACTIVITIES

- Related programs include other projects under this program element, particularly F43-451, Survivability, Habitability, and Damage Control and F43-421, Fluid Dynamics
- Exchange of technical information exists with the Materials Exploratory Development Program (P.E. 62761N)
- There also exist very strong relationships with several advanced development programs which pick up technology from this project for further development and validation. These include Program Elements:

  - 63514N, Shipboard Damage Control
  - 63531N, HY-130 Steel
  - 63588N, SSBN Subsystem Technology
  - 63561N, Submarines (Advanced)
  - 63566N, Amphibious Assault Craft
  - 63569N, Attack Submarine Development

III. Project: F43-422
Program Element: 62543N
DoD Mission Area: 523 - Engineering Technology

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

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD
- Industrial - Bath Iron Works, Bath, ME; Ingalls Shipbuilding, Litto Industries, Pascagoula, MS; Lockheed Missile and Space Company, Sunnyvale, CA; General Dynamics, Electric Boat Division, Groton, CT
- Academic - University of Illinois, Chicago, IL; University of Arizona, Tempe, AZ; Oklahoma State University, Oklahoma City, OK

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 TRIDENT missile compartment design procedure, logistics hatch, and sandwich bulkhead resulted in reduced development costs, anticipated improved logistics with accompanying increased time-on-station, improved arrangements, and reduction in the length of the Trident design
1.2 Basis for the certification of HY-130 steel and titanium submersible structures leading to the construction of the Deep Submergence Rescue Vehicle (DSRV), and the ALVIN and SEACLIFF, respectively
1.3 State-of-the-art summary document containing the latest design analysis methods for high strength steel submarine structures, including HY-130 steel
1.4 Computerized midship section design capability for conventional and advanced surface ships which permits rapid, more cost efficient design iterations and tradeoffs
1.5 Demonstrated approaches to reduce the size and increase the spacing of deep frames in submarines to improve arrangements and/or reduce weight
1.6 Demonstrated the feasibility of lower yield stress, fracture resistant welds which offer an opportunity for major cost savings in submarine construction
1.7 An improved procedure to design helicopter landing decks which will result in reduced topside weight for surface combatants
1.8 Demonstrated the feasibility for relaxing current weld accept/reject standards for submarine hull construction, thus offering an opportunity for reduced construction costs
1.9 Demonstrated the feasibility for monitoring real-time submarine structural performance using acoustic emission techniques which could permit the safe extension of hull inspection intervals, and reduce repair/overhaul inspection time
1.10 Demonstrated that significant weight and cost savings are achievable in non-parallel hull configurations for submarine engine room compartments through the validation of new design analysis methods

III. Project: F43-422 Title: Vehicle Structures
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD
- Industrial - Bath Iron Works, Bath, ME; Ingalls Shipbuilding, Litto Industries, Pascagoula, MS; Lockheed Missile and Space Company, Sunnyvale, CA; General Dynamics, Electric Boat Division, Groton, CT
- Academic - University of Illinois, Chicago, IL; University of Arizona, Tempe, AZ; Oklahoma State University, Oklahoma City, OK

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 TRIDENT missile compartment design procedure, logistics hatch, and sandwich bulkhead resulted in reduced development costs, anticipated improved logistics with accompanying increased time-on-station, improved arrangements, and reduction in the length of the Trident design
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1.7 An improved procedure to design helicopter landing decks which will result in reduced topside weight for surface combatants
1.8 Demonstrated the feasibility for relaxing current weld accept/reject standards for submarine hull construction, thus offering an opportunity for reduced construction costs
1.9 Demonstrated the feasibility for monitoring real-time submarine structural performance using acoustic emission techniques which could permit the safe extension of hull inspection intervals, and reduce repair/overhaul inspection time
1.10 Demonstrated that significant weight and cost savings are achievable in non-parallel hull configurations for submarine engine room compartments through the validation of new design analysis methods

III. Project: F43-422
Program Element: 62543N
DoD Mission Area: 523 - Engineering Technology

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

2. (U) FY 1982 Program

2.1 Continue to emphasize the development of analytical methods to predict the collapse strength of complex submarine hulls
2.2 Assess current Navy requirements for submarine weld strength, weld acceptance and repair/surveillance, and practical application of the acoustic emission method for monitoring structural defects during construction and at sea
2.3 Transition design approaches for reduced local reinforcement of submarine structures to advanced development for validation
2.4 Improve design procedures for submarine ice breakthrough, permitting safe expansion of submarine operational capability
2.5 Structural options to reduce installation cost of non-structural distributive systems
2.6 Complete automated design tool for surface ship structures cost analysis permitting rapid cost comparisons of structural concepts and details
2.7 A new start, directed at developing and demonstrating the feasibility of a surface ship superstructure concept which effectively integrates most topside requirements (e.g., warhead fragment resistance, reduced weight, fire resistance, reduced radar cross section)

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 New design analysis capability for complex, asymmetric submarine structures offering major opportunities for reduced weight, improved arrangements and/or reduced cost
3.2 Conduct explosion tests of fracture specimens having controlled cracks and propose preliminary criteria for ductile fracture initiation in submarine hulls
3.3 Recommend hull structure options (fibrous composites) for mine warfare vessels
3.4 Complete evaluation of procedures for establishing the structural integrity of new surface ship stem forms to accommodate innovative advanced propulsion systems
3.5 Initiate fabrication of titanium models and tests to determine the effect of creep on the inelastic general instability failure mode
3.6 Evaluate performance of straight-through welds which have potential for reducing the cost of titanium hull fabrication
3.7 Methods to accurately predict the response of complex grillage structure including effects of initial distortion, post-buckling, VSTOL thermal loads
3.8 Recommendations for modifying current submarine hull toughness specifications based on structural criteria rather than workmanship/weldability basis

III. Project: F43-422 Title: Vehicle Structures
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.9 Complete draft comprehensive design guidelines for twin-hull ship structure
3.10 Validate procedure for establishing out-of-roundness tolerances for submarine pressure hulls which adequately considers the random nature of actual imperfections

Comparison with FY 1982 Program:

3.11 Ongoing efforts will continue to emphasize tasks directed towards controlling construction and maintenance costs and improving performance of combatant submarines and surface ships
3.12 The major increase in funding is to accelerate the titanium submarine structures effort including fabrication of titanium structural elements and creep collapse models and to initiate a new thrust in composites for naval applications
3.13 The titanium submarine structures program is planned to increase to $2,200 thousand in FY 1983 and $4,200 thousand in FY 1984. This program addresses technology developments in the areas of creep collapse, fatigue and stress corrosion cracking, and hull toughness; concepts for cost reduction and facility requirements will also be addressed
3.14 A new program initiative in composite structures has been approved for a FY 1984 start. Planned funding for FY 1984 is $430 thousand. This program will address applications of composites for both surface ships and submarines. Some near term thrusts include composites for mine sweeper hulls and composites for non-pressure hull submarine structures such as sail, control surfaces and foundations

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F43-422	Structural Design and Test	5,002	4,450	6,335	9,288	Continuing	Continuing

IV. Project: F43-431
Program Element: 62543N
DoD Mission Area: 523 - Engineering Technology

Title: Electrical Energy Conversion and Distribution
Title: Ships, Submarines, and Boats Technology
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Develops advanced electrical motors and generators, including the superconducting (Super C) and segmented magnet types
- Manufactures 3,000 HP laboratory-test electrical machinery which will enable the development of 40,000 HP per shaft systems needed for medium combatant applications
- Supports the integrated machinery thrust which coordinated the design of supportive equipment and hull forms optimizing electric propulsion for naval vehicles
- Develops the most attractive electric machinery design options for installed power, electric drive, machinery monitoring and control, and electric energy storage to provide options for reduced ship size and reduced fuel consumption, and to minimize incompatibilities and vulnerabilities of shipboard machinery elements

(U) RELATED ACTIVITIES

- Program Element 63513N, Shipboard System Component Development; Program Element 63573N, Electric Drive; Program Element 63561N, Submarines (Advanced); Program Element 63508N, Ship Propulsion Systems (Advanced); Program Element 63724N, Shipboard Energy Conservation

(U) WORK PERFORMED BY

- In-House - Argonne National Laboratory, Argonne, IL; David W. Taylor Naval Ship Research and Development Center, Carderock and Annapolis, MD; National Bureau of Standards, Boulder, CO; Naval Ship Systems Engineering Station, Philadelphia, PA
- Industrial - AiResearch Manufacturing Company of Calfornia, Torrance, CA; CTI-Cryogenics, Waltham, MA; General Electric Company, Schenectady, NY; Westinghouse Electric Company, Pittsburgh, PA; Mechanical Technology Inc., Latham, NY
- Academic - None

IV. Project: F43-431
Program Element: 62543N
DoD Mission Area: 523 - Engineering Technology

Title: Electrical Energy Conversion and Distribution
Title: Ships, Submarines, and Boats Technology
Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Advanced Electrical Propulsion Machinery

1.1 Completed conceptual design studies on nominal 40,000 HP per shaft systems to define requirements for 3,000 HP feasibility model systems
1.2 Completed laboratory tests of a 400 HP superconductive propulsion system and evaluated shipboard operations on a specially-configured test craft in the Chesapeake Bay area
1.3 Completed construction and factory tests of major components for two 3,000 HP advanced electrical machinery feasibility model systems
1.4 Conducted supporting technology demonstrations in cryogenic refrigeration equipment, superconductive magnets, liquid metal current collectors, high performance brushes, and lightweight switchgear

Ship Service Electrical Power Conversion and Distribution Equipment

1.5 Constructed a breadboard-model variable speed constant frequency generator system and initiated ship impact analyses of four candidate concepts for derivation of ship service electrical power from propulsion prime movers
1.6 Completed analyses of alternative electric distribution system concepts to optimize power availability efficiency and load/system/source compatability and started feasibility study of DC distribution system
1.7 Completed initial tests on breadboard impedance measurements system for shipboard electric power systems
1.8 Completed development of high power semiconductor device test equipment and started test operations to develop semiconductor device requirements for shipboard solid state equipment
1.9 Demonstrated improved electrolyte/separator materials and improved interrupted-current charge methods in small five to sixty ampere-hour nickel-zinc battery cells

Machinery and Ship Monitoring and Control

1.10 Completed construction of general-purpose, programmable, digital controller employing standard electronic modules and started integration into a lab demonstration of a standardized propulsion and auxiliary machinery control and monitoring system which is based on distributed architecture, microprocessor-based, standardized hardware with a multiplex data link
1.11 Completed assessment of several ship roll reduction system concepts as alternatives to hydraulically-activated fins

1.12 Completed lab feasibility test on time-domain-reflectometer tank level indicator
1.13 Completed experimental-prototype shaft thrust measurement device

2. (U) FY 1982 Program

Advanced Electrical Propulsion Machinery

2.1 Completed construction and factory tests of initial-design, feasibility-model, 3,000 HP superconducting and Segmented Magnet machines
2.2 Continue supporting component technology developments in current collectors, magnets, cryogenic equipment, switchgear and transmission lines
2.3 Identify advanced electric propulsion system component and system design concepts which are considered suitable for transition to full-scale system construction in FY 1983

Ship Service Electrical Power Conversion and Distribution

2.4 Complete assessment of advanced technology component development options for solid state 60 Hz inverters and initiate experimental development in high payoff areas
2.5 Complete analytical assessment of alternate concepts for propulsion derived ship service power and start design of 400 KW lab system
2.6 Complete system continuity, source and load characterization studies for alternative electric plant and distribution system concepts to optimize power availability, efficiency, and load/system/source compatibility and synthesize optimum DC distribution system
2.7 Start evaluation of improved electrolyte/separator materials and charge control methods in 250 ampere-hour nickel-zinc battery cells

Machinery and Ship Monitoring and Control

2.8 Complete assessment of sensor/transducer needs for machinery test and monitoring instrumentation
2.9 Complete tests with experimental clamp-on model of an acoustic wear particle sensor for hydraulic oil systems
2.10 Complete Exploratory Development effort on universal tank level indicator feasibility model
2.11 Complete the programming microprocessor-based general purpose propulsion controllers and incorporate analytical models of electric drive machinery and gas turbine prime movers in laboratory simulation of standardized propulsion and auxiliary machinery control system

IV. Project: F43-431 Title: Electrical Energy Conversion and Distribution
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.12 Complete Exploratory Development investigation of acoustic flame detector

3. (U) FY 1983 and FY 1984 Planned Programs

Advanced Electrical Propulsion Machinery

3.1 Complete lab and test craft operations with 3,000 HP feasibility-model machinery developed under segmented magnet and superconducting program contracts to support the Advanced Development program beginning in FY 1983
3.2 Develop alternatives for sodium-potassium liquid metal current collectors and monolithic solid brushes and evaluate in 400 HP and 3,000 HP machines
3.3 Evaluate components and materials to improve shipboard environmental compatibility of cryogenic helium refrigeration equipment
3.4 Investigate improved superconductive magnet designs for electric drive systems
3.5 Continue investigation of advanced-design switchgear and transmission lines
3.6 Start design and construction of new 3,000 HP feasibility model machinery incorporating advanced-concept components

Ship Service Electric Power Conversion and Distribution

3.7 Complete construction of 400 KW lab model of propulsion-prime-mover derived ship service system
3.8 Complete lab hardware for simulating DC distribution system for vital electronic loads
3.9 Complete specification for advanced-design solid-state 60 Hz converter for submarine service
3.10 Develop generalized guidelines for power semiconductor applications in Navy shipboard equipment
3.11 Complete exploratory development of interrupted-current charge control equipment and transition to fleet service with silver-zinc batteries
3.12 Start development of rechargeable lithium batteries

Machinery and Ship Monitoring and Control

3.13 Complete lab demonstration of microprocessor-based, distributed architecture, multiplex-data-linked, standardized propulsion and auxiliary machinery control system
3.14 Complete exploratory development of ultrasonic wear particle sensor
3.15 Complete exploratory development of improved non-intensive acoustic flowmeter
3.16 Transition pilot-model auxiliary machinery component condition monitoring system to Advanced Development

IV. Project: F43-431
Program Element: 62543N
DoD Mission Area: 523 - Engineering Technology

Title: Electrical Energy Conversion and Distribution
Title: Ships, Submarines, and Boats Technology
Budget Activity: 1 - Technology Base

3.17 Decrease in funding for FY 1983 over FY 1982 is the result of the planned completion of the 3,000 HP machinery evaluation and development work and transition to Advanced Development

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F43-431	Electrical Energy Conversion and Distribution	4,619	6,861	3,828	4,[illegible]	Continuing	Continuing

V. Project: F43-452 Title: Acoustic Silencing
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Develops technology and hardware to reduce noise aboard ships and submarines to a level undetectable by enemy acoustical sensors, both active and passive, and to a level at which ones own ship acoustic sensors are unaffected by platform related noise through the operational speed range
- Existing acoustic deficiencies in ships and submarines are identified through full scale measurements conducted under other programs, and this project addresses identified deficiencies

(U) RELATED ACTIVITIES

- The technology developed under this project supports engineering developments in the following Program Elements:
  - 25634N, Project S0218 - Submarine Silencing
  - 63553N, Project S0229 - Surface Ship Silencing
  - 63562N, Project S0221 - Target Strength Reduction

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA; Naval Underwater Systems Center, Newport, RI
- Industrial - Acoustical Associates, Inc., Cambridge, MA; Bolt, Beranek, and Newman, Inc., Cambridge, MA; Rockwell International Corporation (Autonetics Division), Anaheim, CA
- Academic - Applied Research Laboratory/Pennsylvania State University, State College, PA; Catholic University, Washington, DC; Florida State University, Tallahassee, FL

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Developed an

V. Project: F43-452 Title: Acoustic Silencing
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.2 Develop advanced propulsor designs

1.3 Applied sonar domes with additional improvement

1.4 Developed and tested
1.5 Developed small scale model relationships, acoustical-optical testing techniques,

2. (U) FY 1982 Program

Machinery Quieting

2.1 Develop
2.2 Evaluate in-situ damping measurement

Target Strength Reduction

2.3 Design and develop design guides
2.4 Report on relationships
2.5 Determine effects of

Propulsion Quieting

2.6 Determine design parameters
2.7 Design
2.8 Develop designs and test methods

Hydro-Acoustical Quieting

2.9 Determine sonar sources
2.10 Evaluate designs and scale model sonar arrays

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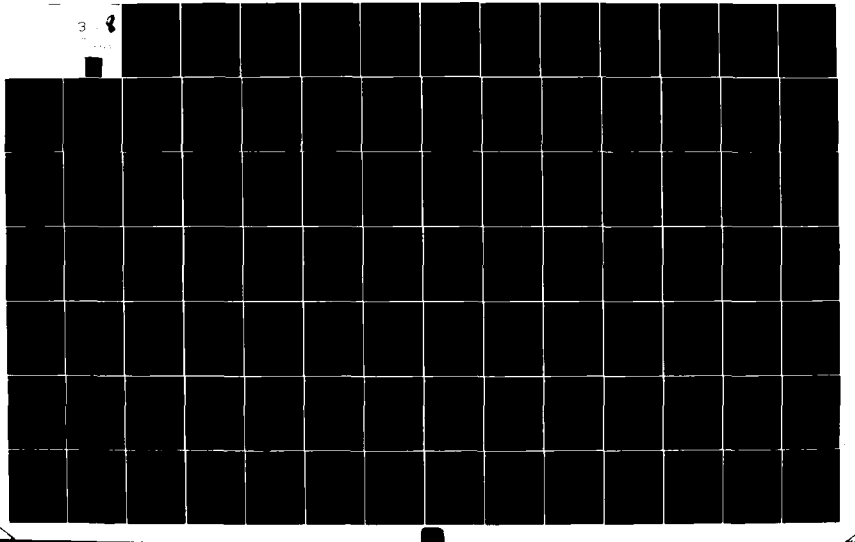

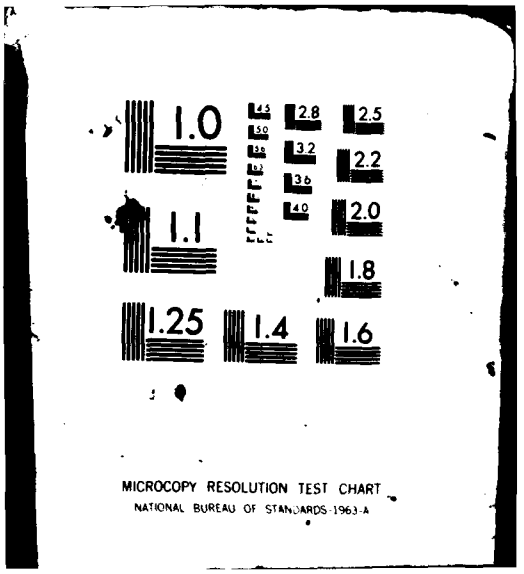
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V. Project: F43-452 Title: Acoustic Silencing
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Noise Masking

2.11 Test and evaluate Compound Air Masker options for selection of concept for shipboard testing

3. (U) FY 1983 and FY 1984 Planned Programs

Machinery Quieting

3.1 Evaluate pump
3.2 Assess analytical methods developed for design tradeoffs

Target Strength Reduction

3.3 Report on technology
3.4 Report on design parameters and an optimization of properties
3.5 Report on

Propulsor Quieting

3.6 Conduct model studies of propeller cavitation

3.7 Develop concepts
3.8 Develop advanced concepts

Hydro-Acoustical Quieting

3.9 Report on design parameters
3.10 Study nonconventional bow dome designs

Noise Masking

3.11 Design and fabricate and install Compound Air Masker
3.12 Conduct performance evaluation of Compound Air Masker

V. Project: F43-452 Title: Acoustic Silencing
Program Element: 62543N Title: Ships, Submarines, and Boats Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.13 The funding increase from FY 1982 to FY 1983 (+$3,040 thousand) represents specific funding requirements in Compound Air Masker (CAMS) development and refinement of costs including escalation characteristic of exploratory development

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F43-452	Acoustic Silencing	5,282	6,660	9,700	8,100	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

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

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

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

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

(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 a few Category 6.2 Program Elements that address only Navy unique needs
- Improves undersea warfare weapons and weapon systems, and develops techology related to these weapons and their systems such as guidance and control, propulsion, hydrodynamics, countermeasure protection, target acquisition, mine sensors, fire control, batteries, warheads, fuzes, propellants, explosives, and related chemistry

(U) BASIS FOR FY 1983 RDT&E REQUEST

Basis:

- The funding for FY 1983 is requested to address the following rapidly emerging Soviet Threat advances:
  - The appearance of higher speed, deeper diving [redacted] submarine targets such as Alfa, Oscar, and Typhoon

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

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

- These factors require the acceleration of certain current tasks and the initiation of new efforts
- Increased attention is planned for technologies such as guidance and control, terminal homing, propulsion, warheads, and combat control
- Advances in these technologies will transition into improvements of current weapons or be used to establish the basis of future weapons

Tasks:

- Complete small scale test torpedo warhead
- Procure 1/5 scale model to initiate tests for damage assessment to submarine
- Demonstrate statistically advanced warhead concept on small scale target sections
- Develop insensitive high performance explosives for undersea, surface launched, and air launched weapon systems
- Develop high energy density closed cycle thermal propulsion and lithium battery technology capability
- Based on test results, design a vehicle resulting in reduced torpedo lengths
- Develop terminal homing concepts for torpedoes, conduct in-water runs to develop target signature data base, and define models and simulations for providing accurate target hit placement to maximize warhead effectiveness
- Develop and test techniques capable of achieving
- Improve guidance and control techniques through evaluation of an guidance system
- Evaluate counter-countermeasure techniques to improve torpedo hit probability
- Define techniques for improved performance against targets
- Extend minefield theory and planning methodology and develop mine delivery concepts
- Develop system for surface ship combat control
- Evaluate components to assess torpedo self-noise reduction techniques
- Integrate submarine technologies

The slight increase in funding from FY 1982 to FY 1983 ($42 thousand) represents a refinement of cost estimates. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

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

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

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Changes in total program element funding for FY 1981, FY 1982, and FY 1983 are +$162, +$1,312, and -$2,640 respectively -- the subprojects within the element have been redefined and somewhat regrouped for better structure/organization
- The increase in FY 1982 in this descriptive summary primarily reflects a $1,775 increase in the Undersea Combat Control effort to address an urgent need by U.S. submarines and surface ships for improved
  The FY 1983 decrease in this program element results from overall Navy budget reductions
- Changes between the funding profiles for the projects shown in the FY 1982 Descriptive Summary and those shown in this Descriptive Summary are primarily the result of redefinition and regrouping of project efforts and contents. Specifically, all major torpedo related efforts are now included in F33-321; Undersea Weapons Combat Control (F33-323), previously included under F33-341, was identified as a separate project to provide high visibility for the increased effort; efforts involving artificial target development and threat target data base development and simulation were combined (F33-326); all mine related tasks were included in F33-322; former Projects F33-361, Submarine Weapon Launching/Handling/Servicing Technology, and F33-571, Energy Technology were terminated; and former Projects F33-351 and F33-354 have been renumbered F33-327 and F33-337 respectively

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

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

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	24,398	21,364	23,710	27,704	Continuing	Continuing
F33-322	Undersea Mines (Formerly F33-300)	1,573	2,100	2,350	2,700	Continuing	Continuing
F33-321	Improved Performance Undersea Vehicle (Formerly F33-301)	2,825	2,893	3,250	3,950	Continuing	Continuing
	Navy Science Assistance Program (Formerly F33-311)	500	0	0	0	Transferred	Transferred
F33-311	Systems Investigations for Undersea Warfare Weaponry (F33-313)	1,020	750	810	900	Continuing	Continuing
F33-322	Minefield Planning (Formerly (F33-314)	350	0	0	0	Continuing	Continuing
F33-321	Undersea Weapons Structures and Fluid Dynamics (Formerly F33-321)	1,866	1,400	1,525	1,800	Continuing	Continuing
F33-321	Undersea Weapons Propulsion (Formerly F33-331)	2,335	2,100	2,325	2,750	Continuing	Continuing
F33-321	Undersea Weapons Guidance and Control (Formerly F33-341)	8,314	7,500	8,200	9,600	Continuing	Continuing
F33-327	Undersea Weapons Warhead and Fuzes (Formerly F33-351)	1,459	2,200	2,450	2,800	Continuing	Continuing
F33-337	Explosive Research and Safety (Formerly F33-354)	3,706	2,421	2,600	2,900	Continuing	Continuing
-	Submarine Weapon Launching/Handling/Servicing Technology (Formerly F33-361)	200	0	200	304	Continuing	Continuing
-	Energy Technology (Formerly F33-571)	250	0	0	0	Continuing	Continuing

NOTE: Project numbers reflect FY 1983 structure. Project numbers used in FY 1982 are in parens next to project titles

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62633N
DoD Mission Area: 523 - Engineering Technology

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

(U) DETAILED BACKGROUND AND DESCRIPTION

° Improves undersea warfare weapons and weapon systems and develops technology related to torpedoes, mines, fuzes, explosives, propellants, sonar target acquisition, torpedo guidance, submarine and surface ship combat control, and torpedo countermeasure protection to counter higher speed, deeper diving, threat submarines and surface ships

° Required capabilities include:

- Torpedoes:

- Mines: Improved ability to provide minefield effectiveness, rapid delivery of large numbers of mines, improved detection, classification, localization of targets, high kill against high speed threats.
- Combat Control: Rapid and accurate localization, tracking, and targeting for threat targets.
- Advanced Weaponry: detection and homing capabilities for torpedoes
- Simulated Targets: Broader acoustic data bases, accurate target models and simulations, and fleet target training devices
- Warheads/Fuzes: Warhead designs for lightweight and heavyweight torpedoes
- Exploratory Research: Insensitive high performance explosives

(U) RELATED ACTIVITIES

° Undersea Target Surveillance (P.E. 62711N); Ocean and Atmospheric Support (P.E. 62759N); Energy and Environmental Protection (P.E. 62765N); and, Defense Advanced Research Project Agency (DARPA)

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62633N
Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

(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
- Industrial - Bolt, Beranek, & Newman, Cambridge, MA; Raytheon, Bedford, MA; McDonnell Douglas, Huntington Beach, CA; Westinghouse, Annapolis, MD; Horrigan Analytics, Chicago, IL; Texas Instruments, Dallas, TX; Singer Co., Librascope Division, Glendale, CA; Systems Consultants, Middletown, RI; General Electric Co., Syracuse, NY; Pacific-Sierra, Palo Alto, CA; Sundstrand, Rolling Meadows, IL; Operations Research, Inc., State College, PA; Tracor, Inc., Rockville, MD; Honeywell, Minneapolis, MN; Lockheed Aerospace Corp., Palo Alto, CA
- 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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

F33-311 - Concept Assessment for Weaponry

1.1 Commenced generation of point designs for the Advanced Submarine-Launched Torpedo (ASLT)
1.2 Completed initial analysis and definition of requirements for an Advanced Submarine-Launched Torpedo (ASLT) to defeat the improved submarine threat
1.3 Completed evaluation of Torpedo Mk 48 Advanced Capability (ADCAP) torpedo [redacted] and defined characteristics
1.4 Determined impact of weapon [redacted]
1.5 Developed point designs for [redacted] open-cycle thermal, closed-cycle thermal, and electric propulsion systems for conventional and low drag torpedo hulls

F33-321 - Torpedo Components and Subsystems

1.6 Designed concept using [redacted] torpedoes and analyzed using simulation techniques
1.7 Obtained at-sea measurements and initiated evaluation of an [redacted] technique

I. *Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.8 Completed initial feasibility studies for torpedo sonar along with preliminary ranging and homing algorithms for the concept
1.9 Conducted at-sea test with hardware to obtain torpedo sonar self-noise
1.10 Demonstrated capability to ruggedize into torpedo size cannisters
1.11 Designed and constructed two 250 HP prototype rotary piston engines
1.12 Successfully demonstrated a ten-cell lithium/silver oxide propulsion source
1.13 Developed a low rate 150 ampere hour lithium/thionyl chloride reserve battery prototype
1.14 Obtained a significant reduction in torpedo radiated noise through the use of hull sections
1.15 Completed analyses or volume limited vehicle using OTTO fuel and Hydroxyl Ammonium Perchlorate (HAP)
1.16 Demonstrated electric propulsion motor technology
1.17 Demonstrated discharge power levels of lithium/silver oxide batteries
1.18 Tested lithium/thionyl chloride battery cells for thermal effect and electrical properties
1.19 Completed fabrication of a low noise speed reducer gear train assembly and commenced laboratory testing
1.20 Demonstrated with in-water tests of the pressure gradient laminar flow vehicle
1.21 Completed construction of the free-running heated laminar flow vehicle, designated Low Drag Vehicle-2 (LDV-2), and commenced range testing
1.22 Conducted in-water tests proving self-noise of the Mk 48 transducer is caused by water flow over the transducer and is independent of the vehicle
1.23 Demonstrated an improved transducer
1.24 Achieved,

F33-322 - Mine Warfare Technology

1.25 Completed initial tests of an experimental optically pumped magnetometer which indicated detection at ranges is feasible
1.26 Made advances in the development of small cryogenic refrigerators with low power consumption for the Superconducting Quantum Interference Device (SQUID) magnetometer
1.27 Developed and documented new analytical methods and measures of minefield effectiveness
1.28
1.29 Evaluation procedures and algorithms have been developed which ranks competing candidate systems

I. *Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.30 Performance predictions for mine processing system have been calculated
1.31 Completed procurement of hardware and fabrication of mines
1.32 Initiated planning for a joint U.S./NATO field program to obtain at-sea data
1.33 Conducted field tests at Fort Lauderdale, FL and Fort Monroe, VA
1.34 Comparative analysis indicated that a is valid for mine application
1.35 Developed a computer-assisted methodology to optimize minefield site selection
1.36 Constructed and laboratory tested a second optically pumped magnetometer and established practical limits of sensitivity, power consumption, and signal-to-noise ratios for mine application
1.37 Completed laboratory tests

F33-323 - Undersea Weapons Combat Control

1.38 Developed and tested a new target motion analysis technique for submarines which improves accuracy and reduces fire control solution time
1.39 Developed Target Motion Analysis (TMA) techniques which improve the solution quality against maneuvering targets. Technology transitioned to advanced development program
1.40 Developed advanced operator display and torpedo guidance concepts for the Mk 48 Advanced Capability. Technology transitioned to advanced development
1.41 Determined characteristics of promising sensor systems
1.42 Completed study on Target Motion Analysis (TMA) development

F33-324 - Advanced Underwater Weaponry

1.43 Developed and implemented model including realistic environmental effects
1.44 Utilized simulation model to evaluate candidate algorithms
1.45 Developed and evaluated a successful algorithm

I. *Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.46 Completed field experiment demonstrating its utility for demonstration purposes when techniques are developed

F33-326 - Underwater Weapon Simulation and Target Devices

1.47 measured for active target strength levels

1.48 Extracted data from at-sea field data

1.49 Exchanged computer submarine target models and experimental data engineers and scientists under The Technical Cooperation Program (TTCP)

1.50 Developed a acoustic model for use on the Naval Ocean Systems Center hybrid simulator and Advanced Lightweight Torpedo (ALWT) and Advanced Capability (ADCAP) program utilization

1.51 Developed a dynamic stability computer model for use in parametric studies

1.52 A theoretical technique has been developed for calculating target strength measurements

F33-327 - Warheads and Fuzes

1.53 developed for the of the Mk 48 Torpedo

1.54 Demonstrated proper functioning

1.55

1.56 Showed that combined the properties of in torpedo warheads

1.57 Finite element developed to predict target response

F33-337 - Explosive Devices Effects Safety

1.58 Completed development and interim qualification testing of cast-cured plastic-bonded explosives (PBX) compositions including two fire and impact resistant main charge explosives, two mechanically strong booster explosives, and an underwater explosive with improved safety

1.59 Synthesis efforts produced new high density explosives

1. *Program Element: 62633N
DoD Mission Area: 523 - Engineering Technology

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

1.60 Demonstrated conditions to achieve over arrangements
1.61 Formulated explosive compositions which demonstrate excellent deformability and processability along with resistance to settling and to hardening during long term storage

2. (U) FY 1982 Program

F33-311 - Concept Assessment for Weaponry

2.1 Complete noise goal studies for the Advanced Submarine-Launched Torpedo
2.2 Continue mission level and requirement sensitivity studies for Advanced Submarine-Launched Torpedo to determine effect on propulsion and guidance requirements
2.3 Develop requirements analyses
2.4 Identify and assess technological approach to countering potential improvements

F33-321 - Torpedo Components and Subsystems

2.5 Award contracts for initiation of efforts and completion of planning documentation
2.6 Conduct in-water tests and analyses to enable completion of system capability documentation
2.7 Conduct in-water tests
2.8 Continue data reduction and algorithm development
2.9 Complete planning of an integrated torpedo towed array sonar effort with the Defense Advanced Research Project Agency (DARPA), and baseline system specifications; initiate system demonstration hardware fabrication specification
2.10 Complete analysis of at-sea data, update signal processing algorithms and procure and initiate hardware fabrication in preparation for total in-water system demonstration
2.11 Document a first-iteration of torpedo tactics for improving torpedo performance
2.12 Conduct in-water tests to obtain a data base for developing torpedo tactics and algorithms
2.13 Begin breadboard design of propulsion system for stand-off weapon

am Element: 62633N
n Area: 523 - Engineering Technology

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

.14 Complete 21-inch breadboard component tests for an advanced stored chemical energy propulsion system (ADSCEPS)
.15 Complete breadboard design of engine for a 21-inch Stored Chemical Energy Propulsion System (SCEPS)
.16 Complete lithium silver oxide battery
.17 Test propulsion motor
.18 Begin development of a lithium thionyl chloride high rate battery
.19 Refurbish Improved Performance Undersea Vehicle (IPUV) and retest in fresh water towing tank
.20 Conduct tests on Improved Performance Undersea Vehicle (IPUV) vehicle in water tank at NASA, Langley Facility
.21 Conduct vehicle tests on Improved Performance Undersea Vehicle (IPUV) in at-sea field runs
.22 Complete self-noise range program on Weapon Silencing Research Vehicle (WSRV)
.23 Fabricate and conduct at-sea tests and evaluate propulsor system

33-322 - Mine Warfare Technology

.24 Determine errors introduced in processing technique

.25 Quantify impact of sea state and sound velocity profile on processing techniques
.26 Complete analysis of current manual methods for selection of mining sites and adequacy of hardware to meet needs of advanced computer assisted design technology
.27 Complete analysis of methodologies suitable for elimination of the current deficiencies in evaluation models
.28 Interface a new test unit and complete data acquisition and analysis for mine applications
.29 Complete laboratory tests

.30 Complete laboratory tests and conduct an at-sea feasibility demonstration
.31 Continue environmental data recording and analysis

33-323 - Undersea Weapons Combat Control

.32 Define a Target Motion Analysis (TMA) model
.33 Define combat control system data flow
.34 Assess the potential contribution to fire control improvement

I. *Program Element: 62633N
DoD Mission Area: 523 - Engineering Technology

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

F33-324 - Advanced Underwater Weaponry

2.35 Complete
2.36 Analyze and modify design requirements within the projected performance envelope
2.37 Quantify overall military usefulness

F33-326 - Underwater Weapon Simulation and Target Devices

2.38
2.39 Analyze data obtained
2.40 Conduct at-sea tests
2.41 Design and fabricate mobile target application
2.42 Develop and test

F33 327 - Warheads and Fuzes

2.43 Complete full scale tests of breadboard
2.44 Establish damage performance of
2.45 Obtain data
2.46 Modify and upgrade analytic codes
2.47 Complete small scale tests
2.48 Initiate effort on warhead concepts
2.49 Initiate analysis and small scale testing warhead concepts
2.50 Define fuze performance requirements
2.51 Establish configuration for fuze
2.52 Complete evaluation of senior technical advisory group (STAG) analytic model warheads
2.53 Initiate target definition

F33-337 - Explosive Devices Effects Safety

2.54 Continue development of insensitive high performance explosives based on new explosive compounds
2.55 Complete development of data base and prediction method for effects on underwater performance on non-ideal explosives

2.56 Complete interim qualification testing
2.57 Complete characterization and identification of mechanisms for new plastic bonded explosives (PBX) compositions
2.58 Complete evaluation of high temperature resistance plastic bonded explosives (PBX) candidates

3. (U) FY 1983 and FY 1984 Planned Programs

F33-311 - Concept Assessment for Weaponry

3.1 Finalize Advanced Submarine-Launched Torpedo (ASLT) performance requirements/design studies; begin follow-on generation weapon configuration analysis; expand subsystem data base
3.2 Investigate the effects of and technological counters capabilities
3.3 Investigate the impact on propulsion system size and weight for Advanced Submarine-Launched Torpedo (ASLT) missions; complete notional systems requirements studies
3.4 Complete operational performance requirements for MUST subgroups; update ASW/Standoff Weapon configuration studies

F33-321 - Torpedo Components and Subsystems

3.5 Develop and evaluate concepts
3.6 Complete algorithm development
3.7 Demonstrate system feasibility and performance capabilities
3.8 Demonstrate capabilities in in-water tests,
3.9 Complete brassboard design of propulsion for 21" torpedo
3.10 Complete electric motor development
3.11 Complete physical chemical properties study for lithium thionyl chloride battery
3.12 Complete lithium silver oxide battery
3.13 Complete construction of test vehicle
3.14 Complete range tests with Weapon Silencing Research Vehicle (WSRV) I
3.15 Evaluate Mk 48 torpedo
3.16 Design and test
3.17 Design, fabricate, and initiate tests of Quiet Transducer 4

F33-322 - Mine Warfare Technology

3.18 Complete methodology dealing with assets allocation

3.19 Complete quantifications of background noise

3.20 Complete tests and environmental impact assessment, and complete configuration design for FY 1984 focused program start
3.21 Verify capability
3.22 Establish system parameters for mine
3.23 Complete transition documentation and transfer to Advanced Development
3.24 Fabricate brassboard mine field test, document, and transition to Advanced Development

F33-323 - Undersea Weapons Combat Control

3.25 Develop a methodology

3.26 Develop a capability which accounts for environmental factors
3.27 Develop Target Motion Analysis (TMA) algorithms, tactics, and requirements
3.28 Complete fire control concept design
3.29 Develop anti-Submarine Warfare (ASW) targeting concepts/techniques
3.30 Complete automated techniques

F33-324 - Advanced Underwater Weaponry

3.31 Design and fabricate for at-sea concept demonstration
3.32 Complete sensitivity analysis of candidate algorithms on simulator and implement selected ones

3.33 Complete initial at-sea torpedo engineering tests
3.34 Complete at-sea concept demonstration

F33-326 - Underwater Weapon Simulation and Target Devices

3.35 Continue acquisition of acoustic signatures
3.36 Obtain data base on submarines
3.37 Develop models for weapon frequencies
3.38 Develop models
3.39 Develop concepts for incorporation into experimental array

I. *Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.40 Design an experimental array utilizing transducer modules
3.41 Build an experimental signal processor to demonstrate and evaluate new algorithms

F33 327 - Warheads and Fuzes

3.42 Initiate full scale brassboard tests
3.43 Procure target model and initiate testing
3.44 Complete small scale tests
3.45 Demonstrate on small scale warheads positioned against targets
3.46 Conduct small scale tests against simple targets
3.48 Select most promising concepts
3.49 Initiate sensor fabrication and testing
3.50 Complete design and initiate construction
3.51 Initiate calculations of target response
3.52 Define response and initiate calculations

F33-337 - Explosive Devices Effects Safety

3.53 Continue development of insensitive high performance explosives based on new explosive compounds
3.54 Continue development of prediction techniques

3.55 Develop data for incorporation
3.56 Complete development of devices
3.57 Evaluate effects of controlled damage on sensitivity of explosives

Changes from FY 1982 to FY 1983

3.58 The slight increase in funding from FY 1982 to FY 1983 (+$42 thousand) represents a refinement of cost estimates

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

5. (U) Milestones: Not applicable

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

° Develops technology for torpedo weapon systems in the areas of detection, classification, localization, tracking, attack, countermeasures, propulsion, hydrodynamics, and structures and silencing to improve the operational techniques of underwater warfare weaponry technology
° Technical areas investigated include:

- electric motors
- batteries
- testing techniques and devices
- combustion engines
- propulsor design
- composite materials
- metal matrix composites
- vibration isolation materials
- structural mechanics
- turbulent boundaries
- signal processing
- sensors (transducers)
- guidance techniques
- weapon technology
- drag reduction

° Resulting technology is applied to:

- torpedo guidance and control
- torpedo propulsion
- notional torpedo system identification
- shells
- weapon system performance prediction
- propulsors

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

° The following Advanced Development (6.3) and Engineering Development (6.4) programs may benefit from progress in this program element:

- 63610N Advanced Lightweight Torpedo (ALWT)
- 63367N Stand-off Weapon
- 63691N/64675N Advanced Capability Mk 48 (ADCAP)
- Mk 46 Torpedo existing weapon update by product improvement programs

(U) RELATED ACTIVITIES

° The major portion of this effort is Navy-oriented, with no special interest or activity in other agencies

(U) WORK PERFORMED BY

° In-House - David W. Taylor Naval Ship Research and Development Center, Carderock, MD; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Underwater Weapons Engineering Station, Keyport, WA; Naval Underwater Systems Center, Newport, RI
° Industrial - Bolt, Beranek, & Newman, Cambridge, MA; Raytheon, Bedford, MA; McDonnell Douglas, Huntington Beach, CA; Westinghouse, Annapolis, MD; Operations Research Inc., State College, PA; Tracor Inc., Rockville, MD; Honeywell, Minneapolis, MN; Lockheed Aerospace Corp., Palo Alto, CA; Sundstrand, Rolling Meadows, IL
° Academic - Applied Physics Laboratory of the University of Washington, Seattle, WA; Applied Research Laboratory of the Pennsylvania State University, State College, PA; Applied Research Laboratory of the University of Texas, Austin, TX

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Recent homing system, propulsion, and weapon silencing accomplishments in this project have transitioned into the Advanced Lightweight Torpedo (ALWT) and Torpedo Mk 48 Advanced Capability (ADCAP) advanced development programs
1.2 Recent hydrodynamic and drag reduction technologies have transitioned into the Advanced Development (6.3) Advanced Expendable Training Target

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Weapon Guidance and Control

1.3 Based on the test results of a laboratory prototype element, a subcontract for design and fabrication was awarded
1.4 Designed concept using a sonar and analyzed using simulation techniques
1.5 Completed development of signal processing schemes based on and their application to detect in high reverberation; initiated processing technique as a consequence of program results
1.6 Completed initial feasibility studies along with preliminary homing algorithms for the concept
1.7 Conducted at-sea test with hardware to obtain torpedo self-noise by torpedoes. Demonstrated capability to

Mine Control

1.8 Incorporated into F33-322

Fire Control

1.9 Incorporated into F33-323

Acoustic Environment and Target Characteristics

1.10 Incorporated into F33-326

Propulsion

1.11 Designed and constructed two 250 HP prototype rotary piston engines
1.12 Successfully demonstrated a ten-cell lithium/silver oxide propulsion source
1.13 Developed a low rate 150 ampere hour lithium/thionyl chloride reserve battery prototype
1.14 Developed a significant reduction in radiated noise
1.15 Completed fabrication of a low noise speed reducer gear train assembly and commenced laboratory testing

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.16 Demonstrated successfully closed cycle thermal propulsion technology in a free-swimming vehicle
1.17 Completed torpedo Mk 48/Advanced Capability (ADCAP) analyses using OTTO fuel/Hydroxyl Ammonium Perchlorate (HAP)
1.18 Demonstrated electric propulsion motor technology
1.19 Demonstrated discharge power levels of lithium/silver oxide batteries
1.20 Tested lithium/thionyl chloride battery cells for thermal effects and electrolytic properties

Hydrodynamics/Weapon Silencing

1.21 Conducted in-water tests proving the self-noise of the Mk 48 transducers is caused by water flow over the transducer and is independent of the vehicle
1.22 Demonstrated in an improved transducer
1.23 Achieved,

1.24 Developed technology for Torpedo Mk 48 Advanced Capability (ADCAP) transducers for self-noise evaluation

Improved Performance Undersea Vehicle (IPUV)

1.25 Demonstrated a with in-water tests of the pressure gradient laminar flow vehicle
1.26 Completed construction of the free-running heated laminar flow vehicle, designated Low Drag Vehicle-2, and commenced range testing

Special Focus Program (SF33-321-3401)

1.27 This is a new start in FY 1982 to develop guidance and control, propulsion, and drag reduction technologies applicable to the long range STAND OFF WEAPON (SOW) Mission. Guidance and control efforts will emphasize technology

2. (U) FY 1982 Program

Weapon Guidance and Control

2.1 Fabricate, test, and document transducer for torpedo application
2.2 Conduct at-sea tests to validate simulation results of sonar

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.3 Complete analytic model and investigate techniques

2.4 Complete planning of an integrated sonar effort with the Defense Advanced Research Project Agency (DARPA); and complete baseline system specifications, procure hardware and initiate system demonstration hardware fabrication

2.5 Complete analysis of at-sea data, update signal processing algorithms, and procure and initiate hardware fabrication in preparation for total in-water system demonstration

2.6 Document a first iteration of torpedo tactics for improving torpedo performance

2.7 Conduct in-water tests to obtain a data base for developing torpedo tactics and algorithms

Propulsion

2.8 Complete breadboard design of propulsion engine for 21 inch diameter torpedo applications
2.9 Complete lithium silver oxide battery
2.10 Test electric propulsion motor
2.11 Begin technology development of a lithium thionyl chloride high rate battery

Hydrodynamic/Weapons Silencing

2.12 Complete Quiet Torpedo Mk 48 self-noise range program
2.13 Evaluate pump-jets on Weapon Silencing Research Vehicle #1
2.14 Fabricate transducers
2.15 Conduct flow noise test
2.16 Fabricate and conduct at-sea tests for evaluation of a propulsor system

Improved Performance Undersea Vehicle (IPUV)

2.17 Refurbish Improved Performance Undersea Vehicle (IPUV) and retest in fresh water tow tanks
2.18 Conduct Improved Performance Undersea Vehicle (IPUV) tests in salt water tow tank using NASA facility
2.19 Investigate in towing tanks
2.20 Complete final report of committee

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Special Focus Program

2.21 Award contracts for initiation of efforts for developing sonars
2.22 Conduct in-water tests and analysis to complete current system capability documentation concept
2.23 Conduct tests to obtain a data base for developing and evaluating concepts
2.24 Evaluate use
2.25 Begin breadboard design of propulsion system for standoff weapon

3. (U) FY 1983 and FY 1984 Planned Programs

Weapons Guidance and Control

3.1 Develop and evaluate
3.2 *Complete* algorithm development for improved homing
3.3 Demonstrate system feasibility and performance capability for homing system
3.4 Demonstrate capabilities in in-water tests,

Propulsion

3.5 Complete brassboard design of propulsion system for 21-inch torpedo
3.6 Complete electric motor development
3.7 Complete physical chemical properties study for lithium thionyl chloride battery
3.8 Complete lithium silver oxide battery

Hydrodynamic/Weapons Silencing

3.9 Complete range tests with Weapon Silencing Research Vehicle (WSRV) I
3.10 Design and test
3.11 Design, fabricate, and initiate tests of Quiet Transducers #4

II. Project: F33-321 (Formerly F33-301, -321, -331, -341) Title: Torpedo Components and Subsystems
Program Element: 62633N Title: Undersea Warfare Weaponry Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Improved Performance Undersea Vehicle (IPUV)

3.12 Complete construction of test vehicle

Special Focus Program

3.13 Complete documentation of capabilities
3.14 Define and document a
3.15 Develop a
3.16 Complete on advanced lightweight torpedoes
3.17 Conduct demonstration of propulsion system

Comparison with FY 1982 Program:

3.18 The slight decrease in funding from FY 1982 to FY 1983 (-$19 thousand) represents a refinement of cost estimates

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F33-321	Torpedo Components and Subsystems	10,658	11,288	11,269	14,979	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62711N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

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

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	36,806	35,810	37,966	42,560	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	*	*	*	*	*
F11-121	Acoustic Arrays for Undersea Surveillance	8,113	9,088	10,399	11,464	Continuing	Continuing
F11-122	Acoustic Transduction Technology	3,330	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	976	985	1,155	1,058	Continuing	Continuing
F11-133	Sensor Integration	400	370	-0-	-0-	Continuing	Continuing

* Transferred to P.E.'s 62766N and 25658N

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Investigates the relevance and technical feasibility of potential solutions to Navy operational needs in Undersea Target Surveillance.
- Addresses the application of acoustic, optic, electromagnetic, magnetic, and other sensor technologies as well as signal and data processing techniques to the detection, localization, classification, and tracking of underwater targets.
- Concentrates on acoustic efforts, which comprise four-fifths of the program.
- Places increased emphasis on new and improved methods to detect targets.

(U) BASIS FOR FY 1983 RDT&E REQUEST

- The increase in FY 1983 funding over that for FY 1982 is due to inflation and change in the scope of F11-121 - Acoustic Arrays for Undersea Surveillance and F11-123 - Acoustic Processing Technology. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

Program Element: 62711N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

Fixed Sensor Systems

- Demonstrate interactive displays and processing resources to improve man-machine interface.
- Improve and test detection, localization, and tracking techniques for fixed, towed, and deployed systems.
- Test at sea
- Perform major real-time experiments at the Acoustic Research Center (ARC).
- Demonstrate and evaluate real-time operation
- Complete surveillance sensors.
- Develop for

Mobile (Airborne and Shipborne) Sensor Systems

- Evaluate the utility of
- Perform experiments on RAMLOOPS (quarter scale submarine) relating to the feasibility of a
- Provide optimized
- Fabricate and complete in-water static testing.
- Develop multibeam processor.
- Develop localization/targeting measurement process models and initiate development of technique models.
- Initiate development of a knowledge-based artifical intelligence system for automated processing.
- Develop experimental

Towed Array Sensor Systems

- Sea test a tactical towed array with
- Sea test a towed array with new reliable telemetry.
- Demonstrate performance advantages towed array over current towed array designs.
- Develop
- Develop and test

Off-Board Sensor Systems

- Demonstrate at-sea tensioning to the Advanced Autonomous Array (A^3).
- Conduct a total system demonstration of a for air ASW.

m Element: 62711N
ssion Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

Demonstrate improved performance of active and passive sensor systems.

nacoustic

Test and validate an Advanced Solid State Array Sensor
Perform operational analysis
Conduct test and evaluation
Evaluate the localization capabilities

tive Adjunct to Undersea Surveillance (AAUS)

Perform at-sea Active Adjunct to Undersea Surveillance measurements

neric Efforts

Complete target strength measurements
Continue sonar calibration standards and measurements work.
Demonstrate at-sea
Identify

MPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

The changes between the total for the Program Element shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-450 in FY 1981, -3376 in FY 1982, and -5458 in FY 1983) are the result of overall budget reductions to the technology base in FY 1981, FY 1982, and FY 1983 and of removing the Navy Science Assistance Program from the Program Element in FY 1982 and FY 1983.
The titles and work within the subprojects were realigned in this Descriptive Summary from those in the FY 1982 Descriptive Summary. The new alignment, which represents subproject organization by technology area, is more functional and improves the description of the work in the Program Element. The following table shows the relationship between the project numbers in this Descriptive Summary and the FY 1982 Descriptive Summary:

Program Element: 62711N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

Project Number In The FY 1982 Descriptive Summary (D.S.)		In FY 1982 D.S. Was:	In FY 1983 D.S. Is:
F11-101	Long Range Acoustic Undersea Surveillance	A Block Program at the Naval Ocean System Center (NOSC)	Distributed in Projects F11-111, F11-121, and F11-123 depending on the nature of the work; work remains at NOSC.
F11-111	Systems Investigations	Feasibility investigations of new notional concepts (mostly analytical work.)	Project F11-111 plus feasibility demonstrations of new systems (analytical and at-sea demonstrations)
F11-119	Navy Science Assistance Program	Same as title	Distributed in P.E. 62766N Independent Exploratory Development and P.E. 25658N Lab Fleet Support
F11-121	Acoustic Undersea Surveillance	Acoustic Arrays for Undersea Surv., Acoustic Transduction Technology, Acoustic Processing Technology, and Target Signal Characteristics	Distributed in F11-121, F11-122, F11-123 and F11-125 as appropriate
F11-122	Radio Frequency Undersea Surveillance	Same as title	F11-131 and is terminated
F11-123	Optical/Infrared/Ultraviolet Undersea Surveillance	Same as title	F11-132 and is the same work
F11-124	Magnetic Undersea Surveillance	Same as title	F11-124 and includes magnetics, optics and hydrodynamic-induced magnetic anomalies

Program Element: 62711N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

F11-125 Special Uncoventional Undersea Surveillance Techniques

Nonacoustic ASW

F11-132, F11-124, and is the same work

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	34,994	37,256	39,186	43,424	Continuing	Continuing
F11-101	Long Range Acoustic Undersea Surveillance	2,740	2,800	2,322	2,948	Continuing	Continuing
F11-111	Systems Investigations	3,320	1,672	894	1,019	Continuing	Continuing
F11-119	Navy Science Assistance Program	*	3,000	3,000	3,000	Continuing	Continuing
F11-121	Acoustic Undersea Surveillance	22,994	22,697	25,082	27,820	Continuing	Continuing
F11-122	Radio Frequency Undersea Surveillance	515	350	568	649	Continuing	Continuing
F11-123	Optical/Infrared/Ultraviolet Undersea Surveillance	737	976	1,000	1,140	Continuing	Continuing
F11-124	Magnetic Undersea Surveillance	2,846	2,900	3,173	3,544	Continuing	Continuing
F11-125	Special Unconventional Undersea Surveillance Techniques	1,842	2,861	3,147	3,304	Continuing	Continuing

* Funded in P.E. 62543N and Project *F11-111 in this program* element.

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- The work in this program element supports the full spectrum of undersea target surveillance from close-in tactical operations to long-range undersea surveillance.
- Because the effort is heavily oriented toward acoustics program.
- Increased emphasis is being placed on new and improved acoustic and nonacoustic methods in an acoustically noisier environment.
- The most critical problem being addressed is the detection, classification, and localization of the submarine.
- The effort is grouped into the following seven areas:
  (a) Fixed Sensor System-- medium- to long-range surveillance, and Bottom Distributed Systems;
  (b) Mobile Shipborne and Airborne Sensor Systems--passive and active acoustics;
  (c) Towed Array Sensor Systems --for both tactical and long-range surveillance;
  (d) Off-Board (deployed/free floating) Sensor Systems--
  (e) Nonacoustic--
  (f) Active Adjunct to Undersea Surveillance--
  (g) Generic Efforts--broad-based technology that is applicable to more than one type of surveillance system.

(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
  62734N, Countermeasures Technology

* *Roman numeral* I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

1. *Program Element: 62711N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

62633N, Undersea Warfare Weaponry Technology
62721N, Command and Control Technology
62762N, Electronic Device Technology
62759N, Ocean and Atmospheric Support Technology
62761N, Materials Technology

(U) WORK PERFORMED BY

- Industrial - Applied Research Laboratory, University of Texas, Austin, TX; Bell Telephone Laboratory, Whippany, NJ; Bolt, Beranek and Newman, Cambridge, MA; General Electric Company, Syracuse, NY; Honeywell Marine Systems, Seattle, WA; Hughes Aircraft, Fullerton, CA; Sanders Associates, Nashua, NH; Hydroacoustics, Inc., Rochester, NY; Polar Research Lab, Santa Barbara, CA; Texas Instruments, Dallas, TX; plus 15 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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Fixed Sensor Systems

1.1 Completed the investigation of
1.2 Tested adaptive beamforming algorithm.
1.3 Implemented large-scale, broadband processing algorithms.
1.4 Developed a processor and delivered it to the Acoustic Research Center (ARC).
1.5 Detected, localized, and tracked targets

1.6 Developed improved man-machine interface formats for a surveillance training/calibration system.
1.7 Devised a new "systolic" processing architecture that significantly increases processor efficiency.

Mobile (Airborne and Shipborne) Sensor Systems

1.8 Fabricated
1.9 Approved a major focussed program, to develop critical components for submarine arrays/

I. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.10 Developed external hull-mounted arrays.
1.11 Constructed hull-mounted arrays.
1.12 Developed and tested an prototype.
1.13 Developed broadband algorithms
1.14 Developed techniques
1.15 Initiated determination

Towed Array Sensor Systems

1.16 Developed adaptive signal-processing techniques for tactical towed arrays.
1.17 Initiated fabrication of a towed array and procured highly reliable telemetry for the array.
1.18 Refined a turbulent boundary layer (TBL) noise model for high-speed towed arrays.
1.19 Demonstrated successfully a to be implemented in a tactical towed array.
1.20 Towed a tactical array whose performance was
1.21 Initiated development of hydrophones.
1.22 Initiated development of using nonacoustic reference sensors.
1.23 Completed analysis of ranging in multipath environments using towed array

Off-Board Sensor Systems

1.24 Redirected the random sonobuoy array program to address a volumetric off-board array for diesel submarine detection.
1.25 Conducted a sea test of the Advanced Autonomous Array (A^3) that demonstrated
- remote unmanned acoustic processing,

1.26 Selected array sensors for areas of high tactical and strategic importance.
1.27 Improved the directional passive sensors.
1.28 Implemented adaptive, passive, signal-enhancement system for evaluation in real-world scenarios.
1.29 Tested the life expectancy in a hostile marine environment.
1.30 Evaluated new and evolving air-deployed sensors
1.31 Completed deep water acoustic tests

1. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.32 Completed test and evaluation

Nonacoustic

1.33 Initiated the fabrication of a breadboard Advanced Solid State Array Sensor (ASAS) formerly called the Solid State Array
1.34 Terminated work on the
1.35 Tested at sea the ability an SSBN at the Atlantic Undersea Test and Evaluation Center (AUTEC).
1.36 Flight tested and evaluated the results.
1.37 Began fabrication
1.38 Conducted a laboratory test
1.39 Performed flight test
1.40 Conducted in-water experiment
1.41 Completed evaluation
1.42 Completed single-sensor detection characterization

Active Adjunct to Undersea Surveillance (AAUS)

1.43 Tested the Active Adjunct to Undersea Surveillance (AAUS) succesfully in a lake.
1.44 Designed the Active Adjundt to Undersea Surveillance (AAUS) array structure, handling system, and power system and assembled the processing system.

Generic Efforts

1.45 Solved the reverse voltage problem of the lithium thionyl chloride High Energy Density Battery (HEDB) but recognized that dynamic distribution inhomogeneities mitigate against continuing this program.
1.46 Validated 1/300-scale target-strength measurements to describe full-scale target echo effects and determined target strength estimates for U.S. and Soviet models.
1.47 Designed and partially completed construction

1. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2. (U) FY 1982 Program

Fixed Sensor System

2.1 Develop and evaluate man-machine interface (MMI) technology to support an expanded role for applications.
2.2 Develop improved data-base management techniques for Integrated Undersea Surveillance System (IUSS).
2.3 Develop tools to automate information from acoustic displays
2.4 Develop and evaluate fixed, mobile, and off-board sensor system techniques for improved detection and/or holding and reacquisition.
2.5 Evaluate false threat dismissal.
2.6 Implement and evaluate improved target tracking algorithms at the Acoustic Research Center (ARC).
2.7 Evaluate the application of "systolic" processor arrays to surveillance-processing problems.
2.8 Demonstrate experiment at the Acoustic Research Center (ARC).
2.9 Perform the following at the Acoustic Research (ARC).
2.9.1
2.9.2
2.9.3 Coherent spectrum signature,
2.9.4
2.9.5 multiarray technology demonstration,
2.9.6 Broad Area Search Experiments.
2.10 Initiate laboratory testing for Sound Surveillance System (SOSUS) application.
2.11 Collect and review data from various data bases.
2.12 Complete studies

Mobile (Airborne and Shipborne) Sensor Systems

2.13 Analyze the utility of
2.14 Conduct study to relate engineering tradeoffs to operational performance.
2.15 Complete fabrication of additional applications.
2.16 Initiate development
2.17 Demonstrate and evaluate
2.18 Evaluate detection/classification potential
2.19 Complete processing evaluation.
2.20 Initiate the design of test bed for processor.

I. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.21 Develop techniques.

Towed Array Sensor Systems

2.22 Evaluate the self-noise improvement potential for both surveillance and tactical towed arrays.
2.23 Determine detection improvements for tactical towed arrays
2.24 Determine towed array high-resolution estimation.
2.25 Test tactical towed array module.
2.26 Improve the analytical model
2.27 Complete fabrication
2.28 Complete surveillance towed array materials investigation.
2.29 Complete the hydrophone and begin design for incorporating it into a towed array module.
2.30 Define optimal, long-length, flexible,
2.31 Demonstrate

Off-Board Sensor Systems

2.32 Complete the analysis and the report on the at-sea test of the Advanced Autonomous Array with other surveillance assets.
2.33 Develop an enhanced low-power processor design for Advanced Autonomous Array application.
2.34 Initiate the system design concept for off-board sensor arrays.
2.35 Determine the circumstances under which off-board sensors should be deployed and the means by which they can be most effectively deployed.
2.36 Conduct at-sea tests with new and evolving sonobuoy systems.
2.37 Identify critical components for the next generation of off-board sensor in accordance with the recommendations of the September 1981 off-board sensor workshop at the Naval Air Development Center, Warminster, Pennsylvania.
2.38 Develop a
2.39 Evaluate the sensors utilized
2.40 Complete fabrication of test units.
2.41 Evaluate active sensor units for tests.

Nonacoustic

2.42 Flight test the new Advanced Solid State Array Sensor.
2.43 Conduct a

2.44 Measure
2.45 Initiate fabrication
2.46 Conduct an additional test
2.47 Complete the analysis
2.48 Complete the analysis
2.49 Complete the evaluation of several classes of nonacoustic algorithms.
2.50 Complete the analysis of improved submarine nonacoustic

Active Adjunct to Undersea Surveillance

2.51 Complete the design plans, a shipboard installation plan, the transducer handling system, and most of the transducer testing for the Active Adjunct to Undersea Surveillance demonstration experiment.

Generic Efforts

2.52 Demonstrate
2.53 Measure the target strength
2.54 Continue sensor standard and measurements work.
2.55 Develop low-frequency calibration sources.
2.56 Develop near-field calibration techniques.

3. (U) FY 1983 and FY 1984 Planned Programs

Fixed Sensor Systems

3.1 Continue the demonstration
3.2 Continue Broad Area Search Experiments at the Acoustic Research Center.
3.3 Demonstrate and refine techniques for fixed, mobile and off-board sensor systems.
3.4 Demonstrate and evaluate real-time operation at the Acoustic Research Center.
3.5 Procure and sea test for Sound Surveillance System (SUSUS) application.
3.6 Complete
3.7 Initiate preparations for a major prototype demonstration.

I. *Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Mobile (Airborne and Shipborne) Sensor Systems

3.8 Validate the use of the KAMLOOPS quarter-scale submarine model

3.9 Select the best baffle approach to meet objectives.
3.10 Transfer the standard to industry for product engineering.
3.11 Develop signal processor requirements and the configuration of the doppler sonar adjunct system.
3.12 Complete detector.
3.13 Develop experimental, sonar.
3.14 Initiate development of a knowledge-based artificial intelligence system for automated shipboard sonar processing.
3.15 Implement multibeam test bed.
3.16 Complete analysis test results.
3.17 Initiate breadboard development.

Towed Array Sensor Systems

3.18 Complete sea test of tactical towed test bed array
3.19 Complete development of reference sensors for tactical towed arrays.
3.20 Sea test a towed array with new highly reliable telemetry.
3.21 Perform dynamic laboratory tests on new surveillance towed array materials and plan for sea tests.
3.22 Demonstrate the performance advantages of the towed array design over current towed array designs.
3.23 Determine and quantify
3.24 Develop optimized array/processor configuration

Off-Board Sensor Systems

3.25 Demonstrate improved at-sea tensioning and in-buoy processing of the Advanced Autonomous Array.
3.26 Use sea-test data to validate an improved low-power processor for application to Advanced Autonomous Array in-buoy processing.
3.27 Deploy from a helicopter or an airplane a prototype for off-board sensor arrays.
3.28 Complete the identification of missions and scenarios for off-board sensors and determine the implications for their further development.
3.29 Develop candidates for sonobuoy system.

3.30 Develop critical components for the next generation of off-board sensors in accordance with off-board sensor workshop recommendations.
3.31 Conduct a total system demonstration.
3.32 Complete at-sea demonstration.
3.33 Develop candidate.

Nonacoustic

3.34 Test and validate an Advanced Solid State Array Sensor.
3.35 Perform operation analysis.

3.36 Conduct test and evaluation of second-generation sensor system.
3.37 Fabricate demonstration unit and complete in-water static testing.
3.38 Implement results of target detection.
3.39 Develop concepts for nonacoustic sensors.
3.40 Complete simulations.

Active Adjunct to Undersea Surveillance

3.41 Perform at-sea Active Adjunct to Undersea Surveillance measurements to resolve reverberation and signal-processing issues.

Generic Efforts

3.42 Demonstrate at sea against a submarine target.
3.43 Complete and appraise analytical methods.

Changes from FY 1982 to FY 1983

3.44 The increase in FY 1983 funding over that for FY 1982 is due to inflation and change in the scope of F11-121 and F11-123.

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

5. (U) Milestones: Not applicable.

6

11. Project: F11-111 Title: Concept Assessment for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- This project assesses the technical viability of system concepts that have significant promise for improving undersea target surveillance.
- The system concepts include Bottom Distributed Systems, [redacted] advanced tactical sonar systems for use with ships and aircraft, the Advanced Autonomous Array, and the Active Adjunct to Undersea Surveillance.

(U) RELATED ACTIVITIES

- Close liaison is maintained with the Defense Advanced Research Projects Agency, Tactical Technology Office, Ocean Monitoring and Control Division, through joint program reviews, workshops, symposia, and informal discussions particularly in its Advanced Autonomous Array, active sonar, and fiber optics programs.
- Related program elements are:

62543N, Ships, Submarines and Boats Technology
62633N, Undersea Warfare Weaponry Technology
62721N, Command and Control Technology
62734N, Countermeasures Technology
62759N, Ocean and Atmospheric Support Technology
62761N, Materials Technology
62762N, Electronic Device Technology

(U) WORK PERFORMED BY

- Industrial - Defense Systems, Inc., McLean, VA; Hydroacoustic, Inc., Rochester, NY; Ketron, Inc., Arlington, VA; Polar Research Laboratory, Santa Barbara, CA; RCA, Burlington, MA, and Somerville, NJ; Sanders Associates, Inc., Nashau, NH; and others to be selected.
- In-House - Naval Air Development Center, Warminster, PA; Naval Civil Engineering Laboratory, Port Hueneme, CA; 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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Fixed Sensor Systems

1.1 Initiated planning process [redacted]

1.2 Compiled relevant environmental acoustic data
1.3 Initiated work on ranging techniques.

Mobile (Airborne and Shipborne) Sensor Systems

1.4 Fabricated and successfully flight tested a 40 percent scale model
1.5 Designed and fabricated a prototype full-scale model
1.6 Completed an analysis of delivery tactics and a system simulation by computer.
1.7 Initiated a preliminary design study to develop mechanisms
1.8 Modeled
1.9 Modified battle group ASW simulation to consider a direct-support role.
1.10 Conducted preliminary design studies
1.11 Completed study of nonobtrusive labeling systems,

Off-Board Sensor Systems

1.12 Completed first major validation sea test of the Advanced Autonomous Array in the Pacific Ocean in October 1980.
1.13 Completed analysis

Active Adjunct to Undersea Surveillance

1.14 Tested in December 1980 and in August 1981; when combined with modeling results, these tests indicated a practical array to be feasible.
1.15 Assembled a signal-processing system.

2. (U) FY 1982 Program

Fixed Sensor Systems

2.1 Review the available and developmental sensor designs for application and evaluate various receiving sensor configurations for acoustic optimization.
2.2 Measure the relative current differentials
2.3 Evaluate the Office of Naval Research Air Deployed Oceanographic Mooring concept
2.4 Obtain the statistics and description

2.5 Evaluate the satellite as a potential data link
2.6 Perform
2.7 Conduct a requirements analysis including microprocessor and data storage requirements.
2.8 Conduct surveillance requirements and operational analysis study.
2.9 Define an concept.
2.10 Initiate Bottom Distributed Systems program.
2.11 Complete a preliminary design of the Bottom Distributed Systems program.
2.12 Analyze and evaluate processing algorithms for Bottom Distributed Systems.

Mobile (Airborne and Shipborne) Sensor Systems

2.13 Design and fabricate on-board avionics
2.14 Complete wind-tunnel testing
2.15 Complete preliminary design study.
2.16 Complete study and if possible, make recommendations to counter the submarine.
2.17 Evaluate and develop recommendations for improving their capabilities.
2.18 Evaluate the interrelationships

2.19 Initiate a study to develop and analyze basic search and prosecution tactics for various missions using nonacoustic techniques
2.20 Complete a summary and the required data bases for evaluating sonar performance.
2.21 Initiate a study to determine tactical sonar performance shortfalls and technology gaps

Off-Board Sensor Systems

2.22 Investigate improved Advanced Autonomous Array suspension systems.
2.23 Investigate navigation and communication alternatives for Advanced Autonomous Array.
2.24 Analyze Vertical Line Arrays as an option to the horizontal line arrays currently being used with Advanced Autonomous Array.
2.25 Initiate the development of an advanced, low-power signal processor.

II. Project: F11-111 Title: Concept Assessment for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Active Adjunct to Undersea Surveillance

2.26 Complete testing of the hydroacoustic sources and procure a spare source.
2.27 Procure all hardware for array, handling system, and instrumentation.
2.28 Finalize an at-sea test plan.

3. (U) FY 1983 and FY 1984 Planned Programs

Fixed Sensor Systems

3.1 Fabricate and test a feasibility demonstration model[ ]
3.2 Perform a detailed analysis and concept validation for Bottom Distributed System sensor configurations.
3.3 Implement and test algorithms for use with Bottom Distributed Systems.
3.4 Perform a Bottom Distributed System processing validation with real data.

Mobile (Airborne and Shipborne) Sensor Systems

3.5 Conduct a full-scale demonstration[ ]in FY 1983.
3.6 Complete the study to develop and analyze basic search and prosecution tactics.
3.7 Complete the identification of[ ]missions and scenarios and determine the implications for sona technology.
3.8 Complete the tactical sonar performance assessment[ ]

Off-Board Sensor Systems

3.9 Test the improved Advanced Autonomous Array buoy system at-sea.
3.10 Demonstrate an advanced, low-power signal processor.

Active Adjunct to Undersea Surveillance

3.11 Conduct at-sea test of[ ]

Comparison with FY 1982 Program:

3.12 The decrease in FY 1983 funding under that for FY 1982 is as a result of overall budget reductions.

11. Project: F11-111 Title: Concept Assessment for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F11-111	Concept Assessment for Undersea Surveillance	4,625	6,105	5,671	6,070	Continuing	Continuing

III. Project: F11-121 Title: Acoustic Arrays for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- This project addresses the detection of acoustic energy by various configurations of receiving sensors.
- The work includes, but is not necessarily limited to, sensor configurations for fixed, mobile, towed, and off-boa (deployable) applications and addresses both active and passive acoustic sensor systems.
- The work is grouped into the following four generic areas:
  (a) Fixed Sensor Systems-- for medium- to long-range surveillance,
  (b) Mobile (platform-borne) Sensor Systems-- for short- to medium-range tactical surveillance,
  (c) Towed Array Sensor Systems-- for tactical and long-range surveillance, and
  (d) Off-Board (deployed/free-floating) Sensor Systems-- primarily air-launched sensors for tactical and/or barri surveillance.

(U) RELATED ACTIVITIES

- Close liaison is maintained with the Ocean Monitoring and Control Division of the Defense Advanced Research Projects Agen in areas such as surveillance arrays through joint program reviews, workshops, symposia, and informal discussions.
- Related program elements are:
  62543N, Ships, Submarines, and Boats Technology
  62633N, Undersea Warfare Weaponry Technology
  62759N, Ocean and Atmospheric Support Technology
  62761N, Materials Technology

(U) WORK PERFORMED BY

- Industrial - Bendix Corporation, Los Angeles, CA; Gould, Inc., Baltimore, MD; Planning Systems, Inc., Fairfax, VA; Raythe Co., Newport, RI; Sanders Associates, Nashua, NH.
- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Air Development Center, Warminster, PA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, D and Orlando, FL; Naval Underwater Systems Center, New London, CT, and Newport, RI.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

III. Project: F11-121 Title: Acoustic Arrays for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Fixed Sensor Systems
1.1 Completed the design of arrays (SUSUS) and initiated procurement
1.2 Terminated investigation of directional hydrophones for bottom surveillance arrays because of the data link channel requirements.

Mobile (Airborne and Shipborne) Sensor Systems
1.3 Received approval to develop

1.4 Transitioned

Towed Array Sensor Systems
1.5 Initiated fabrication of a prototype
1.6 Procured highly reliable telemetry
1.7 Developed a laboratory impulse-testing technique

1.8 Modified analytical models to achieve improved self-noise predictions for tactical towed arrays.
1.9 Tested a tactical towed-array
1.10 Completed the fabrication
1.11 Investigated
tactical towed arrays.
1.12 Demonstrated successfully that will be implemented in a tactical towed array.

Off-Board Sensor Systems
1.13 Sea tested an Advanced Rapidly Deployable Surveillance System buoy, Directional Composite Sensor, that can be used to better discriminate against
1.14 Redirected the Random Sonobuoy Array program to address a volumetric off-board array.
1.15 Tested the life expectancy in a hostile marine environment.
1.16 Completed test and evaluation of Directional Frequency Analysis Recording sonobuoys
1.17 Sea tested modified hardware; results showed

III. Project: F11-121 Title: Acoustic Arrays for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Generic Efforts
1.18 Constructed and sea tested

2. (U) FY 1982 Program

Fixed Sensor Systems
2.1 Initiate laboratory testing for Sound Surveillance System application

Mobile (Airborne and Shipborne) Sensor Systems
2.2 Develop data required for design of
2.2.1 measure machinery-induced noise at potentially
2.2.2 update theoretical models of acoustic isolation mounts and shields for hull-mounted acoustic sensors.

Towed Array Sensor Systems
2.3 Complete fabrication of a towed array.
2.4 Complete analysis and testing of towed arrays.
2.5 Complete analytical investigation
2.6 Improve the analytical models for tactical towed arrays to:
2.6.1 relate
2.6.2 determine limitations on use of finite element analysis
2.7 Simulate in the laboratory tactical towed array modules.
2.8 Survey the shark bite threat to towed systems.
2.9 Complete surveillance towed array materials investigation.
2.10 Initiate design with universal application.
2.11 Complete and begin design for incorporating it into a towed array module.

Off-Board Sensor Systems
2.12 Define the critical technical issues in the implementation
2.13 Initiate the system design concept for off-board sensors.
2.14 Determine the circumstances under which off-board sensors should be deployed and the means by which they can be most effectively deployed.
2.15 Conduct at-sea tests with new and evolving sonobuoy systems.

III. Project: F11-121 Title: Acoustic Arrays for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.16 Identify critical components for the next generation of off-board sensors in accordance with the recommendations of the September 1981 off-board sensor workshop at the Naval Air Development Center, Warminster, PA.

3. (U) *FY 1983 and FY 1984 Planned Programs*

(U) Fixed Sensor Systems
3.1 Procure and sea test [redacted] for Sound Surveillance System application.

Mobile (Airborne and Shipborne) Sensor Systems
3.2 Develop and validate theoretical models of submarine structures that accurately predict the essential features of [redacted]
3.3 Develop and test models and sample sections [redacted]

Towed Array Sensor Systems
3.4 Sea test a [redacted] towed array with new, highly reliable telemetry.
3.5 Test new surveillance towed array materials dynamically in the laboratory and plan at-sea tests.
3.6 Construct and test at sea tactical towed array [redacted] at high tow speeds.
3.7 Demonstrate the performance advantages [redacted] tactical towed array over current towed array designs.

Off-Board Sensor Systems
3.8 Modify the [redacted]
3.9 Deploy from the air a prototype [redacted] for off-board sensor arrays.
3.10 Complete the identification of missions and scenarios for off-board sensors and determine the implications for their further development.
3.11 Develop candidates [redacted]
3.12 Develop critical components for the next generation of off-board sensors in accordance with off-board sensor workshop recommendations.
3.13 Develop candidates [redacted]

III. Project: F11-121 Title: Acoustic Arrays for Undersea Surveillance
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.14 The increase in FY 1983 funding over that for FY 1982 is due to inflation and change in the scope of F11-121

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F11-121	Acoustic Arrays for Undersea Surveillance	8,113	9,088	10,399	11,464	Continuing	Continuing

IV. Project: F11-123 Title: Acoustic Processing Technology
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- The advent of [redacted] have combined to increase the need for improved acoustic processing technology.
- This project addresses the development of acoustic processing techology to improve processor hardware, develop signal processing algorithms for passive and active sonars, improve information processing to enhance operator performance, and develop sonar automation.

(U) RELATED ACTIVITIES

- Close liaison is maintained with the Defense Advanced Research Projects Agency, Tactical Technology Office, Ocean Monitoring and Control Division, through joint program reviews, workshops, symposia, and informal discussions particularly in its Advanced Autonomous Array (A^3), Acoustic Research Center (ARC), and active sonar programs.

- Related program elements are:
  62543N, Ships, Submarines, and Boats Technology
  62633N, Undersea Warfare Weaponry Technology
  62721N, Command and Control Technology
  62734N, Countermeasures Technology
  62759N, Ocean and Atmospheric Support Technology
  62762N, Electronic Device Technology

(U) WORK PERFORMED BY

- Industrial -- Bell Telephone Laboratories, Whippany, NJ; Bolt, Beranek and Newman, Cambridge, MA, San Diego, CA, and Washington, DC; Ensco, Inc., Springfield, VA; General Electric Co., Syracuse, NY; Honeywell Marine Systems, Seattle, WA; Oricon Corporation, La Jolla, CA; Tetra Tech, Inc., Arlington, VA; Texas Instruments, Inc., Dallas, Texas; TRW, Inc., McLean, VA; Westinghouse Electric Corp., Annapolis, MD; and 16 others.
- In-House -- Naval Air Development Center, Warminster, PA; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, White Oak, MD; and Naval Underwater Systems Center, New London, CT.

IV. Project: F11-123 Title: Acoustic Processing Technology
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Fixed Sensor Systems

1.1 Studied processor architecture optimization using new systolic array concepts
1.2 Implemented algorithms at the Acoustic Research Center
1.3 Completed the investigation

1.4 Developed beam-merging displays
1.5 Determined the performance of Data Assembly displays
1.6 Identified useful parameters for target reacquisition
1.7 Developed and transitioned to the fleet improved displays for Training System Exercises (TRANSEX)

Mobile (Airborne and Shipborne) Sensor Systems

1.8 Demonstrated a
1.9 Developed several implementing algorithms
1.10 Transitioned processing methods to PE 63504N
1.11 Designed, implemented, and evaluated processing techniques

1.12 Implemented the
algorithms on an array processor
1.13 Completed a performance comparison between sonars with real data for a minehunting application
1.14 Designed, developed, and fabricated a breadboard, sonar receiver
1.15 Initiated a supporting the Advanced Minehunting Sonar System
1.16 Initiated the development of a technology
1.17 Developed and evaluated prototype that was successfully tested at sea on three occasions on surface ships and submarines and that demonstrated the feasibility of
1.18 Completed the evaluation of techniques
1.19 Developed a detection and tracking algorithm

IV. Project: F11-123 Title: Acoustic Processing Technology
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.20 Initiated the development for airborne applications, with which instructional type displays can be evaluated with operational software

Towed Array Sensor Systems

1.21 Demonstrated in a high-speed test
1.22 Developed adaptive signal-processing techniques in towed arrays
1.23 Completed the analysis of towed array
1.24 Completed acoustic effort for towed arrays

Off-Board Sensor Systems

1.25 Demonstrated breadboard versions
1.26 Developed for Directional Frequency Analysis Recording (DIFAR) sonobuoys
1.27 Initiated the development

2. (U) FY 1982 Program

Fixed Sensor Systems

2.1 Test in breadboard form at the Acoustic Research Center (ARC)
2.2 Conduct a signal search
2.3 Complete the analysis
2.4 Complete the Harmonic Correlation classification-processing experiment data analysis
2.5 Complete the evaluation of features for tracking enhancement
2.6 Install improved man-machine interface algorithms at the Acoustic Research Center (ARC)
2.7 Evaluate improved target association concepts
2.8 Evaluate beam-merging displays at the Acoustic Research Center (ARC)
2.9 Evaluate

IV. Project: F11-123 Title: Acoustic Processing Technology
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.10 Perform the following at the Acoustic Research Center coherent spectrum signature

Mobile (Airborne and Shipborne) Sensor Systems

2.11 Develop and implement a prototype processor extending
2.12 Demonstrate processing at sea
2.13 Evaluate performance of autoregresssive processing
2.14 Initiate development
2.15 Develop and implement including inputs from deployed and off-board arrays
2.16 Evaluate the utility of techniques for detection and classification
2.17 Develop a constant-resolution processing mode with large Fast Fourier Transforms (FFTs)
2.18 Develop a specification criteria for anisotropic noise
2.19 Evaluate
2.20 Complete the fabrication of equipment and collection of data
2.21 Complete the evaluation
2.22 Analyze and evaluate its detection/classification potential

2.23 Develop and implement an active sonar prototype processor

2.24 Determine improvements for tactical sonars in severe noise environments
2.25 Define critical design issues that impact the integration of
2.26 Complete the fabrication of a prototype
2.27 Demonstrate on at-sea data
2.28 Develop measures of effectiveness for evaluation
2.29 Initiate algorithm development
2.30 Complete the evaluation

Towed Array Sensor Systems

2.31 Determine detection improvements for towed arrays using an module
2.32 Determine towed array using high-resolution estimation techniques

Off-Board Sensor System

2.33 Test an
2.34 Test the performance of an with newly developed large scale integrated (LSI) circuits
2.35 Develop an enhanced, low-power processor design for Advanced Autonomous Array (A^3) application
2.36 Develop a
2.37 Develop an efficient
2.38 Evaluate Directional Frequency Analysis Recording (DIFAR) with real data
2.39 Continue development
2.40 Complete the packaging deployment design and critical component analysis of test units

3. (U) FY 1983 and FY 1984 Planned Programs

Fixed Sensor Systems

3.1 Evaluate the at the Acoustic Research Center during an at-sea experiment
3.2 Demonstrate and refine
3.3 Implement and demonstrate improved data base management techniques and improved
3.4 Initiate algorithm development to exploit
3.5 Continue the demonstration of technology developments to improve the man-machine interface, target association, passive ambiguity surface (PAS) image processing, and target reacquisition

Mobile (Airborne and Shipborne) Sensor Systems

3.6 Develop signal-processor requirements and configuration of a doppler sonar adjunct system
3.7 Evaluate the detection and classification performance of concepts
3.8 Develop and evaluate a
3.9 Initiate the development of a breadboard
3.10 Conduct an at-sea demonstration of the concept
3.11 Perform tests and complete the post test analysis
3.12 Develop an processing concept
3.13 Design and implement a acoustic-processing test bed
3.14 Develop and evaluate processing algorithms

IV. Project: F11-123 Title: Acoustic Processing Technology
Program Element: 62711N Title: Undersea Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.15 Complete the simulation and select and initiate the approach to demonstrating the technology
3.16 Perform design experiments that are critical to its demonstration
3.17 Initiate the development of a estimation algorithm
3.18 Collect at-sea data for evaluation of concepts
3.19 Initiate a task directed at utilizing the information contained in

3.20 Develop algorithms based on statistical techniques
3.21 Evaluate techniques for minehunting
3.22 Develop an experimental minehunting sonar and evaluate its performance
3.23 Evaluate classification performance of an automated processor in a selected multitarget environment
3.24 Interface functions
3.25 Quantify performance improvements in multitarget environments
3.26 Complete the
3.27 Evaluate detection, estimation, and classification subsystem performance for passive sonars
3.28 Implement

Towed Array Sensor System

3.29 Complete development and evaluation
3.30 Design, fabricate, and test at sea
3.31 Develop an optimized array-processor configuration for towed array focussing
3.32 Evaluate for implementation in next-generation sonobuoys
3.33 Use at-sea test data to validate an improved low-power processor

3.34 Implement algorithms
3.35 Develop for broadband application

Generic Efforts

3.36 Initiate the development of a knowledge-based artificial intelligence system

Comparison with FY 1982 Program

3.37 The increase in FY 1983 funding over that for FY 1982 is due to inflation and change in the scope of F11-123

ct: F11-123
ement: 62711N
n Area: 521 - Electronic and Physical Sciences

Title: Acoustic Processing Technology
Title: Undersea Target Surveillance
Budget Activity: 1 - Technology Base

rogram to Completion: This is a continuing program

ilestones: Not applicable

esources (Dollars in Thousands)

Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Acoustic Processing Technology	10,306	11,644	13,466	16,285	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62712N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Surface/Aerospace Target Surveillance
Budget Activity: 1 - Technology Base

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

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	29,575	33,634	35,016	36,593	Continuing	Continuing
F12-100	Airborne Surface/Aerospace Target Surveillance	5,671	-0-	-0-	-0-		
F12-111	Concept Assessment for Surveillance	-0-	4,404	3,350	2,480	Continuing	Continuing
F12-113	Systems Investigations	2,267	-0-	-0-	-0-		
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-		
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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports development of surveillance systems and associated processing equipment to detect, track, classify, and identify targets
- 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
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Surface/Aerospace Target Surveillance
Budget Activity: 1 - Technology Base

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Continue development of sensor technology for over-the-horizon surveillance in support of early warning for fleet defense and targeting of offensive weapons systems
- Increases of $210 in F12-132, $250 in F12-133, $75 in F12-152 and $10 in F12-701, and decreases of $63 in F12-131 and $150 in F12-134 are due to refined cost estimates
- Increases of $700 in F12-130, and $672 in F12-151 are in part due to refined cost estimates but also reflect added emphasis on classification and identification techniques
- F12-141 increased $732 due to additional interest in the potential for space surveillance systems
- F12-111 decreased $1,054 in anticipation of moving tasks from concept development to hardware/software tasks
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Major changes between funding shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are the result of a re-definition of projects, project titles and project numbers
- F12-100 Airborne Surface/Aerospace Target Surveillance has been distributed into F12-111, F12-131, F12-132 and F12-151
- F12-102 USMC Tactical Surveillance has been renumbered F12-134
- F12-113 System Investigation for Surface/Aerospace Target Surveillance has been included in F12-111
- F12-133 Special/Unconventional Surface Surveillance has been renamed Sensor Integration but retains the same number
- F12-141 Radio Frequency Aerospace Surveillance has been split into F12-131 and F12-151
- F12-143 Special Unconventional Aerospace Surveillance has been redesignated F12-141 with some of the tasks transferred to F12-111
- F12-151 Multipurpose Radio Frequency Surveillance remains the same. The $213 decrease in FY 1983 is due to refined cost estimates
- Overall decreases of $343 in FY 1981 and $2,442 in FY 1982 are due to refined cost estimates while a reduction of $8,591 in FY 1983 is due to changing naval priorities

Program Element: 62712N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Surface/Aerospace Target Surveillance
Budget Activity: 1 - Technology Base

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	24,309	29,918	36,076	43,607	Continuing	Continuing
F12-100	Airborne Surface/Aerospace Target Surveillance	6,408	5,440	6,454	7,100	Continuing	Continuing
F12-102	USMC Tactical Surveillance	1,520	2,085	2,140	2,550	Continuing	Continuing
F12-113	System Investigation for Surface/Aerospace Target Surveillance	695	250	-0-	-0-	Continuing	Continuing
F12-133	Special/Unconventional Surface Surveillance	460	722	1,075	1,472	Continuing	Continuing
F12-141	Radio Frequency Aerospace Surveillance	1,948	7,163	9,200	9,753	Continuing	Continuing
F12-143	Special/Unconventional Aerospace Surveillance	4,936	10,035	11,517	15,737	Continuing	Continuing
F12-151	Multipurpose Radio Frequency Surveillance	7,920	3,670	4,990	6,225	Continuing	Continuing
F12-152	Multipurpose Optical/Infrared/Ultraviolet Surveillance	422	553	700	770	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Includes exploratory development of sensor system technology for the detection, identification, classification, and localization of all targets on or above the surface of the earth.
- Platforms including conventional aircraft, remotely piloted vehicles, surface craft, spacecraft, and associated weapons
- Presumes targets to be hostile and equipped with sophisticated countermeasures, capable of high speed, evasive maneuvering, and control of electromagnetic radiation
- The major new capabilities required of Navy surveillance systems that are addressed by this Program Element are:

  - Increased range of sensor systems to accommodate increased range capability of both offensive and defensive weapons
  - Extraction of information from sensors that will lead to the identification or classification of targets
  - Improvements to the critical surveillance systems used by the fleet for air electronic warfare and shipboard air defense
  - Reduction of size and weight of sensors without reduction in performance
  - Use of combined information from multiple sensors
  - Maintenance of required performance in spite of hostile actions such as electronic countermeasures, anti-radiation missiles, electronic support measures, as well as direct attack

(U) RELATED ACTIVITIES

- 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 procedure, 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

I. *Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

- Related program elements are:

  62721N - Command and Control Technology
  62734N - Countermeasures Technology
  62332N - Strike Warfare Weaponry Technology

(U) WORK PERFORMED BY

- In-House - Naval Air Development Center, Warminster, PA; Naval Electronic Engineering Office, Norfolk, VA; Naval Intelligence Support Center, Washington, DC, Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Navy Space Systems Activity, Los Angeles, CA; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA

- Industrial - Beech Aircraft Company, Wichita, KS; Bunker Ramo, West Lake Village, CA; Computer Sciences Corporation, Falls Church, VA; Environmental Research Institute of Michigan, Ann Arbor, MI; Fairchild Camera, Syosset, NY; General Dynamics, San Diego, CA; General Electric Company, Utica, NY; Grumman Aircraft Corporation, Bethpage, Long Island, NY; Hughes Aircraft Company, Culver City, CA; Hughes Aircraft, El Segundo, CA; Hughes Aircraft, Fullerton, CA; ITEK Corporation, Lexington, MA; ITT Gilfillian, Los Angeles, CA; RCA Laboratories, Princeton, NJ; Stein Associates, Waltham, MA; Systems Research Laboratory, Reseda, CA; Teledyne Ryan, San Diego, CA; Westinghouse, Baltimore, MD

- Academic - Cambridge University, Cambridge, England; Georgia Institute of Technology, Atlanta, GA; Ohio State University, Columbus, OH; University of Pennsylvania, Philadelphia, PA; Stanford Research Institute, Palo Alto, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Surveillance

1.1 Demonstrated ability to relate soil resistivity measurements to soil trafficability
1.2 Developed algorithms for integration of primary shipboard sensors, tactical data links and multisource track management data
1.3 Completed electro-optic test bed with laser rangefinder
1.4 Developed and laboratory tested an airborne multisensor automatic ship classification algorithm
1.5 Completed acoustic detection and classification range predictions for airborne over-the-horizon ship classification
1.6 Established preliminary design for airborne remotely piloted vehicle sensors

1. *Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.7 Conducted successful imaging demonstration of the indium antimonide (In Sb) photovoltaic (PV) hybrid infrared array
1.8 Successfully demonstrated infrared multiframe coherence transformation and integration processing
1.9 Completed Shared Focal Plane Studies
1.10 Investigated over-the-horizon targeting capability of antisubmarine warfare aircraft to determine optimum sensor suites when those aircraft are equipped with the HARPOON missile

2. (U) FY 1982 Program

Surveillance

2.1 Complete and test brassboard model of an air droppable soil penetrometer
2.2 The Multisource Track Management task will initiate integration concept development and modeling of advanced sensors/sources
2.3 Field test electro-optic test bed with laser range finder
2.4 Define and quantify sensor requirements for airborne multisensor ship classifications
2.5 Define software and hardware requirements for validating acoustic detection and classification range predictions for over-the-horizon detection of ships
2.6 Define Remotely Piloted Vehicle platform characteristics, data link requirements, and preliminary payload design
2.7 Field test a high-resolution infrared focal plane array imager
2.8 Begin development of a breadboard infrared multiframe Integration Processor
2.9 Begin fabrication of Shared Focal Plan hardware
2.10 Define the subsystem requirements imposed on antisubmarine aircraft by the expansion of their mission to include anti surface warfare
2.11 Collect data base to demonstrate feasibility of frequency and polarization domain target classification
2.12 Begin development of a sensor suite for a remotely piloted long endurance high altitude vehicle

3. (U) FY 1983 and FY 1984 Planned Programs

Surveillance

3.1 Transition the Marine Corps soil trafficability Air Droppable Soil Penetrometer to advanced development
3.2 Determine performance and design requirements for an Advanced Multisource Track Management System for an Advanced Shipboard Combat Direction System
3.3 Terminate electro-optic test bed with laser rangefinder
3.4 Define airborne multisensor classifier requirements

I. *Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.5 Conduct sea tests to validate acoustic detection and classification range predictions for over-the-horizon detection of ships
3.6 Develop and test sensors for an airborne remotely piloted vehicle in support of anti-air warfare
3.7 Fabricate and demonstrate multi-thousand element infrared focal plane array
3.8 Complete and test Breadboard Multiframe Integration Processor for electro optics imaging
3.9 Complete and test Shared Focal Plane hardware for airborne reconnaissance
3.10 Define baseline sensor suite and a strawman system architecture for a combined airborne antisubmarine and antisurface warfare surveillance/targeting capability

Changes from FY 1982 to FY 1983

3.11 The increase in FY 1983 is due to inflation and refined cost estimates.

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

5. (U) Milestones: Not applicable.

II. Project: F12-131
Program Element: 62712N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Radio Frequency Surveillance
Title: Surface/Aerospace Target Surveillance
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Addresses reliable and consistent classification of enemy surface ships at stand-off ranges
- Develops techniques for large volume surveillance of airborne threat targets
- Supports improvement of shipboard combat capabilities
- Supports development of miniature lightweight radio frequency sensors
- Covers both active and passive sensors over the radio spectrum, as well as extremely low frequency through millimeter waves, in the presence of noise clutter and electronic countermeasures

(U) RELATED ACTIVITIES

- Many of the tasks and subtasks are similar to parallel efforts by the U.S. Air Force and/or U.S. Army
- When development objectives are identical, joint projects are established to oversee the efforts of the individual services and avoid unintentional duplication
- Distribution of development status summaries and test reports serves as a continuous media for inter-service technical data exchange, as well as frequent inter-service laboratory visits

(U) WORK PERFORMED BY

- In-House - Naval Air Development Center, Warminster, PA; Naval Electronic Engineering Office, Norfolk, VA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA

- Industrial - Control Data Corporation, Minneapolis, MN; Fairchild Camera, Syosset, NY; General Electric Corporation, Syracuse, NY; Goodyear Aerospace Corporation, Litchfield Park, AZ; Grumman Aircraft Corporation, Bethpage, Long Island, NY; Hughes Aircraft, Fullerton, CA; ITT Gilfillian, Los Angeles, CA; Litton Industries, Van Nuys, CA; Probe Systems, Sunnyvale, CA; Raytheon, Goleta, CA; RCA Laboratories, Princeton, NJ; SRI International, Menlo Park, CA; Stein Associates, Waltham, MA; Valley Forge Research Center, Philadelphia, PA; Westinghouse Defense Systems, Baltimore, MD

- Academic - Georgia Institute of Technology, Atlanta, GA

II. Project: F12-131 Title: Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments (Efforts funded in Projects F12-100 and F12-141 in FY 1981 and prior)

Radar Target Discrimination, Detection and Location

1.1 Developed experimental [ ] radiometer sensor [ ]

Radar Imaging, Classification and Processing

1.2 Demonstrated near real-time classifiable images in field tests
1.3 Automatic ship classification system obtained high classification rates in the laboratory

Airborne Early Warning Radar

1.4 Successfully demonstrated roof-top integration of Ultra High Frequency (UHF) solid state modules and an embedded antenna

Shipboard Combat Capabilities

1.5 Demonstrated automatic tracking of [ ] targets following initial operator designation
1.6 Demonstrated dual band frequency agility with SENRAD radar

2. (U) FY 1982 Program

Radar Target Discrimination, Detection and Location

2.1 Complete improvement to experimental [ ] radiometer sensor [ ]

Radar Imaging, Classification and Processing

2.2 Develop automated feature extraction to aid interpreter
2.3 Initiate operational system definition of an automatic classifier
2.4 Begin development of integrated 1D, 2D and 3D image processor

II. Project: F12-131 Title: Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Airborne Early Warning Radar

2.5 Analyze adaptive radar data collected with non-dispersive receivers

Shipboard Combat Capailities

2.6 Install low sidelobe antenna on SENRAD radar
2.7 Complete the antenna subsystem for the Fixed Array Surveillance Radar (FASR)
2.8 Complete the X-Band subsystem for the Directed Mirror Antenna Radar (DMAR)

Cooperative/Non Cooperative Target Recognition

2.9 Define equipment requirements for Passive Non-Cooperative Target Recognition (PNCTR)
2.10 Develop Long Range Target Identification (LORTID) techniques
2.11 Conduct flight test program to demonstrate techniques of radar profile and electronic support measure (ESM) intercept in concert for classifying and fingerprinting potential targets

3. (U) FY 1983 and FY 1984 Planned Programs

Radar Target Discrimination and Detection

3.1 Complete investigation of polarization scattering matrix phenomena associated with high speed missiles

Radar Imaging, Classification and Processing

3.2 Adapt automated feature extraction to multi-purpose automatic ship classifier
3.3 Continue High Speed radio frequency processing effort

Airborne Early Warning Radar

3.4 Continue adaptive radar techniques

11. Project: F12-131 Title: Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Shipboard Combat Capabilities

3.5 Investigate 2D/3D Multi-Frequency Scanned Radar for improved electronic counter-countermeasure performance
3.6 Determine feasibility of an S-Band Surveillance Radar Concept
3.7 Demonstrate high reliability/availability radar transmitter

Comparison with FY 1982 Program:

3.8 Funding decrease of approximately $63 thousand in FY 1983 compared to FY 1982 is due to refined cost estimates

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F12-131	Radio Frequency Surveillance	0	8,495	8,432	8,651	Continuing	Continuing

III. Project: F12-141 Title: Satellite/Remote Platform Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- [redacted]
- [redacted]
- The Fleet requires "defense in depth" to guarantee its survivability and operational viability
- Defense in depth requires sufficient early detection, rapid data processing, and short communications delays to guarantee that response forces are in optimal positions to meet the threat
- Addresses active and passive sensors as well as associated control, tasking, processing, distribution, and display mechanisms for the detection, classification, and tracking of aircraft attack

(U) RELATED ACTIVITIES

- The Defense Advanced Research Project Agency, the U.S. Air Force and the National Aeronautics and Space Administration have similar tasks addressing uniquely different requirements
- When development objectives are identical, joint projects are established to oversee the efforts of the individual services and avoid duplication
- Distribution of development status summaries and test reports serves as a media for inter-service technical data exchange as do frequent inter-service laboratory visits and joint program reviews

(U) WORK PERFORMED BY

- In-House - Goddard Space Flight Center, Greenbelt, MD; Naval Air Development Center, Warminster, PA; Naval Electronic Engineering Office, Norfolk, VA; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA

- Industrial - Aerojet Electro Systems, Azusa, CA; AIL ETON Corporation, Long Island, NY; Arthur D. Little Company, Boston, MA; Ball Brothers Corporation, Denver, CO; Communications and Information Systems, San Diego, CA; CTEC, San Diego, CA; Coulten Industries, Boston, MA; Harris Corporation, Melbourne, FL; IBM Corporation, Los Angeles, CA; Orincon Corporation, San Diego, CA; SAI, San Diego, CA; TRW, Space Park, CA; VERAC Corporation, San Diego, CA; Xebec Corporation, San Diego, CA

- Academic - Georgia Institute of Technology, Atlanta, GA

III. Project: F12-141 Title: Satellite/Remote Platform Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Ocean Surveillance

1.1 Developed Ocean Surveillance Integration Model (OSIM) to analyze ocean surveillance environment
1.2 Initiated development of an ocean surveillance tracker/correlator (OSTC)
1.3 Completed Fusion Research Network to permit real-time transmission of sensor data from operational and experimental sensors to a Fusion Center
1.4 Conducted PATHFINDER real-time sensor data correlation experiment

SPACEGUARD

1.5 Completed orbital radar model
1.6 Developed math model to determine requirements for aircraft classification from a surveillance radar
1.7 Initiated study to determine requirements for aircraft classification from a surveillance radar

High Altitude Remote Platform Surveillance

1.8 Conducted survey of on-going technology efforts that could support the development of small, lightweight advanced sensor payloads that interface with High Altitude Long Endurance unmanned vehicles

Sensor Processing Improvements

1.9 Identified current High Frequency/Direction Finder (HF/DF) deficiencies

2. (U) FY 1982 Program

Ocean Surveillance

2.1 Ocean Surveillance Integration Model (OSIM) will be used to begin analysis of sensor performance against air targets
2.2 Complete the software design for Ocean Surveillance Tracker/Correlator (OSTC)

2.3 Conduct further testing and transition of the merchant motion and electronic intelligence gathering modules

2.4 Analyze PATHFINDER real-time sensor data correlation experiment

SPACEGUARD

2.5 Define space radar requirement
2.6 Examine target classification techniques
2.7 Begin development of components and techniques to counter natural or man-made radiation hazards

High Altitude Remote Platform Surveillance

2.8 Define mission application and interface
2.9 Determine sensor/platform interface requirements
2.10 Complete sensor concept definitions and begin design studies

Sensor/Processing Improvements

2.11 Begin experimental processing of real world signals on an acousto-optics Optical Transform Intercept System (OTIS)
2.12 Verify newly developed High Frequency/Direction Finding (HF/DF) fix algorithms
2.13 Determine the potential of the Defense Satellite Program (DSP) to detect BACKFIRE bombers

3. (U) FY 1983 and FY 1984 Planned Programs

Ocean Surveillance

3.1 Develop and evaluate the
3.2 Complete air tracking
3.3 Use results of PATHFINDER experiment analysis to refine the Ocean Surveillance Integration Model

SPACEGUARD

3.4 Define space radar design requirements
3.5 Continue to examine target classification techniques
3.6 Complete the definition of a candidate spaceborne infrared system

III. Project: F12-141 Title: Satellite/Remote Platform Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.7 Continue determination of satellite radiation survivability

High Altitude Remote Platform Surveillance

3.8 Integrate command, control and communication equipment with the controller
3.9 Develop interface specification measures sensors into the system

3.10 Integrate electronic support measures sensors into the system
3.11 Integrate the communications intelligence sensors into the system

Sensor/Processing Improvements

3.12 Continue development of acousto-optical processing for real-time spectral analysis of wideband signals
3.13 Merge High Frequency/Direction Finding (HF/DF) fix algorithms with Time Difference of Arrival (TDOA) and High Frequency acquisition data
3.14 Continue attempting to access Defense Satellite Program (DSP) infrared data to exploit the detection of slow flying targets

Comparison with FY 1982 Program:

3.15 Funding increases of $732 in FY 1983, as compared to FY 1982, are a result of increased emphasis on spaceborne development activity and remotely piloted vehicles

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F12-141	Satellite/Remote Platform Surveillance	6,712	8,500	9,232	9,293	Continuing	Continuing

IV. Project: F12-151 Title: Multi-Purpose Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Develop new technologies for rapid detection, localization, classification and tracking of targets
- The geographical area of concern extends out [redacted] from the high value task force
- Places particular emphasis on missile threats to U.S. Naval Forces
- Directed towards improving signal detection, sorting, classification, identification and platform location
- Active surveillance efforts concentrate on radar image target classification

(U) RELATED ACTIVITIES

- In some of the task areas, the Air Force and/or the Army accomplishes similar work
- Because mission requirements and flight profiles vary considerably between services, development objectives are not often the same; however, when they are identical, funding is pooled and joint development projects are established
- Two examples of this type of project are:
  - Development of high speed analog-to-digital converters (with Air Force Avionics Laboratory)
  - A joint project with the Army (with considerable interest on the part of the Air Force also) in the development and demonstration of automatic radar pattern recognition, a technology which offers considerable potential in the increasingly complex field of classification and identification of non-cooperative targets

(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, White Oak, MD; Naval Weapons Center, China Lake, CA
- Industrial - AIL ETON Corporation, Long Island, NY; Amherst Corporation, Applied Technology Division of Itek, Sunnyvale, CA; Cubic Corporation, San Diego, CA; Electronic Data Systems, Fairfax, VA; ESL Corporation, Sunnyvale, CA; Hazeltine Corporation, Long Island, NY; General Electric Company, Utica, NY; Hughes Aircraft Company, El Segundo, CA; Litton Industries, Van Nuys, CA; Louis Corporation, RCA/Government Communications Systems Division, Somerville, NJ; Teledyne Ryan Corporation, San Diego, CA; Watkins Johnson Corporation, Boston, MA; Westinghouse Defense and Electronic Systems Center, Baltimore, MD; Xerox Corporation, Pasadena, CA
- Academic - Georgia Institute of Technology, Atlanta, GA

IV. Project: F12-151 Title: Multi-Purpose Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Airborne Sensor System Technology

1.1 Completed advanced Electronic Support Measures system design definition
1.2 Demonstrated critical digital subsystem technology for Low Band Electronic Support Measure system

Signal Detection and Platform Location

1.3 Initiated procurement of components to build an optical Radio Frequency downconverter
1.4

Signal Sorting, Classification and Identification

1.5 Completed brassboard High Speed Signal sorter
1.6 Conducted preprocessing of acousto-optic radar classification system data
1.7 Automation Radar Pattern Recognition (ARPR) feature extractor transitioned to advanced development

Electronic Support Measures (ESM)

1.8 Fabricated and tested a millimeter wave Electronic Support Measures metal-oxide-metal diode
1.9 Fabricated and tested a two stage ultra fast tunable microwave filter
1.10 Fabricated a four channel acousto-optic interferometer processor
1.11 Collected test data from an SPS-39 radar and a P-3 aircraft to develop algorithms to correlate radar and electronic support measure (ESM) data

Electronic Countermeasures (ECM)

1.12 Developed and tested a main lobe notcher
1.13 Investigated spread spectrum techniques for improved radar operation in an Electronic Countermeasures environment

IV. Project: F12-151 Title: Multi-Purpose Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

Radar Imaging Classification

1.14 Developed a [redacted] adar

2. (U) FY 1982 Program

Airborne Sensor System Technology

2.1 Demonstrate Low Band Electronic Support Measures processor architecture
2.2 Complete Bistatic radar software definition

Signal Detection and Platform Location

2.3 Develop optical Radio Frequency downconverter breadboard
2.4 [redacted]

Signal Sorting, Classification and Identification

2.5 Complete Very High Speed Integrated Circuit (VHSIC) processor architecture design
2.6 Complete definition of optical processing architecture

Electronic Support Measures (ESM)

2.7 Combine the millimeter wave Electronic Support Measures and metal-oxide-metal diode with interferometer components for test and evaluation
2.8 Combine the four channel acousto-optic interferometer processor, four channel phase tracking antennas and the interferometer front-end for field test
2.9 Develop and test radar/Electronic Support Measures correlation algorithms

Electronic Countermeasures (ECM)

2.10 Sidelobe canceller and mainlobe notching will be investigated theoretically and experimentally to isolate performance-limiting phenomena and instrumentation deficiencies

IV. Project: F12-151 Title: Multi-Purpose Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

Radar Imaging Classificaion

2.11 Develop a two-dimensional radar target base
2.12 Fabricate a high frame-rate inverse synthetic aperture radar (ISAR) processor
2.13 Investigate cross polarization techniques to reduce clutter and improve imaging

3. (U) FY 1983 and FY 1984 Planned Programs

Airborne Sensor System Technology

3.1 Develop software and build brassboard Low Band Electronic Support Measures processsor

Signal Detection and Platform Location

3.2 Test and evaluate optical radio frequency downconverter

Signal Sorting, Classification and Identification

3.3 Build Breadboard optical processor
3.4 [redacted]

Electronic Support Measures (ESM)

3.5 Build a brassboard millimeter wave Electronic Support Measures receiver
3.6 Fabricate a three-stage ultra-fast-tunable microwave filter

Radar Imaging Classification

3.7 Apply artificial intelligence techniques to the Frequency Agile Imaging Radar
3.8 Combine cross polarization techniques, the frequency Agile Imaging Radar and the automatic target classifier

IV. Project: F12-151 Title: Multi-Purpose Radio Frequency Surveillance
Program Element: 62712N Title: Surface/Aerospace Target Surveillance
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.9 Funding increase of approximately $672 thousand in FY 1983 compared to FY 1982 is due principally to refined cost estimates and added emphasis on classification and identification techniques

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F12-151	Multipurpose Radio Frequency Surveillance	5,920	5,340	6,012	6,579	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62721N
Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

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

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	35,381	29,161	30,577	35,609	Continuing	Continuing
F21-201	Information Management	1,394	0	0	0	----	----
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		
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	Continuing	Continuing
F21-245	Battlefield Command & Control	1,650	1,320	1,320	1,667	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Information timeliness for decision making necessitates technology development for efficient transmission/dissemination, processing/correlation of sensor data/information
- Develops and demonstrates new technologies for Navy command and control and evaluates these techniques through system design, test, and simulation

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Initiated new technology developments in the areas of artificial intelligence and stellar navigation

Program Element: 62721N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Command and Control Technology
Budget Activity: 1 - Technology Base

- Initiated planning efforts for testing and evaluating the S-1 computer development
- Adjustments and refined cost estimates were implemented between projects which are characteristic of exploratory development
- 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 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-94 in FY 1981, - 1721 in FY 1982 and - 1409 in FY 1983) are the result of refined cost estimates including escalation indices, application of a Navywide budget reduction and in FY 1982 a Congressional reduction. Internal program changes result from a redefinition of projects, project numbers, and project titles thereby causing redistribution of funding

- The S-1 program contained in project F21-241 was scaled down to include initiation of test and evaluation plans/program

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	27,773	35,475	30,882	31,986	Continuing	Continuing
F21-201	Information Management	1,672	1,075	2,437	2,780	Continuing	Continuing
F21-202	Information Processing and Display	1,230	1,130	1,495	1,700	Continuing	Continuing
F21-203	US Marine Corps Command Control Technology	1,435	1,650	1,696	1,780	Continuing	Continuing
F21-211	Systems Investigations	2,747	2,715	3,170	3,500	Continuing	Continuing
F21-221	Acoustic Communications	800	825	325	0	Continuing	Continuing
F21-222	Electromagnetic Communications	9,391	10,040	10,540	10,970	Continuing	Continuing
F21-224	Internal Communications	320	340	350	400	Continuing	Continuing
F21-232	Radio Frequency (RF) Navigation	200	420	275	0	Continuing	Continuing
F21-233	Optical/Infra Red/Ultra Violet Navigation	761	0	0	0	Terminated	Terminated
F21-234	Inertial Navigation	997	987	750	800	Continuing	Continuing
F21-235	Miscellaneous Navigation Technology	2,091	2,123	2,230	2,556	Continuing	Continuing
F21-241	Information Transformation	3,951	12,620	5,760	6,000	Continuing	Continuing
F21-242	Information Storage and Retrieval	760	0	0	0	Completed	Completed
F21-243	Display Technology	204	230	459	0	Continuing	Continuing
F21-244	Information Assessment	1,214	1,320	1,395	1,500	Continuing	Continuing

Program Element: 62721N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Command and Control Technology
Budget Activity: 1 - Technology Base

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62721N Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Encompasses the exploratory development in support of Navy command and control systems which acquire, process, and disseminate information required by a commander in planning, directing, and controlling operations
- Advances several communication technologies including underwater, electromagnetic, optical, wire, and others for information transfer; acoustic, radio frequency, geophysical, inertial, and other navigational technology; information processing, including information transformation, storage, retrieval, and display technology for ships, submarines, aircraft, and shore activities

(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, Technical Area Description, 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 62759N, 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS, e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will be used in front of the word "Project" on the first page of each Project PEDS, e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

I. *Program Element: 62721N Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(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 Research Laboratory, Washington, DC; Naval Underwater Systems Center, Newport, RI

- Industrial - AIL, Long Island, NY; AMETEK, Hatfield, PA; Bell Aerospace Corporation, Buffalo, NY; Boeing Aircraft and Aerospace, Seattle, WA; Draper Laboratories, Cambridge, MA; GTE Sylvania, Mt. View, CA; Hughes Research Laboratory, Malibu, CA; ITT Corporation, Nutley, NJ; McDonnell-Douglas Corporation, St. Louis, MO; Megatek Corporation, San Diego, CA; Pacific Sierra Research, Los Angeles, CA; Raven Industries, Sioux Falls, SD; Raytheon Company, Bedford, MA; RCA, Camden, NJ; Semcor Corporation, Cherry Hill, NJ; Telephonics, Huntington, Long Island, NY; Texas Instruments, Dallas, TX; UNIVAC, St. Paul, MN; Westinghouse Electric Corporation, Baltimore, MD; International Business Machines, Owego, NY; Emerson Corporation, St. Louis, MO; Singer-Kearrfott, Little Falls, NJ; Litton Guidance and Control Division, Woodland Hills, CA; Honeywell, Minneapolis, MN; Hazeltine, Long Island, NY

- Academic - Information Sciences Institute, Rio Del Ray, CA; Ohio State University, Columbus, OH; Stanford Research Institute, Menlo Park, CA; University of California, Lawrence Livermore Laboratory, Livermore, CA; University of Pennsylvania, Philadelphia, PA; Georgia Tech University, Atlanta, GA; Carnegie Mellon University, Pittsburgh, PA; Software Options, Cambridge, MA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Command and Control

1.1 Capabilities of the Advanced Command Control Architecture Testbed were continued for use by CINCPACFLT in wargaming and employed extensively in the evaluation of command and control technologies
1.2 System design for distributed data base management system (DBMS) has been completed and reviewed and the approach was developed for implementing the languages and component architectures of a centralized ADAPLEX data base management system
1.3 Two generations of the Structured Computer-Aided Logic Design (SCALD) System in the design and construction of the MARK II-A computer have been developed
1.4 Implementation of design in both uniprocessor and a full-scale multiprocessor system, ultimately containing 16 of the uniprocessors, is proceeding

1.5 Visual Information Evaluation System (VIEW) was transferred from the PDP 11/70 to a VAX 11/780 to assist in extensions for multiple user access; a joint DARPA/Navy effort was developed for continuing Visual Information Evaluation System development

Communications and Networking

1.6 Developed feasibility model of frequency hopping modem for the AN/ARC-182 VHF/UHF radio
1.7 Delivered feasibility model of an HF spread spectrum anti-jam and low probability intercept airborne radio
1.8 In joint effort with DARPA, successfully completed at-sea tests of a blue-green optical submarine communications system
1.9 Designed and built an aircraft L-band, multifunction, adaptive antenna array capable of beamforming and null steering which provides the capability to increase the Joint Tactical Information Distribution System antijam margin for testing in FY 1982

2. (U) FY 1982 Program

Communications and Networking

2.1 Determine feasibility of utilizing distributed processing in command system functions
2.2 Plan and conduct tests for a shore-to-submarine evaluation of acoustic communications

Command and Control

2.3 Initiate an artificial intelligence baseline program responsive to Navy's command and control problems
2.4 Continue antisubmarine warfare capabilities in combat systems through the use of simulations to identify sensitivities
2.5 Complete test design and evaluate navigation in long-range weapon systems
2.6 Complete development of MARK II-A multi-processor for the S-1 project; investigate the applications of the S-1 processor to Navy embedded computer systems; initiate and develop a Navy tests and evaluation plan for the Mark II-A uniprocessor and multi-processor

3. (U) FY 1983 and FY 1984 Planned Programs

Communications and Networking

I. *Program Element: 62721N Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.1 Investigate the problems of security, privacy, availability, gateway to other systems, protocols, and interfaces for a Navy Command Center network
3.2 Apply advanced data base networking concepts to combat systems for ships, aircraft, and Marine Corps Centers
3.3 Evaluate [redacted] aircraft-to-carrier communications link
3.4 Develop a low cost, extremely high frequency communications capability with passive antenna steering
3.5 Design and fabricate a modular multimode communications buoy
3.6 Develop modular radio frequency components for use in an integrated modular aircraft communication system
3.7 Develop the adaptive broadband aircraft antennas to operate with a modular concept

Command and Control

3.8 Design natural language processing capability for preparing messages
3.9 Develop an operational type data base management system
3.10 Apply artificial intelligence technologies to situation assessment, information management, and user interfaces
3.11 Determine the feasibility of using a minicomputer for processing in an experimental Advanced Submarine Command System
3.12 Complete work on a secure air traffic control system for the Marine Corps
3.13 Evaluate new memory technology for application to military aircraft
3.14 Continue development of the S-1 program with principal emphasis on evaluations of the processor in Navy systems

Changes from FY 1982 to FY 1983

3.15 The changes between the FY 1982 and FY 1983 (+$1,416 + 4.8%) are primarily due to increased spending in the essential area of radio frequency communications. Other changes are minor refined costs estimates for escalation.

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

5. (U) Milestones: Not applicable.

Project: F21-222 Title: Radio Frequency Communications
Program Element: 62721N Title: Command and Control Technology
Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

DETAILED BACKGROUND AND DESCRIPTION

- Develops advances in the technology base which can be applied to improving the communications capability of the Navy and Marine Corps
- Areas of emphasis include overt, jam resistant, and low probability of intercept techniques; increased reliability, interoperability, maintainability, and affordability; minimizing the impact of communications requirements on platform speed, depth (submarine only), and maneuverability; increased capacity through adaptive modem and compression techniques; and the reduction of volume and weight of communications systems

RELATED ACTIVITIES

- Interservice coordination is effected through the Office of the Under Secretary of Defense for Research and Engineering, and by Joint Service/Industry symposia, conferences, workshops, and informal direct liaison between program managers within the Naval Material Command, the Army Material Command, Defense Advanced Research Projects Agency, the Air Force Systems Command, and the Marine Corps Development and Education Command

WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; ECOM, Ft. Monmouth, NJ; Naval Air Development Center, Warminster, PA; Naval Electronic Systems Test and Evaluation Detachment, St. Inigoes, MD; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC

- Industrial - American Electronics Laboratories, Inc., Colman, PA; AMETAK, Hatfield, PA; E-Systems, Falls Church, VA; GTE Sylvania, Mt. View, CA; ITT Cable Hydrospace, San Diego, CA; ITT Electro-Optics Products Division, Roanoke, VA; MARR, Inc., Rockville, MD; Megatek Corporation, San Diego, CA; Pacific Sierra Research, Los Angeles, CA; Raven Industries, Sioux Falls, SD; SHE Corporation, San Diego, CA; Westinghouse Electric Corporation, Baltimore, MD, Harris Corp., Melbourne, FL; General Dynamics Corp., San Diego, CA; Hughes Aircraft Corp., Fullerton, CA; Rockwell Collins Division, Cedar Rapids, IA; Power Hybrids, Los Angeles, CA; Hazeltine Corp., Long Island, NY; CALSPAN, Buffalo, NY; Sperry Univac, Salt Lake City, UT

- Academic - None

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

(U) FY 1981 and Prior Accomplishments

II. Project: F21-222 Title: Radio Frequency Communications
Program Element: 62721N Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.1 Feasibility Models for digitally processing current Navy narrow band signals in the UHF/VHF bands have been developed
1.2 Wideband frequency division multiplex system for distribution of intermediate frequencies has been completed
1.3 Completed mechanical design of a multimode trailing wire antenna, with cable ready for test and evaluation
1.4 Fabricated expendable buoy and completed an at-sea evaluation of this buoy model
1.5 Successfully completed a ship launch and deployment experiment
1.6 Lab testing and interoperability of the WSC-3 radio for use in the Mobile Access Terminal was successfully completed
1.7 antenna for submarine application has been completed

2. (U) FY 1982 Program

2.1 Test the HF anti jam-Low Probability of Intercept system developed in FY 1981
2.2 At sea tests to evaluate the use of the WSC-3 radio as a part of the Mobile Access Terminal (Defense Advanced Research Projects Agency development) to be completed
2.3 Develop networking techniques aimed at automating communication networks to achieve dynamic circuit allocation
2.4 Integrate the buoy and electronics together with a new armored fiber optic tow cable and winch, and conduct tests on launching, towing, and control of electronics
2.5 Build feasibility model of wideband digital processor for demodulation of Joint Tactical Information Distribution System (JTIDS), Global Positioning System (GPS), Identification Friend or Foe (IFF) and Tactical Air Navigation (TACAN) signals
2.6 Complete the adaptive array for JTIDS and initiate testing

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Initiate adaptive frequency and power control techniques to improve towed buoy and high frequency surface wave communications
3.2 Identify, test, and evaluate optical components to develop prototype receiver for a range of applications
3.3 Continue efforts in broadband covert communications
3.4 Continue exploratory development work on an antijam modem and adaptive antenna for aircraft communications
3.5 Develop a hybrid radio frequency receiver front end for modular radio design
3.6 Continue Packet Radio (Mobile Access Terminal) for shipboard application
3.7 Continue development of a wideband buss architecture for aircraft

II. Project: F21-222 Title: Radio Frequency Communications
Program Element: 62721N Title: Command and Control Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: I - Technology Base

3.8 Develop speech recognition techniques for constraints of an aircraft interior

Comparison with FY 1982 Program:

3.9 The funding chages reflected in this project are minor and are due to cost escalation and program expansion

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F21-222	Radio Frequency Communications	9,379	8,690	9,835	11,497	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62734N
Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

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

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	25,036	27,931	29,144	31,507	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

(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 (C^3)
- Target acquisition
- Weapon guidance

Program Element: 62734N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Countermeasures Technology
Budget Activity: 1 - Technology Base

- Objectives comprise operational deception for precombat and combat operations; a dilution of force that the hostile command can apply by use of long range decoys, emplaced 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

(U) BASIS FOR FY 1983 RDT&E REQUEST

- There is rapid growth in Soviet Ocean Surveillance, in aggressive Soviet tactics in open-ocean areas, and in Soviet operational capabilities for aerospace, surface, and subsurface warfare, thus necessitating a vigorous countermeasures program effort toward providing the wherewithal other than that provided under other technological subareas to defeat enemy vehicles, weapons, surveillance systems, and command and control systems
- Such a countermeasures program depends upon advancing the pertinent technology bases and exploiting them to develop the techniques and systems which will inject greater delays and uncertainties into enemy command/control/communications, reduce the effectiveness of their weapon systems, and exploit opportunities for technical/tactical surprises
- The increase in FY 1983 funding over that for FY 1982 is due to escalation and other refinements in cost estimates which are characteristic of the exploratory development budget review
- 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 1984

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-$798 in FY 1981, +$50 in FY 1982, and -$1,176 in FY 1983) are due primarily to transitions to advanced development and redirected efforts within Countermeasures projects in FY 1982 and out-years, and escalation reductions pursuant to revised fiscal policy
- In order to enhance fiscal and technical management, the following project realignments were instituted:
  - F34-311 established to provide positive management of Classified Project funding
  - F34-375 instituted as separate project to reflect a major emphasis in Electro-Optical/Infrared/Ultraviolet Countermeasures
  - F34-377 established to reflect emphasis on upgrade of Underwater Demolition Team/Special Warfare Technology
  - F34-393 is continuation of FY 1981 F34-300 (USMC Land Mine Countermeasures)

Program Element: 62734N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Countermeasures Technology
Budget Activity: 1 - Technology Base

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	25,731	25,834	27,881	30,320	Continuing	Continuing
F34-300	USMC Land Mine Countermeasures	640	1,860	2,000	2,440	Continuing	Continuing
F34-371	Undersea Target Countermeasures and Deception	7,457	9,295	10,325	11,250	Continuing	Continuing
F34-372	Aerospace/Surface Target Countermeasures and Deception	12,357	10,808	12,110	12,680	Continuing	Continuing
F34-373	Underwater Demolition Team/Explosive Ordnance Disposal Equipment and Techniques	1,946	1,680	2,596	2,750	Continuing	Continuing
F34-374	Satellite Countermeasures and Defenses	2,331	781	850	1,200	Continuing	Continuing
F34-384	Nuclear Warfare Vulnerability and Hardening	1,000	800	*	*	*	*
F34-388	High Power Microwaves	0	610	**	**	**	**

* Transferred to Program Element 62764N
** Transferred to Program Element 62768N

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62734N
Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Provide advances in technologies supporting the development of new and improved countermeasures systems
- These advances provide greater effectiveness in the deception of hostile surveillance and command/control/communications capabilities during precombat operations; in the dilution of the enemy force by use of both long range and short range deception, decoys, and jammers over the combat areas; and in the deception, jamming, and destruction of enemy sensors or weapons guidance control circuitry during combat actions
- Programs to provide such technology are underway in the acoustic and electromagnetic spectra including radio-frequency, infrared, visual, and ultra violet
- The technology ranges from operational deception and electromagnetic countermeasures to acoustic countermeasures and mine-detection/mine-sweeping
- Explosive ordnance disposal technology is also funded in this element
-

(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; 62712N, Surface/Aerospace Target Surveillance Technology; 62721N, Command/Control Technology; 62761N, Materials 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

- Office of Naval Technology management assures 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 apportionment review by the Under Secretary of Defense for Research and Engineering

(U) WORK PERFORMED BY

- In-House - 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 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 Laboratory, 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 Laboratory, New London, CT
- Industrial - Integrated Systems Corporation, Santa Monica, CA; ITL Research, Los Angeles, CA; Hughes Aircraft Corp., Fullerton, CA; ITT, Van Nuys, CA; Lockheed Missiles and Space Corporation, Sunnyvale, CA; MANTECH International, Washington, DC; Norden Division of United Aircraft Corporation, East Hartford, CT; 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
- Academic - Applied Research Laboratory, University of Texas, Austin, TX; Applied Research Laboratory of Pennsylvania State University, State College, PA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Electronic Warfare

1.1 [redacted] Expendable Jammer transitioned to advanced/engineering development
1.2 Generic Infrared Jam Codes transitioned to advanced development in the AN/ALQ-XX jammer for use on helicopters to counter [redacted] guided threats
1.3 The [redacted] Signature program transitioned to advanced development and will provide the technology to enable missile threat warning systems
1.4 Integrated Tactical Electronic Warfare System (ITEWS) transitioned to advanced development to provide solid-state integrated on-board aircraft electronic warfare systems. It is anticipated that the Integrated Tactical Electronic Warfare System will be the next major advanced development airborne electronic warfare thrust

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.5 Outlaw Indian absorptive material developed under this program was transferred to the Naval Air Systems Command and Naval Electronics Systems Command advanced development, and to the U.S. Army and USMC as a countermeasure

1.6 The technology acquired in the Advanced Weapons Management System (AWMS) transitioned to Advanced Development in the Transmitter and Acquisition Receivers for the EA-6B Advanced Capability program

1.7 Millimeter Wavelength technology developed in this project area transitioned to advanced development of the tri-service Millimeter Threat Warning Receiver

1.8 The solid state amplifier, gallium arsenide (GaAs) high speed processing, automated data processing, and response techniques technologies developed in this project greatly enhanced the Integrated Tactical Electronic Warfare System (ITEWS) and made transition of that system to Advanced Development possible

1.9 Chaffs and decoys have been demonstrated

1.10 Established a data base for countermeasures against enemy command, control, and guidance systems and monopulse radar and other advanced electronic counter-countermeasure features in missile seekers

1.11 Millimeter wave electronic countermeasure system technology development is evolving rapidly

1.12 Continued technology development for Gyrotron radio frequency power amplifiers for super power electronic countermeasure transmitters

1.13 Successfully demonstrated technology via the Target Selection Confusion Offboard Decoy (TSCO) for Anti-Ship missile defense (ASMD)

1.14 Acquired and installed a radar to facilitate radar cross-section measurements for enhanced countermeasures development

1.15 A one-half scale version of the Long Duration Expendable Decoy Vehicle (LODED) has been successfully flown and work has begun on a full scale model. Long Duration Expendable Decoy Vehicle will be capable of carrying electronic decoy payloads

1.16 Completed a five-year development plan for Command, Control and Communications (C^3) Countermeasures to ensure a logical technology development path

Mine Countermeasures

1.17 Successfully completed the final increment of a four-year series of joint U.S./United Kingdom tests to obtain statistically valid data on the explosive neutralization vulnerability of modern sea mines, both on the bottom and buried

1.18 Completed the design and fabrication of a gravity powered breadboard subassembly vehicle for neutralization of mines moored on the ocean volume

1.19 Formulated, ratified, and initiated execution of a partitioned program between the U.S., U.K., and Australia on "Passive Mine Countermeasures" under which the Target Ship Self-Protection work is being done

1. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.20 Completed initial exploratory development tests of the [redacted] Mine Neutralizer (HIRAN VMN)
1.21 Completed evaluation of five (5) Remotely Piloted Underwater Mine Countermeasures (RUMIC) vehicles and identified one for continued development
1.22 Developed Abrasive Grit application to moored mine sweep wire which is expected to reduce standard cutter needs by 2/3 and significantly improve performance in obstructed moored minefields

Acoustic and Torpedo Countermeasures

1.23 Developed and field-tested a [redacted] countermeasure for the surface ship
1.24 Determined performance/design requirements for a countermeasure against a [redacted] sonar threat and a countermeasure against a two-way wire-guided torpedo threat and transferred specifications to the Advanced Torpedo Decoy program now in Program Element 64562N, Project S0235 (Submarine Acoustic Countermeasures System (SUBACS))
1.25 Completed torpedo hull-rupture modeling effort
1.26 Developed and verified a linear elastic torpedo-hull response model for use in determining vulnerability of torpedoes to countermeasures
1.27 Identified the Soviet sonobuoy threat and employment doctrine and determined the characteristics of a sonobuoy countermeasure needed to defeat the sonobuoy threat
1.28 Developed a dynamic, real time, interactive active sonar model which is being utilized as the primary tool for the development of performance, design characteristics, and tactics for active sonar countermeasures
1.29 Completed performance and design requirements for active sonar countermeasures

Explosive Ordnance Disposal and Special Warfare Technologies

1.30 Built and tested a prototype Surface/Subsurface Clearance Vehicle (SSCV) for explosive ordnance clearance
1.31 Successfully demonstrated a prototype Remotely Operated Mechanical Case Entry Trepanner (ROMCET) to allow non life-endangering neutralization of live ordnance
1.32 Established data base for countermeasures against foreign ordnance to provide positive continuing exploratory development
1.33 Established new Special Warfare subproject in FY 1982 to develop technology for upgrading support for the mission and needs of the Underwater Demolition Team (UDT) and Sea, Air, and Land Team (SEAL)

U.S. Marine Corps Land Mine Countermeasures

1.34 Completed Line Charge land effectiveness measurements task. This provided initial data base for explosive neutralization and continuity for overall explosive neutralization equipments development program

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.35 Optimized design for Fuel-Air-Explosive (FAE) Warhead through design analysis and experiments in this program. This improved warhead impacts on increased effectiveness for a transitional countermine system Catapult Fuel-Air-Explosive (CATFAE) under development by the USMC
1.36 Produced data which provided proposed solution to zone of reduced impulse near the line charge of the M58A1 Linear Demolition Charge to be implemented into the Advanced Linear Demolition Charge program proposal
1.37 Acquired foreign technology for the countermine warfare program. This includes hardware which has been involved in actual foreign mine clearance tasks in the relatively recent past as well as mine fuzing information to be utilized in mine countermeasures tests. This understanding of foreign technology impacts the design of future mine and countermine systems as well as identifying technology areas requiring additional development efforts (equipment to be utilized in continuing R&D efforts in this arena)

2. (U) FY 1982 Program

Electronic Warfare (Includes new Electro-optical/Infrared/Ultraviolet (EO/IR/UV) (and Satellite Countermeasures) technology emphasis areas)

2.1 Refine program threat documentation, assess implications for surface combatant countermeasures
2.2 Complete experiment definition for Anti-Radiation Missile-Identification
2.3 Complete prototype effort for radar hardware/software. Resolve implementation issues for CV/CG, DDG, etc.; plan and conduct tests and interoperability demonstrations
2.4 Complete assessment of multi-function radar role in battle group Anti-Radiation Missile Countermeasures (ARM-CM). Define potential test/demonstration effort
2.5 Identify future Anti-Radiation Missile Countermeasures requirements
2.6 Identify hardware configuration for use in next generation Tri-Service "generic Anti-Radiation Missile" test vehicle
2.7 Demonstrate management control features compatible with Automatic Detection and Track (ADT) software in current CV/CG/DDG classes
2.8 Complete software for simulating multifunction radar control strategies
2.9 Complete test and evaluation of Millimeter Wave (MMW) receiver
2.10 Complete preliminary modules of
2.11 Provide completed design of adaptive receiver
2.12 Complete subassembly package design for RF digital memories
2.13 Test and evaluate technology developments in chaff cartridges
2.14 Complete brassboard design for aircraft forward-fired acquisition, communications, and tracking (ACT) decoy
2.15 Provide preliminary concept for jammer (airborne)
2.16 Complete tests to determine vulnerability potential of sensors

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.17 Evaluate new concepts for
2.18 Complete analysis on short range correlation
2.19 Continue analysis of various types of fuel
2.20 Conduct at-sea test of technology developments
2.21 Investigate receiver technologies
2.22 Develop and evaluate engagement algorithms and associated displays for control systems

2.23 Develop command decision aids for command, control and communications countermeasures
2.24 Intensify efforts in high power technology
2.25 Initiate development of a control system
2.26 Increase Ship's Area Electronic Warfare project efforts with goal of expanding multi-ship, multi-missile interaction for enhancing task force/task group survivability
2.27 Concept definition Electronic Counter Countermeasures (ECCM)
2.28 Commence development of preliminary study measurements of ships/aircraft/selected land vehicles

Mine Countermeasures (MCM)

2.29 Conduct experiments to determine target/environmental limits of proposed future Mine Countermeasure sonar
2.30 Complete feasibility demonstration of High Rate Volume Mine Neutralization (HIRAN) concept and transition to advanced development
2.31 Complete Neutralizer Feasibility Demonstration
2.32 Conclude Concept Assessment
2.33 Conduct at-sea evaluation of sonar body model
2.34 Begin at-sea evaluation of experimental towlines
2.35 Complete analysis of sweep
2.36 Select configuration for monitor
2.37 Complete assessment of concepts for low visiblity helo Mine Countermeasure operations
2.38 Intensify shallow water Mine Countermeasure techniques efforts

Acoustic and Torpedo Countermeasures

2.39 Complete threat hull-rupture field test series
2.40 Complete Handbook on small device launch trajectory/envelope
2.41 Finalize assessment of launchers

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.42 Assess Submarine Advance Combat System (SUBAC)/Acoustic Warfare (AW) utility and effectiveness
2.43 Complete Sonobuoy technology effort
2.44 Transition surface ship technology/systems concept work to Advanced Development in Project S0225 (P.E. 63506N)
2.45 Complete investigation of acoustic dicriminant functions

Explosive Ordnance Disposal and Special Warfare Technologies

2.46 Demonstrate electronic dipole countermeasures
2.47 Develop a Radio Frequency (RF) and electrostatic resistant blasting cap
2.48 Investigate and identify technology available for "all-metal" ordnance locator
2.49 Examine and investigate bombs
2.50 Acquire and evaluate Explosive Ordnance Disposal tool
2.51 Design, build, and test erosive cutting tool brassboard
2.52 Complete Fuel-Air-Explosives parametric design and evaluate results
2.53 Initiate] Countermeasures

U.S. Marine Corps Land Mine Countermeasures

2.54 Continue Land Mine Countermeasure threat update, computer model development, and systems effectiveness measurement effort
2.55 Complete NATO Land Mine Concept survey
2.56 Complete Foam-Fuel Air Explosive (FAE) and Liquid-Dust FAE tests and evaluate results for development utilizing technological results observed
2.57 Complete land minefield field assistance device brassboard and evaluate performance
2.58 Initiate development of prototype fieldable Land Minefield assistance device
2.59 Develop Advanced Systems Concept for Minefield Planning Aid Systems
2.60 Develop test procedures and test concepts for main charge destruction of land mines for amphibious assault, test, and report results
2.61 Conduct assessment of land mine neutralization in desert and beach areas and report results
2.62 Establish initial facilities for acquisition of Mine/Countermine information Initiate training; design and conduct tests; evaluate results

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Electronic Warfare

3.1 Demonstrate management control features compatible with Automatic Detection and Track (AUT) software in current CV/CG/DDG classes
3.2 Complete software for simulating radar control strategies
3.3 Perform analytic assessment and tests definition for countermeasures

3.4 Complete special project experiment on Anti-Radiation Missile-Identification (ARM-ID)
3.5 Complete design of adaptive receiver (airborne)
3.6 Complete subassembly package design for Radio Frequency (RF) digital memories
3.7 Complete breadboard design for aircraft decoy
3.8 Complete] Electronic Countermeasures (ECM) technology development and transition to Advanced Development in FY 1984 (joint program with DARPA)
3.9 Continue to develop Electronic Countermeasures techniques against an evolving threat technology
3.10 Intensify efforts to develop an effective electronic countermeasure capability against observed/projected threat
3.11 Increase efforts in antenna technology area
3.12 New Start/Special Focus in Command, Control, and Communications Countermeasures (C^3 CM)
3.13 Develop and test off-board decoys (continuing)
3.14 Flight test Long Duration Expendable Decoy (LODED) vehicle for validation
3.15 Coordinated effort with USAF in Electronic Countermeasure
3.16 Develop brassboards for Jamming Took-through
3.17 Intensify Countermeasures technology efforts through newly established special focus programs
3.18 Initiate tests of a laser
3.19 Develop IR/RF colocation technology
3.20 Identify and investigate materials to counter sensors
3.21 Joint development of laser with DARPA

Mine Countermeasures

3.22 Complete Feasibility Demonstration of Bottom Mine Neutralization Concept and Transition to Advanced Development

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DEPARTMENT OF THE NAVY SUPPORTING DATA FOR FISCAL YEAR 1983 BUD--ETC(U)
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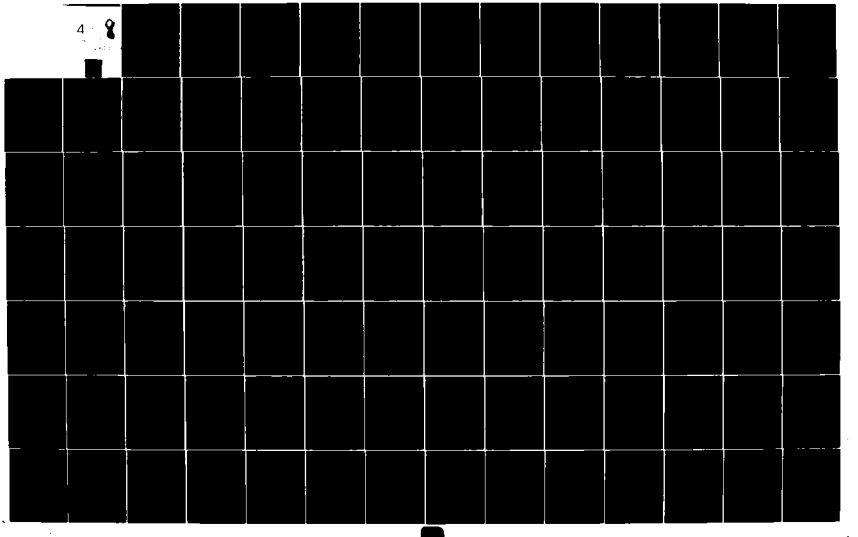

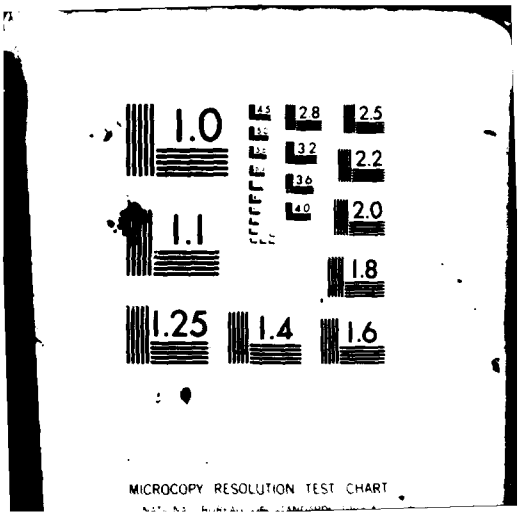
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I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.23 Complete Remote Undersea Mine Countermeasures (MCM) Technology Feasibility Demonstration
3.24 Transition Technology to Systems Development
3.25 Complete Mine Countermeasures System Field Trials
3.26 Complete modification of extended breakthrough model to allow easy incorporation of new sweeping and hunting techniques
3.27 Complete sea testing of advanced clearance hardware
3.28 Complete evaluation of candidate technology for improving Mine Countermeasure-1 (MCM-1) capability
3.29 Complete design for port and selected straits mine countermeasures
3.30 Complete identification of new mine countermeasures equipment needs for craft-of-opportunity
3.31 Continue experiments at Naval Ocean System Center ocean research tower to determine target/environmental limits on future sonar
3.32 Explore tradeoffs for different approaches to Mine Countermeasures detect/classify systems
3.33 Deploy research tool in mobil measurements aboard Research Vehicle for wider based environmental input data Complement San Diego data on mine countermeasures topics examined in FY 1981-83 and new topics
3.34 Provide services to obtain at-sea test data
3.35 Conduct tow test with motion compensator; complete transducer and flow noise tests; establish/justify goals and thresholds
3.36 Conduct heat conductivity/current test of experimental S-cables
3.37 Investigate magnets and coils
3.38 Conduct broad based technical investigation to identify Mine Countermeasures (MCM) relevant technological advances
3.39 Investigate composite foils
3.40 Design/fabricate/test experimental hardware; complete analysis of multiple influence sweep; conduct explosive tests
3.41 Complete investigation of Airborne Mine Countermeasures (AMCM) hostile environment
3.42 Develop algorithms for control/change to mine countermeasures tactics

Acoustic and Torpedo Countermeasures

3.43 Complete development of discriminant functions
3.44 Transition Explosive Charge Technology to advanced development in the Submarine Acoustic Countermeasures System (SUBACS)
3.45 Complete torpedo internal component vulnerability tests
3.46 Complete covert launcher Experimental Development Model (xdm) field tests
3.47 Transition launcher technology to Advanced Development, Project S0210/Submarine Acoustic Countermeasures System II

I. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Explosive Ordnance Disposal and Special Warfare Technologies

3.48 Test disposal de-armer
3.49 Develop remote fuze actuator development
3.50 Develop surface towed induction locator
3.51 Develop Isotope radiator
3.52 Test induction device for ordnance location
3.53 Develop remotely operated vehicle
3.54 Complete testing of the electrochemical machining/acid trepanning tool
3.55 Design and build erosive cutting tool
3.56 Develop membrane gas separation system
3.57 Design strippable tool protection coating
3.58 Identify specific technical approaches for further development
3.59 Complete "critical question" experiments on countermeasures approach

U.S. Marine Corps Land Mine Countermeasures

3.60 Complete full scale computer modeling capability inputs and in depth systems analysis of advanced concepts; report assessment of modeling
3.61 Update algorithms for combat analysis model; report algorithms modifications
3.62 Identify programs for initiation and develop system concepts; continue Fuel Air Explosives (FAE) Warhead Optimization; develop Advanced Fuel Air Explosives Concept
3.63 Develop test designs for effectiveness/performance measurements; report on test/data
3.64 Complete development of prototype simulation model and prepare specifications for advanced development model; complete specifications
3.65 Test vulnerability of mines ; report test
3.66 Reassess technology for mine charge initiation; report on technology
3.67 Conduct assessment of attenuation of explosive charges in snow and permafrost; report results of assessment
3.68 Conduct field tests with cooperation of U.S. Army in cold weather to verify mine response versus pressure/impulse
3.69 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
3.70 Design, test, and develop procedures for data base collection to support Advanced Systems Concept; report on test design/results

1. *Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - ETectronic and Physical Sciences Budget Activity: 1 - Technology Base

Changes from FY 1982 to FY 1983

3.71 No significant changes in major thrusts

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

5. (U) Milestones: Not applicable

II. Project: F34-372 Title: Electronic Warfare
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Foreign navies, in addition to expanding frequencies or spectra coverage, are using sophisticated technological advances to reduce their vulnerability [redacted] and are supporting more aggressive tactics in open ocean operations
- They have expanded their surveillance and tactical reconnaissance range capabilities in the critically vital precombat period, necessitating improvement of our countermeasures
- This project supports development of countermeasures systems which neutralize enemy sensor or weapons systems, which detect, identify, track, and support attacks on our ships and aircraft
- Pursues the nullification of enemy counter-countermeasures, [redacted]

(U) RELATED ACTIVITIES

- Annual Office of Naval Technology (ONT) technical assessments, Tri-Service committees, Assistant Secretary of the Navy (Research, Engineering and Systems) reviews and Under Secretary of Defense for Research and Engineering apportionment reviews assure coordination and mutual exploitations of advances
- The incorporation of threat projections into the management guidance for exploratory development efforts is being assured through the working relationships of intelligence research and development interfaces
- Related program elements are: 62712N, Surface/Aerospace Target Surveillance; 62721N, Command and Control Technology; 62761N, Materials Technology; 62762N, Electronic Devices Technology

(U) WORK PERFORMED BY

- In-House - 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, Point Mugu, CA
- Industrial - Aerojet General Corporation, Sacramento, CA; Corning Glass Inc., Durham, NC; Hughes Aircraft Company, Fullerton, CA; Hycor Inc., North Woburn, MA; Norden Division of United Aircraft Corporation, East Hartford, CT; Raytheon Corporation, Goleta, CA and Waltham, MA; Stanford Research Institute, Menlo Park, CA; Texas Instruments Inc., Dallas, TX; Watkins-Johnson Inc., Palo Alto, CA; Westinghouse, Baltimore, MD
- Academic - None

II. Project: F34-372 Title: Electronic Warfare
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Airborne Electronic Warfare

1.1 The Expendable Jammer transitioned to advanced/engineering development
1.2 Generic Infrared Jam Codes transitioned to advanced development in the AN/ALQ-XX jammer for use on helicopters to counter guided threats
1.3 The Signature program transitioned to advanced development and will provide the technology to enable missile threat warning systems
1.4 Integrated Tactical Electronic Warfare System (ITEWS) transitioned to advanced development to provide solid-state integrated on-board aircraft electronic warfare systems; it is anticipated that this system will be the next major advanced development airborne electronic warfare thrust
1.5 Outlaw Indian absorptive material developed under this program was transferred to the Naval Air Systems Command and Naval Electronics Systems Command advanced development, and to the U.S. Army and U.S. Marine Corps as a countermeasure
1.6 The technology acquired in the Advanced Weapons Management system (AWMS) transitioned to advanced development in the Transmitter and Acquisition Receivers for the EA-6B Advanced Capability program
1.7 Millimeter Wavelength technology developed in this project area transitioned to advanced development of the tri-service Millimeter Threat Warning Receiver
1.8 The solid state amplifier, Gallium Arsenide high speed processing, automated data processing, and response techniques technologies developed in this project greatly enhanced the Integrated Tactical Electronic Warfare System (ITEWS) and made transition of that system to Advanced Development possible

Ships Electronic Warfare

1.9 Chaff and decoys have been demonstrated
1.10 Established a data base for countermeasures against enemy command, control, and guidance systems and monopulse radar and other advanced electronic counter-countermeasure features in missile seekers
1.11 Millimeter wave electronic countermeasure system technology development is evolving rapidly
1.12 Continued technology development for gyrotron radio frequency power amplifiers for super power electronic countermeasure transmitters

II. Project: F34-372 Title: Electronic Warfare
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.13 Successfully demonstrated technology _ _ via the Target Selection Confusion Offboard decoy (TSCO) for Anti-Ship Missile Defense (ASMD)
1.14 Acquired and installed a _ radar to facilitate radar crosssection measurements for enhanced countermeasures development
1.15 A one-half scale version of the Long Duration Expendable Decoy Vehicle (LODED) has been successfully flown and work begun on a full scale model. LODED will be capable of carrying electronic decoy payload _
1.16 Completed a five-year development plan for Command, Control, and Communications (C^3) countermeasures to ensure a logical technology development path

2. (U) FY 1982 Program

Electronic Warfare

2.1 Refine program threat documentation, assess implications for surface combatant countermeasures (CM)
2.2 Complete experiment definition for Anti-Radiation Missile-Identification (ARM-ID)
2.3 Complete prototype effort for radar _ _ hardware/software; resolve implementation issues for CV/CG, DDG, etc.; plan and conduct tests and _ interoperability demonstrations
2.4 Complete assessment of multi-function radar role in battle group Anti-Radiation Missile Countermeasures (ARM-CM); define potential test/demonstration effort
2.5 Identify future Anti-Radiation Missile Countermeasures (ARM-CM) requirements
2.6 Identify _ hardware configuration for use in next generation Tri-Service "generic Anti-Radiation Missile" test vehicle
2.7 Demonstrate _ _ management control features compatible with Automatic Detection and Track (ADT) software in current CV/CG/DDG classes
2.8 Complete software for simulating multifunction radar control strategies
2.9 Complete test and evaluation of Millimeter Wave (MMW) _ _ receiver
2.10 Complete preliminary modules of _
2.11 Provide completed design of adaptive receiver
2.12 Complete subassembly package design for Radio Frequency (RF) digital memories
2.13 Test and evaluation of technology developments in _ _ chaff cartridges
2.14 Complete brassboard design for aircraft forward-fired acquisition, communications and tracking (ACT) decoy
2.15 Provide preliminary concept for _ jammer (airborne)
2.16 Conduct at-sea test of echnology developments
2.17 Investigate _ _ receiver technologies

II. Project: F34-372 Title: Electronic Warfare
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.18 Develop and evaluate engagement algorithms and associated displays for control systems

2.19 Develop command decision aids for command, control and communications-countermeasures (C^3-CM)
2.20 Intensify efforts in high power technology
2.21 Initiate development of a control system
2.22 Increase Ship's Area Electronic Warfare project efforts with goal of expanding multi-ship, multi-missile interaction for enhancing task force/task group survivability

3. (U) FY 1983 and FY 1984 Planned Programs

Electronic Warfare

3.1 Demonstrate management control features compatible with Automatic Detection and Track (ADT) software in current CV/CG/DDG classes
3.2 Complete software for simulating radar control strategies
3.3 Perform analytic assessment and tests definition for countermeasures

3.4 Complete special project experiment on Anti-Radiation Missile-Identification (ARM-ID)
3.5 Complete design of adaptive receiver (airborne)
3.6 Complete subassembly package design for RF digital memories
3.7 Complete breadboard design for aircraft decoy
3.8 Complete electronic countermeasure technology development and transition to Advanced Development in FY 1984 (joint program with DARPA)
3.9 Continue to develop electronic countermeasure techniques against an evolving threat technology
3.10 Intensify efforts to develop an effective electronic countermeasure capability against observed/projected threat
3.11 Increase efforts in antenna technology area
3.12 New Start/Special Focus in command, control and communications-countermeasures
3.13 Develop and test off-board decoys (continuing)
3.14 Flight test Long Duration Expendable Decoy (LODED) vehicle for validation
3.15 Coordinated effort with U.S. Air Force in
3.16 Develop brassboards for jamming look-through

II. Project: F34-372 Title: Electronic Warfare
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.17 The change in funding profile between FY 1982 and 1983 (+$458 thousand) is due to escalation and refinement of costs characteristic of exploratory development

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F34-372	Electronic Warfare	7,874	8,293	8,751	9,219	Continuing	Continuing

III. Project: F34-376 Title: Mine Countermeasures
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Established the technology base and covers feasibility/conceptual efforts in airborne/shipborne mine countermeasures, acoustic warfare and inshore undersea warfare
- Mine countermeasures developments are used to identify, adapt, and demonstrate technological advances which offer improved techniques and equipment designs for the defeat of sea mines
- The mines are rendered harmless by activating the mine outside the damage radius or by detecting the mine and marking it for avoidance or neutralization
- Ships/submarine signatures are reduced/modified to reduce their mine vulnerabilities
- Acoustic warfare advances the ship/submarine countermeasures technology which provide the basis for new/improved techniques and equipment to use against both weapon and platform sensors

(U) RELATED ACTIVITIES

- The project is concerned solely with the needs and requirements unique to the Navy and Marine Corps; however, related technological efforts are coordinated with DoD and the other services by symposia, special advisory groups, and annual Office of Naval Technology (ONT) technical assessment utilizing technical expertise from outside activities for objective assessment

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Coastal Systems Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Underwater Systems Center, New London, CT and Newport RI
- Industrial - Hydrospace Research Corporation, Rockville, MD; MANTECH International, Washington, DC; Planning Systems, Inc., McLean, VA; Raytheon Company, Portsmouth, RI
- Academic - Applied Research Laboratory of Pennsylvania State University, State College, PA; Applied Research Laboratory of the University of Texas, Austin, TX
- Related Program Elements: 62633N, Undersea Warfare Weaponry Technology and 62711N, Undersea Target Surveillance Technology

III. Project: F34-376 Title: Mine Countermeasures
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Successfully completed the final increment of a four-year series of joint U.S./United Kindgom tests to obtain statistically valid data on the explosive neutralization vulnerability of modern sea mines, both on the bottom and buried
1.2 Completed the design and fabrication of a gravity powered breadboard subassembly vehicle for [redacted] neutralization of mines moored on the ocean floor
1.3 Formulated, ratified, and initiated execution of a partitioned program between the U.S., U.K., and Australia on "Passive Mine Countermeasures" under which the Target Ship Self-Protection work is being done
1.4 Completed initial exploratory development tests of the [redacted] Volume Mine Neutralizer (HIRAN VMN)
1.5 Completed evaluation of five (5) remotely piloted underwater mine countermeasures (RUMIC) vehicles and identified one for continued development
1.6 Developed abrasive grit application to moored mine sweep wire which is expected to reduce standard cutter needs by 2/3 and significantly improve performance in obstructed moored minefields

2. (U) FY 1982 Program

2.1 Conduct experiments to determine target/environmental limits of proposed future Mine Countermeasures (MCM) sonar
2.2 Complete feasibility demonstration of [redacted] Volume Mine Neutralization (HIRAN) concept and transition to advanced development
2.3 Complete [redacted] Neutralizer Feasibility Demonstration
2.4 Conclude [redacted] Concept Assessment
2.5 Conduct at-sea evaluation of [redacted] sonar body model
2.6 Begin at-sea evaluation of experimental towlines
2.7 Complete analysis of [redacted] sweep
2.8 Select configuration for [redacted] monitor
2.9 Complete assessment of electro-optical (EO) concepts for low visibility helo mine countermeasure operations
2.10 Intensify shallow water mine countermeasure techniques efforts

III. Project: F34-376 Title: Mine Countermeasures
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Complete feasibility demonstration of Bottom Mine Neutralization Concept and transition to advanced development
3.2 Complete Remote Undersea Mine Countermeasure Technology Feasibility Demonstration
3.3 Transition Technology to Systems Development
3.4 Complete Mine Countermeasure System Field Trials
3.5 Complete modification of extended breakthrough model to allow easy incorporation of new sweeping and hunting techniques
3.6 Complete sea testing of advanced clearance hardware
3.7 Complete evaluation of candidate technology for improving Mine Countermeasure-1 (MCM-1) capability
3.8 Complete design of for port and selected straits mine countermeasures
3.9 Complete identification of new mine countermeasures equipment needs for craft-of-opportunity
3.10 Continue experiments at Naval Ocean Systems Center ocean research tower to determine target/environmental limits on future sonar
3.11 Explore tradeoffs for different approaches to mine countermeasures detect/classify systems
3.12 Deploy research tool in mobile measurements aboard Research Vehicle for wider based environmental input data Complement San Diego data on topics examined in FY 1981 - 83 and new topics
3.13 Provide services to obtain at-sea test data
3.14 Conduct tow test with motion compensator; complete transducer and flow noise tests; establish/justify goals and thresholds
3.15 Conduct heat conductivity/current test of experimental cables
3.16 Investigate rare earth magnets and cryogenic coils
3.17 Conduct broad based technical investigation to identify mine countermeasures relevant technological advances
3.18 Investigate composite foils
3.19 Design/fabricate/test experimental hardware; complete analysis of multiple influence sweep; conduct explosive tests
3.20 Complete investigation of Airborne Mine Countermeasures (AMCM) hostile environment
3.21 Develop algorithms for control/change to mine countermeasures tactics

III. Project: F34-376 Title: Mine Countermeasures
Program Element: 62734N Title: Countermeasures Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program:

3.22 This new funding line (F34-376) was established to ensure proper fiscal and technical attention. Acoustic/Torpedo Countermeasures, Explosive Ordnance Disposal technology, and Special Warfare technology programs have been established as separate project areas in FY 1982 (and removed from the Mine Countermeasures management area).

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F34-376	Mine Countermeasures	6,979	6,918	7,485	7,590	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

ıent: 62735N
Area: 521 - Electronic and Physical Sciences

Title: High Energy Laser Technology
Budget Activity: 1 - Technology Base

:ES (PROJECT LISTING): (Dollars in Thousands)

itle	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
)TAL FOR PROGRAM ELEMENT	38,276	57,487	63,210	69,440	Continuing	Continuing
igh Energy Laser Weaponry & Technology	38,276	57,487	63,210	69,440	Continuing	Continuing

:SCRIPTION OF ELEMENT AND MISSION NEED

velops High Energy Laser technology and resolves critical technical issues related to the potential use of a continuous ve laser in a weapon role, with emphasis on antiship missile defense
e planned program, code named SEA LITE, will culminate with lethality tests at the White Sands Missile Range
ring the SEA LITE program, a High Energy Laser will be exercised against realistic targets and scenarios
e results of these demonstrations are expected to show the feasibility of ship-based, High Energy Laser weapons

)R FY 1983 RDT&E REQUEST

mplete fabrication and acceptance tests of hot spot tracker; integrate into SEA LITE Beam Director
semble and complete factory acceptance tests of the SEA LITE Beam Director
stall and check out] White Sand Missile Range
rform laser damage tests on components of candidate SEA LITE targets
velop and procure diagnostic instrumentation for installation in SEA LITE target missiles
dify target missiles for use in SEA LITE tests
e SEA LITE experimental high energy laser system will be the first in the nation to demonstrate a weapons level rformance. It will be capable of putting nearly 100 times more energy on target per second than the experimental stem used by the Navy to shoot down TOW anti-tank missiles at TRW's Capistrano, California test site in 1978
e SEA LITE program has been reviewed by the Defense Science Board and endorsed as the cornerstone of the DOD high energy eld test program. SEA LITE will provide essential data to support high energy laser development activities throughout)

this is a continuing program, the above funding includes outyear escalation and encompasses all work or development ases now planned or anticipated through FY 1984 only

Program Element: 62735N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: High Energy Laser Technology
Budget Activity: 1 - Technology Base

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

° The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are:

- FY 1981 - an increase of $151 due to cost refinements
- FY 1982 - a decrease of $486 due to cost refinements and deescalation
- FY 1983 - a reduction of $1,994 to accommodate an across the board technology base funding reduction.

° Beginning in FY 1982, pulsed chemical lasers are funded in PE 62768N

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	35,312*	38,125	57,973	65,204	Continuing	Continuing
F35-388	High Energy Laser Weaponry & Tech	35,312*	38,125	57,973	65,204	Continuing	Continuing

* Funded in Program Elements 63754N and 63587N in FY 1980 and prior years

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62735N Title: High Energy Laser Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Speed of light delivery of lethal energy to the target by a High Energy Laser weapon eliminates two error sources; target motion and trajectory prediction, from the fire control problem; reaction time and ability to hit crossing and maneuvering targets
- High Energy Laser weapons have minimal guidance/dispersion error permitting selection of vulnerable areas on target for improved kill probability
- Laser weapons have a passive optical target tracking system which allows operation under conditions of emission control
- High Energy Laser weapons can switch rapidly from target to target
- Develops a technology base in continuous wave laser devices and beam director systems
- Pursues an understanding of the phenomenology associated with both laser beam propagation through the atmosphere and the interaction of the laser beam with target materials
- Formulates the analytical tools required to conduct tradeoff efforts, measure effectiveness, and project costs for a High Energy Laser weapon system
- Develops and tests an experimental High Energy Laser system at weapon power level which demonstrates the potential utility of a High Energy Laser in an antiship missile defense role (SEA LITE Program)
- SEA LITE experimental system will be tested against threat representative targets flown in realistic scenarios to project the required performance of an operational weapon
- Prior to FY 1981, Program Elements 63754N, High Energy Laser, and 63587N, Test Bed Demonstration, supported development of the High Energy Laser technology base, subsystem development, field tests, and the lethality demonstration program

(U) RELATED ACTIVITIES

- Other directed energy technology including pulsed chemical lasers is being pursued under PE 62768N
- The Air Force is carrying out an Advanced Radiation Technology Program, PE 63605F, Evaluation of Damage Effects on Materials of Air Force Interest. This element includes the employment of an experimental high energy laser on board a C-135 aircraft
- DARPA is supporting the development of advanced lasers and pointer-trackers for space applications
- All DOD High Energy Laser programs are closely coordinated by the Under Secretary of Defense for Research and Engineering

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS, e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

I. *Program Element: 62735N Title: High Energy Laser Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(U) WORK PERFORMED BY

- In-House - Fleet Analysis Center, Corona, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Pt. Mugu, CA; Naval Surface Weapons Center, Dahlgren, VA
- Industrial - Applied Physics Laboratory, Johns Hopkins University, Baltimore, MD; Science Applications, Inc., Arlington, VA; Hughes Aircraft Company, Culver City, 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; Lockheed Missile and Space Corp., Sunnyvale, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

High Energy Continuous - Wave Chemical Lasers

1.1 Developed a [redacted] chemical laser which was mated to the Navy pointer-tracker to demonstrate the ability to transmit a high power beam to a selected aimpoint on a dynamic target and maintain the beam on the aimpoint for sufficient time to cause disabling damage
1.2
1.3 This demonstration regarded as the most significant event in U.S. High Energy Laser development to date
1.4 Completed fabrication and initial characterization tests of the [redacted] chemical laser for the SEA LITE Program
1.5 Completed critical design review of SEA LITE Beam Director
1.6 Conducted tests to confirm performance of high risk elements in the SEA LITE system
1.7 Conducted damage vulnerability tests to determine characteristics of candidate SEA LITE targets

2. (U) FY 1982 Program

2.1 Complete fabrication of components necessary to allow operation of [redacted] laser at White Sands Missile Range
2.2 Fabricate SEA LITE Beam Director
2.3 Complete design and initiate fabrication of Hot Spot Tracker for the Beam Director
2.4 Complete field test of the Automatic Aimpoint Selection and Maintenance subsystem and initiate integration into the SEA LITE Beam Director
2.5 Award contracts for modification of SEA LITE targets to incorporate diagnostic instrumentation

I. *Program Element: 62735N Title: High Energy Laser Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

3. (C) FY 1983 and FY 1984 Planned Programs

3.1 Move [redacted] laser to White Sands Missile Range (WSMR) and complete characterization tests
3.2 Complete fabrication and factory acceptance tests of SEA LITE Beam Director; move Beam Director to White Sands Missile Range (WSMR), and complete characterization tests
3.3 Complete fabrication of Hot Spot Tracker, perform characterization tests and integrate into SEA LITE Beam Director
3.4 Produce target instrumentation, install in targets, and perform flight qualifications at White Sands Missile Range
3.5 Complete subsystem installation and integration at White Sands Missile Range
3.6 Initiate check-out tests of total SEA LITE system

Changes from FY 1982 to FY 1983

3.7 Program content is unchanged

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

5. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62757N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Human Factors and Simulation Technology
Budget Activity: 1 - Technology Base

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

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	8,055	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports development of improved visual and weapons simulation capabilities and individualized automated training techniques to minimize the expensive use of operational equipment for training
- Supports development of a more effective man-machine-mission relationship to assure, in the design of equipment, that the demands and environment created by the equipment are compatible with abilities and characteristics of the human operator and maintainer

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Continue evaluation of suitability of candidate systems with advanced wide angle visual and motion cuing capabilities for a helicopter trainer concept
- Accelerate the development of radar target acquisition techniques to increase the probability of detection of airborne targets as a function of range
- Complete the development of psychophysiological fatigue and stress reduction techniques applicable to long endurance missions
- Complete feasibility model of a multi-spectral image simulation system having display characteristics such that proper correlation between sensors can be detected and used to identify targets faster and more accurately
- Initiate identification of maintenance tasks which are most difficult to perform and evaluate design concepts to improve maintenance performance in shipboard systems
- Increase in funding for Project F57-525 over the FY 1982 total (922 thousand) will permit the acceleration of the development of radar target acquisition techniques to increase the probability of detection of airborne targets and to initiate efforts to design and evaluate concepts to improve maintainers performance and increase operational readiness aboard ship

Program Element: 62757N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Human Factors and Simulation Technology
Budget Activity: 1 - Technology Base

- As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY

- (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: -38 in FY 1981; -1,606 in FY 1982; and -1,094 in FY 1983. These decreases result from the termination of several efforts in simulation technology and the decision not to initiate several efforts in human factors engineering.

- Other minor changes from the element funding profile shown in the FY 1982 Descriptive Summary result from refined estimates of cost including escalation and other minor adjustments characteristic of research and exploratory development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,672	5,901	8,093	9,149	Continuing	Continuing
F57-525	Human Factors Technology	1,927	2,225	3,693	4,335	Continuing	Continuing
F57-526	Simulation Technology	3,745	3,676	4,400	4,814	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62757N Title: Human Factors and Simulation Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- NEED - Minimize expensive use of operational equipment for training
  - Element supports: development of technology to improve visual and weapons simulation capabilities; voice technology to improve the effectiveness of training devices; individualized automated training techniques to improve performance measurement
- NEED - Weapon systems must be compatible with the abilities of the human operators and maintainers
  - Element supports: development of human factors design data to assure a more effective man-machine-mission relationship; techniques to reduce the information overload in command and control systems; development of job designs and procedures to improve human performance

(U) RELATED ACTIVITIES

- To assure coordination and avoid duplication, a continuous exchange of information is conducted with the Army, Air Force, other governmental agencies, the private industry sector, academic institutions and three Technology Advisory Groups
- Related program elements are:
  - 63701N, Human Factors Engineering Development
  - 64703N, Training Devices Prototype Development
  - 62205F, Training and Simulation Technology
  - 62716A, Human Factors in Military Systems

(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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62757N Title: Human Factors and Simulation Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

- Industrial - Technology Service Corp., Santa Monica, CA; American Airlines, Dallas, TX; Singer-Link Division, Binghamton, NY; Applicon, Inc., Rockville, MD; Science Applications, Inc., Orlando, FL; McDonnell Douglas, St. Louis, MO; Honeywell, Inc., Minneapolis, MN; Analytics, Willow Grove, PA; Perceptronics, Woodland Hills, CA; International Telephone & Telegraph, Nutley, NJ

- Academic - University of Illinois, Champaign, IL; University of South Carolina, Columbia, SC; Ohio State University Research Foundation, Columbus, OH

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Improved Weapon System Maintenance

1.1 Less than adequate performance by maintenance technicians has led to decreased operational readiness
1.2 Major cause of poor maintenance technician performance is weapon system design
1.3 Identified design features in the F-14 and the SH-2F platforms which influence maintenance effectiveness
1.4 Developed data base of design features which contribute to reduced maintenance manhours and improved maintenance performance

Design of Aircrew Training

1.5 Developed a computer-aided system for providing instructional data for the prelaunch and navigation mission phases
1.6 Concepts have been incorporated into two low cost cockpit procedures trainers for the SH-3H and A3 aircraft
1.7 Improves efficiency of conducting aircrew training systems analyses and design by 75 percent

Workload Reduction in Submarine Combat Control Systems

1.8 Demonstrated a technique to reduce workload through
a. Rapid convergence of passive target range estimates
b. Displaying confidence limits around individual and combined range estimates
c. Alerting command to critical range-related events

Target Acquisition Effectiveness

1.9 Accuracy in mission planning is dependent on realistic estimates of pilot performance

1. *Program Element: 62757N Title: Human Factors and Simulation Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

1.10 Pilot performance must be predicted as a function of mission and weapon system variables
1.11 Data was developed for predicting performance as a function of target type, target configuration and target surroundings
1.12 Identification of these parameters has made possible more efficient training procedures and more realistic estimates of mission success

2. (U) FY 1982 Program:

Human Factors Technology

2.1 Complete human factors evaluation relating control, sensor and display systems characteristics to operator-aircrew performance
2.2 Continue the identification and selection of voice compatible functions for possible application with voice interactive systems
2.3 Accelerate efforts to improve the performance of ship propulsion plant personnel in both watchstanding and maintenance by using human factors technology to reduce the level of skill required and by development of more efficient work procedures
2.4 Initiate development of human factors data which can increase the probability of radar detection of airborne targets
2.5 Complete development of vibration design criteria and auditory stress evaluation factors

Simulation Technology

2.6 Complete exploratory development by demonstrating the feasibility of the pilot helmet mounted display to provide a significant increase in scene detail in the area of interest to the pilot
2.7 Initiate development of motion cuing, aural and visual system requirements for helicopter simulation
2.8 Complete transformation of Defense Mapping Agency data base to format suitable for computer image generation
2.9 Continue with development of voice technology to enhance man-machine interaction in training
2.10 Complete development of small portable electronic maintenance troubleshooting aid
2.11 Continue development of enhanced target and ocean models for generating acoustic signals with the fidelity required for training with advanced, operational signal processing equipment
2.13 Initiate development and evaluation of artificial intelligence techniques for transferring subject matter expert information to a knowledge base which can be accessed by a training simulator
2.14 Continue the development of training requirements for a part task missile envelope recognition trainer

1. *Program Element: 62757N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Human Factors and Simulation Technology
Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Human Factors Technology

3.1 Determine the basic characteristics for limited connected speech recognition for voice interactive systems
3.2 Accelerate the specification of requirements for assessing digital radar target acquisition and complete comparison of analog and digital radar target acquisition
3.3 Evaluate experimental procedures and job designs on a pilot ship to determine their effectiveness in improving the performance of propulsion plant personnel
3.4 Initiate identification of maintenance tasks which are most difficult to perform and evaluate design concepts to improve maintenance performance in shipboard systems
3.5 Complete the development of psychophysiological fatigue and stress reduction techniques applicable to long endurance missions

Simulation Technology

3.6 Transition the pilot helmet mounted display feasibility model to Advanced Development
3.7 Continue evaluation of suitability of candidate systems with advanced wide angle visual and motion cuing capabilities for a helicopter trainer concept
3.8 Implement on a microprocessor system the target and ocean models for generating acoustic signals and determine their effectiveness in simulating an existing ASW trainer
3.9 Complete feasibility model of a multispectral image simulation system having display characteristics such that proper correlation factors between sensors can be detected and used to identify targets
3.10 Evaluate artificial intelligence concepts adapted into a training context and complete design of a laboratory system
3.11 Complete development of requirements for a part task missile envelope recognition trainer
3.12 Continue development of advanced noise technology which will permit the trainee to interact directly with the training device via automated speech technology and initiate development of feasibility model

Changes from FY 1982 to FY 1983

1. *Program Element: 62757N Title: Human Factors and Simulation Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3.13 The 1,568 thousand increase in the element total will permit the acceleration of the development of radar target acquisition techniques to increase the probability of detection of airborne targets; increased emphasis to permit completion of the development of multi-spectral image simulation techniques for the detection and identification of targets; the initiation of efforts to design and evaluate concepts to improve maintenance performance in order to increase ship operational readiness; and to expedite completion of the development of the requirements for a part-task missile envelope recognition trainee.

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

5. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62758N
DoD Mission Area: 522 - Environmental and Life Sciences
Title: Biomedical Technology
Budget Activity: 1 - Technology Base

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

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	10,061	10,619	8,996	9,589	Continuing	Continuing
F58-523	Personnel Protective and Survival Equipment and Clothing	1,695	1.445	1,244	1,388	Continuing	Continuing
F58-524	Medical Support Technology	5,112	0	0	0	Discontinued	Discontinued
F58-524*	Injury and Disease Prevention	0	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 and Enhancement	1,525	1,655	1,317	1,448	Continuing	Continuing

*Restructured Project

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Prevents or mitigates threats to health and degradation of performance to assure mission success
- Develops technology essential to protect Navy and Marine Corps personnel deployed in environments involving exposure to physical, chemical, biological, and psychological hazards
- Maintains high personnel performance levels, physical and mental health, and maximizes recovery from disease and injury
- Biomedical technologies applicable to these problems are not generally required or advanced by the civilian community

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Continue the development of:
  - New fibers and fabrics for protective garments for personnel exposed to chemical and physical hazards
  - Aircrew personnel life support, survival, rescue, and emergency egress systems
  - Sustained G-tolerance criteria
  - Criteria for protection against Navy relevant chemical and physical hazards
  - Technology to rapidly diagnose and treat disease and injury
  - Criteria to assess and insure maximum performance of personnel

Program Element: 62758N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Biomedical Technology
Budget Activity: 1 - Technology Base

- Since this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are an increase in FY 1981 of $273 due to reprogramming, a decrease in FY 1982 of $387 resulting from budget reductions; and a decrease in FY 1983 of $3700 resulting from, 1) a transfer of management responsibility for Navy infectious disease and combat dentistry programs to the Army ($1800), and 2) budget reductions

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9,967	9,788	11,006	12,696	Continuing	Continuing
F58-523*	Personnel Protective and Survival Equipment/Clothing	1,524	2,004	1,950	2,210	Continuing	Continuing
F58-524	Medical Support Technology	8,443	7,784	0	0	Discontinued	Discontinued
F58-524*	Injury and Disease Prevention	0	0	4,989	5,753	Continuing	Continuing
F58-527	Casualty Care	0	0	2,307	2,714	Continuing	Continuing
F58-528	Personnel Performance Assessment and Enhancement	0	0	1,760	2,019	Continuing	Continuing

*Restructured projects

(U) OTHER APPROPRIATIONS FUNDS: None.

Element: 62758N
Title: Biomedical Technology
Area: 522 - Environmental and Life Sciences
Budget Activity: 1 - Technology Base

BACKGROUND AND DESCRIPTION

orts are directed toward the protection and improvement of the physical and mental effectiveness of Navy and Marine
ps personnel in all operational environments
lores new technologies essential to:

Develop and refine personnel protective clothing and equipment
Prevent or maximize recovery from disease and injury
Maintain and enhance personnel performance
Define human response and tolerance to toxic chemicals, nonionizing radiation, thermal stress, accelerative forces, and high/low-pressure environments, noise and psychological stresses

ACTIVITIES

tematic exchange of reports, attendance at meetings, workshops, study panels, and symposia facilitate coordination and
peration with other military services, U.S. governmental and international agencies

RFORMED BY

-House - Naval Air Systems Command, Washington, DC; Naval Medical Research and Development Command, Bethesda, MD;
fice of Naval Research, Arlington, VA; Naval Supply Systems Command, Washington, DC; and Marine Corps Development and
ication Command, Quantico, VA

ACCOMPLISHMENTS AND FUTURE PROGRAMS

1981 and Prior Accomplishments

Personnel Protective and Survival Equipment and Clothing

neral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Progam Element PEDS e.g.,
; to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used
the word "Project" on the first page of each Project PEDS e.g., II.1.1. refers to the first item in paragraph 1 of the
t PEDS for this Program Element.

1. *Program Element: 62758N Title: Biomedical Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

1.1 Holographic techniques were adapted to the problem of rejecting multifrequency lasers
1.2 Developed a urine collection system for female aviators
1.3 Developed a two-piece intermediate/extreme cold weather jacket
1.4 Developed prototype protective clothing for females
1.5 Developed improved materials and construction techniques for safety footwear
1.6 Completed a new athropometric survey of aircrew personnel

Injury and Disease Prevention

1.7 Determined thresholds for eye and skin toxicity of shipboard fire suppressant chemicals
1.8 Demonstrated that microwave radiation reflected from the heart contains information on its functional status
1.9 Three human subjects reached a record pressure depth of 686 m (69 times normal sea level pressure)
1.10 Determined correlation of cerebral cortex activity to $+G_z$ sustained acceleration

Casualty Care

1.11 Completed development of prototype computer-assisted program for diagnosing acute abdominal pain aboard submarines
1.12 Demonstrated feasibility of using particulate bone grafts for reconstruction of maxillofacial injuries
1.13 Developed a method to access the efficacy of selected pharmaceuticals and surgical procedures to improve and accelerate nerve regeneration
1.14 Determined that hyperbaric oxygen therapy will significantly improve healing of infected wounds
1.15 Developed an in vivo assay to determine the rate at which liposomes (lipid preparations used to carry drugs and oxygen in the blood) are removed from the blood
1.16 Type A and Type B bloods have been successfully transformed into a universal donor (Type O) blood

Personnel Performance Assessment and Enhancement

1.17 Developed a technique for identifying the critical auditory components involved in sonar detection and classificatior
1.18 Completed a laboratory technique to separate synthetic prostaglandin (PGBx) fractions.
1.19 Anthropometric constraints associated with the TA-4 series aircraft have been upgraded

2. (U) FY 1982 Program

I. *Program Element: 62758N Title: Biomedical Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

Personnel Protective and Survival Equipment and Clothing

2.1 Develop techniques to seal holographic multi-wavelength laser protective system to aviators helmet visors
2.2 Begin development of devices to enhance communications by selectively blocking out high intensity noise
2.3 Conclude evaluation of a helicopter ballistic protective helmet.
2.4 Begin development of new technology for miniature, maintenance free, long duration emergency aircrew high pressure breathing systems
2.5 Complete assessment of problems associated with extended range search and rescue of downed aircrewmen
2.6 Complete evaluation of ejection seat seatback restraint and survival equipment stowage package
2.7 Begin development of minicomputer/radio technology for escape, evasion and rescue of downed aircrewmen
2.8 Begin development of a personal, disposable, chemical heat generating device for emergency anti-exposure protection
2.9 Continue development of water-proof, lightweight, cold weather clothing for USMC amphibious operations (Combat Immersion Suit)

Injury and Disease Prevention

2.10 Resume studies on effects of microwave radiation exposure on the central nervous and endocrine systems. Complete studies on brain metabolism
2.11 Begin development of improved criteria for insecticide control and personal protection against coastal Culicoides sand fly
2.12 Establish exposure limits for JP-5 and marine diesel fuels
2.13 Continue studies on human tolerance to deep sea diving
2.14 Man-rate motion generator (MOGEN) and interface it with data acquisition and control systems, and begin human experiments
2.15 Continue vaccine development against the malaria sporozoite
2.16 Continue acquisition and analysis of health data of submariners
2.17 Continue development of physiological standards for evaluation of techniques and devices to enhance tolerance to sustained longitudinal axis accelerations
2.18 Complete determination of female strength requirements for activation of parachutes
2.19 Begin determination of requirement for fire resistant flight clothing subassemblies

Casualty Care

2.20 Commence development of a radiated animal model for evaluating selected medical and surgical therapies

I. *Program Element: 62758N Title: Biomedical Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

2.21 Complete development of a procedure to suppress specific immunocompetent cells which cause graft versus host disease
2.22 Continue development of procedures to obtain therapeutic quantities of soluble bone growth factor
2.23 Begin submarine sea-trials of a computer-assisted diagnostic program for abdominal pain
2.24 Complete development of a automated disease and injury reporting system for use in Navy outpatient clinics
2.25 Commence development of electromagnetic radiation-based life signs detector and vital signs monitor
2.26 Complete development of a computer model to predict oxygen delivery to tissues by resuscitative solutions of varying compositions
2.27 Start development of a procedure to repair severed blood vessels rapidly and without the use of sutures
2.28 Continue development of means to resuscitate hypothermic, hemorrhagic shock casualties
2.29 Continue development of procedures to decrease cold-induced tissue damage
2.30 Continue development of fluid supplements for treating cold-induced dehydration
2.31 Continue development of a microwave radiation device to rewarm hypothermic patients
2.32 Continue efforts to purify enzymes involved in transforming Type A and Type B blood into a universal Type O donor blood, and begin human evaluation of blood transfusions
2.33 Continue efforts to develop synthetic, stroma free hemoglobin blood substitutes

Personnel Performance Assessment and Enhancement

2.34 Complete development of self-reporting measures for assessing airsickness, and validate using flight simulators and vestibular dysfunction tests
2.35 Continue development of tests for assessing sensory, cardiovascular, and performance competence of older aviators
2.36 Continue evaluation of identified vocal and linquistic factors that have potential for controlling certain aircraft functions
2.37 Continue development of techniques for assessing the efficacy of aircraft heads-up visual displays
2.38 Continue studies to establish the pharmacological active structure of PGBx (a synthetic prostaglandin)
2.39 Complete requirements analysis for development of new concepts for aircrew positioning and restraint
2.40 Continue studies on techniques to improve G-tolerance
2.41 Continue aircrew anthropometric correlation with T-2C, A-7 and AV-8 aircraft
2.42 Begin a theory analysis for mathematical modeling of thermal exchange characteristics of personnel clothed in protective clothing
2.43 Begin establishing requirements for development of specifications for a device to simulate human exposure to extreme temperatures

I. *Program Element: 62758N Title: Biomedical Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Personnel Protective and Survival Equipment and Clothing

3.1 Initiate test and evaluation of materials for use in United States Marine Corps protective clothing and equipment
3.2 Complete test and evaluation of high pressure/emergency breathing systems for aircrewmen
3.3 Complete test and evaluation of prototype miniature radio/computer for long range survival navigation by downed aircrewmen

Injury and Disease Prevention

3.4 Continue efforts to develop methods for controlling sand flies and initiate development of a non-toxic pest management scheme for control of cockroaches aboard ship
3.5 Complete threat analysis of non-fire resistant flight clothing subassembles
3.6 Complete development of exposure limits for OTTO Fuel II, nitrate ester propellants and hydraulic fluids of interest to the Navy
3.7 Complete development of methods to identify individuals who are susceptible to noise-induced hearing loss
3.8 Quantify the hazard of noise exposures exceeding eight hours duration
3.9 Complete development of a protocol for rapid heat acclimatization of Marines on LHA ships
3.10 Initiate evaluation of chronic exposure of primates to microwave radiation, and complete determination of effects of radio frequency radiation on the immune system
3.11 Complete determination of thresholds of microwave-induced alterations on performance
3.12 Complete quantitative evaluation of multiple inert gas mixtures in decompression
3.13 Begin development of personnel exposure guidelines for two and four-hour durations at the 0.1-0.6 Hz range of simulated ship heave motion, and begin development of guidelines for a six-hour exposure
3.14 Begin development of pharmacological intervention techniques to reduce adverse physiological and performance effects of short and medium-duration exposure to heave motion
3.15 Complete animal studies on enzymes which cause dental plaque dispersion
3.16 Begin development of procedures to prevent cardio-respiratory deconditioning during prolonged submarine patrols, and complete epidemiological survey of health hazards associated with submarine patrols

Casualty Care

3.17 Begin development of triage indices for personnel exposed to nuclear radiation

1. *Program Element: 62758N Title: Biomedical Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3.18 Begin development of computer-assisted diagnostic program for chest pain for submarine sea-trials
3.19 Complete the development of a device to join severed blood vessels without sutures
3.20 Complete development of fluid supplements to treat hypothermic casualties
3.21 Complete the development of an electromagnetic device to rewarm cardiac tissue of hypothermic casualties, and therapeutic procedures to decrease cold-induced tissue damage

Personnel Performance Assessment and Enhancement

3.22 Complete evaluation of techniques for improving longitudinal axis G-tolerance.
3.23 Complete development of aircrew cockpit assignability coding system
3.24 Complete validation of a mathematical model for modeling thermal exchange characteristics of protective clothing
3.25 Complete development of a human thermal exposure simulation device
3.26 Complete analyses of the structural components of the synthetic prostaglandin PG8x, and initiate studies for establishing dose-response curves and toxicity on small animals and primates
3.27 Complete efforts to define the limits of sustained physical performance, and initiate development of techniques and procedures for enhancing physical endurance
3.28 Initiate development of methods to assess night vision competency in aviation personnel and techniques to evaluate the effectiveness of aids to enhance night vision

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

5. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62759N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Ocean and Atmospheric Support Technology
Budget Activity: 1 - Technology Base

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

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	22,545	21,585	20,557	21,827	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Provides for exploratory and applied research in support of Navy environmental needs for weapons 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
- Includes converting geophysical parameters into militarily significant terms, displaying this data in suitable formats, and distributing these predictions in a timely manner

(U) BASIS FOR FY 1983 RDT&E REQUEST

- The introduction of electro-optical systems requires improvement in predictive capabilities within the marine boundary layer and development addressing this area will be pursued
- Radio interferometry will be further developed to provide increased accuracy in precise time determination
- Development effort will be continued which is necessary to expand the mixed-layer ocean dynamics model to include advection, investigate underwater acoustic backscatter and forward scatter mechanism, initiate full scale limited area ocean modeling, effect quantitative analyses of energy exchange at the air/sea interface, and develop topographic and acoustic models to support active surveillance

Program Element: 62759N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Ocean and Atmospheric Support Technology
Budget Activity: 1 - Technology Base

- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-423 in FY 1981, -2,369 in FY 1982 and -5,556 in FY 1983) are the result of reorganizations within the element--i.e., effort in F59-556 Deep Ocean Engineering was transferred to P.E. 62760N; effort in F59-559 was integrated with F59-552; and major at-sea experiments which were originally structured to support shipboard tactical sonar in F59-552 were cancelled.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	24,368	22,973	23,954	26,113	Continuing	Continuing
F59-551	Atmospheric Environmental Support	3,975	4,620	4,750	5,200	Continuing	Continuing
F59-552	Ocean Acoustics	10,243	5,010	6,000	6,650	Continuing	Continuing
F59-553	Environmental Remote Sensing	970	1,750	1,950	2,150	Continuing	Continuing
F59-554	Astronomy and Astrophysics	1,498	1,200	1,204	1,063	Continuing	Continuing
F59-555	Polar Environmental Support	3,107	2,350	2,600	2,850	Continuing	Continuing
F59-556	Deep Ocean Engineering	2,325	1,620	300	350	Continuing	Continuing
F59-557	Ocean Environmental Support	2,250	2,350	2,600	2,850	Continuing	Continuing
F59-558	Marine Biology	*	1,000	1,150	1,250	Continuing	Continuing
F59-559	Specialized ASW Acoustic Support	*	3,073	3,400	3,750	Continuing	Continuing

*These funds were assigned to other projects, principally Project F59-552, in FY 1980.

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62759N
Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports environmental technology developments directed toward the solution of environmental problems for electro-optic weapon systems, tactical sonar systems, fixed and deployable sonar surveillance systems, undersea weaponry, undersea communications, navigation and technology to increase accuracy in time determination
- Effort is directed to the disciplines of general ocean dynamics, marine biology, underwater acoustics, marine geology, hydrography, solar radiation, ionospheric physics, meteorology, electro-optics meteorology, and marine boundary layer physics
- Supports developments to expand mixed-layer ocean dynamics model, investigate underwater acoustic scatter mechanisms, initiate full scale limited area ocean modeling, quantitative analyses of energy exchange at air/sea interface, obtain typographic and acoustic models to support active surveillance

(U) RELATED ACTIVITIES

- Meteorological Research, Development, Test, and Evaluation is coordinated by the Under Secretary of Defense (Research and Engineering)
- The oceanographic program is related to all underwater acoustic programs for detection, classification, and localization of submarines including acoustic intelligence
- Coordination is accomplished through numerous interacting formal and informal working groups such as Underwater Acoustics Symposium, classified USN Journal of Underwater Acoustics, strategy teams, and the Office of Oceanographer of the Navy
- Coordination of polar research is facilitated through the Interagency Arctic Research Working Group under the National Science Foundation

(U) WORK PERFORMED BY

- In-House - 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

I. *Program Element: 62759N
Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences
Budget Activity: 1 - Technology Base

° 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 Institute of Oceanography, LaJolla, CA; Woods Hole Oceanographic Institution, Woods Hole, MA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Atmospheric Modeling and Prediction

1.1 Completed feasibility tests and transitioned to advanced development a method for analysis/prediction of atmospheric conditions out to three days on a global scale and a method for predicting tropical cyclone movement with 30% accuracy improvement over existing capability
1.2 Extended the Integrated Refractive Effects Prediction System to include electronic warfare scenarios
1.3 Completed an assessment of refractive effects on NATO SEASPARROW missile
1.4 Simplified models developed to sense sudden ionospheric disturbances and predict time to recovery, to predict high and very low frequency effects caused by polar cap absorption, and to use solar wind measurements for predicting magnetic and ionospheric disturbances

Applied Ocean Acoustics

1.5 Developed and validated predictive capability for propagation loss
1.6 Developed methodology to account for system and area specific differences in spatial and spectral charateristics of ambient ocean noise
1.7 Measured experimentally very low frequency wind wave and ship radiated ambient noise components
1.8

1.9 Developed processing that potentially may lead to a technique to predict topographic reverberation where no previous data is available

Environmental Remote Sensing

1.10 Demonstrated and transitioned to Advanced Development passive microwave techniques for remotely measuring ocean surface temperature and wind speed
1.11

I. *Program Element: 62759N Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

1.12 Developed man-machine techniques for extraction and display of operationally significant environmental data from satellite imagery
1.13 Completed and distributed the Navy Tactical Applications Guide for the analysis and interpretation of satellite imagery

Astronomy and Astrophysics

1.14 Determined stellar positions and radio sources with the 61-inch astrometric reflector; results appear to surpass in accuracy those determined by any other existing telescope
1.15 Developed electrographic camera which has achieved 25 to 50 times greater efficiency than that of conventional astrophotography

Arctic Environmental Acoustics

1.16
1.17

1.18

Ocean Modeling and Prediction

1.19 Developed a mixed layer ocean prediction model that is now undergoing testing at the Fleet Numerical Oceanographic Center, Monterey, CA

Marine Biology

1.20

(P.E. 63260N)

2. (U) FY 1982 Program

Atmospheric Modeling and Prediction

2.1 Conduct feasibility studies of a combined ocean/atmosphere coupling prediction system
2.2 Complete analysis of Navy weapon systems requiring atmospheric environmental support and develop interface mechanisms

I. *Program Element: 62759N Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

2.3 Develop high latitude ionospheric radio propagation prediction models and solar disturbance forecasting techniques
2.4 Develop and evaluate direct and remote sensors for aerosol extinction measurements

Applied Ocean Acoustics

2.5 Expand numerical modeling techniques to include more complicated descriptions of frontal systems and ocean bottom effects, especially in sloping bottom regions
2.5 Analyze results of field experiment using deep moored receiver and explosive sources to determine sediment attenuation, arrival structure of signals via various paths, and coherence of energy
2.6 Analyze ambient noise experimental data and develop noise fluctuation characteristics
2.7 Demonstrate an acoustic, storm noise, predictive capability
2.8 Derive the effect of ocean frontal systems on sonar performance

Environmental Remote Sensing

2.9 Test and evaluate microwave and laser radar techniques for remote probing of the atmosphere and the ocean
2.10 Measure ocean waves with microwave radar, atmospheric characteristics with special lidar techniques, and ocean temperature and salinity with a blue-green lidar sensor

Astronomy and Astrophysics

2.11 Perform a laser satellite ranging experiment and begin ranging by Lunar laser with the purpose of improving Lunar orbit theory work
2.12 Initiate studies of astronomical refraction and new ultraprecise optical star positioning methods

Arctic Environmental Acoustics

2.13
2.14
2.1
2.1

Ocean Modeling and Prediction

2.17 Develop simulation model

2.18 Develop a Global Deep Ocean Numerical Prediction Model

2.19 Develop a 3-dimensional regional prediction model

Marine Biology

2.20 Marine mammals currently in use will be examined to further utilize basic echolocation capabilities (active and passive) for detection and classification tasks

2.21 New species of pinipeds (seals and sea lions), cetaceans (dolphins, porpoises and small whales) and elasmobranches (sharks, rays and skates) will be evaluated for deep diving capability, echolocation, hearing, manipulative ability, response to automated training and maintenance procedures and higher order concept formation.

3. (U) FY 1983 and FY 1984 Planned Programs

3.1
3.2
3.3

Ocean Modeling and Prediction

3.4 Initiate and expand development of techniques for blending high density satellite data with sparse subsurface thermal data

3.5 Collect laser data to evaluate suitability of the technique to define multidirectional and multimodal wave spectra

3.6 Improve the Navy's capability to map and chart the marine environment (new start)

3.7

3.8 Develop a useable wave model for ship hull performance assessment

Marine Biology

3.9 Continue defining new techniques for the training and health maintenance of marine animals

I. *Program Element: 62759N
Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences
Budget Activity: 1 - Technology Base

Atmospheric Modeling and Prediction

3.10 Provide a capability to accurately measure, model, and predict the effect of marine atmosphere on transmission of electromagnetic/electro-optic sensor, communications and weapons systems
3.11 Develop and test higher resolution atmospheric models and expand prediction up to twelve days

Applied Ocean Acoustics

3.12 Apply specific knowledge of the parameters of the ocean environment to improvements in acoustic sensor systems
3.13 Transition environmental acoustic technology on a continuous basis to combat system designers, operators, and tacticians
3.14 Develop a tested performance estimation capability, along with guidelines for design and development, for tactical ASW/USW systems in shallow water
3.15 Establish a systematic characterization of acoustic back- and forward-scattering to support the needs of weapons guidance and mine countermeasures systems
3.16 Quantify the threat to high-frequency acoustic systems posed by biological false targets
3.17 Develop and test models for low-frequency reverberation which will characterize the major features of the reverberation process and provide a quantitative prediction capability for exploratory design and development of acting system prototypes

Environmental Remote Sensing

3.18 Exploit existing airborne, shipborne, and satellite sensors and data processing/display techniques to obtain environmental data for fleet support
3.19

Astronomy and Astrophysics

3.20 Improve time transfer around the globe from the present 100 nanosecond level to the 1-5 nanosecond level in five to seven years
3.21 Provide the Navy and DOD real-time source of Earth rotation prediction, independent of foreign input
3.22 Improve star position measurement techniques to support new navigational systems

ram Element: 62759N
on Area: 522 - Environmental and Life Sciences

Title: Ocean and Atmospheric Support Technology
Budget Activity: 1 - Technology Base

Arctic Environmental Acoustics

3.23 Support readiness of submarine forces to operate in all ice-covered seas
3.24
3.25

Marine Biology

3.26 Determine the capabilities of new marine animal species to satisfy select Navy objectives
3.27 Determine bisonar detection, behavioral control, and hydrodynamic properties of marine animals
3.28 Continue biomedical capability development via preventive medicine, nutritional evaluation and selective breeding

Program to Completion: This is a continuing program.

Milestones: Not applicable.

II. Project: F59-552 Title: Applied Ocean Acoustics
Program Element: 62759N Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Improves our understanding of basic acoustic processes and their impact on undersea warfare system performance.
- Includes investigations of the generation and propagation of acoustic energy in the ocean and its interaction with the ocean boundaries - the ocean floor and surface
- Develops a predictive capability derived from field experimentation and numerical modeling of propagation loss, bottom interaction, ambient noise, volume reverberation, surface scattering, coherence/fluctuation, and false targets
- It does not include transducer development or signal processing technology which are part of the Undersea Target Surveillance Program (Program Element 62711N), but supports these areas for systems designs, force level analysis, and performing predictions

(U) RELATED ACTIVITIES

- Related to Navy undersea warfare programs for detection, classification, and localization of submarines and acoustic intelligence
- Provides technology support to Advanced Development programs in underwater acoustics
- Coordination is accomplished through numerous interacting formal and informal working groups such as the strategy team, Underwater Acoustics Symposium, and the classified Navy Journal of Underwater Acoustics

(U) WORK PERFORMED BY

- In-House - 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, Newport, RI
- 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 Institute of Oceanography, San Diego, CA; Woods Hole Oceanographic Institute, Woods Hole, MA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Completed analysis of data collected with the Advanced Detection Array to ascertain the environmental limitations on array design and ambient noise statistics

II. Project: F59-552 Title: Applied Ocean Acoustics
Program Element: 62759N Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

1.2 Fabricated a system to investigate low frequency ocean residual noise, after ship noise is removed
1.3 Completed and documented methods to quantitatively validate the accuracy of underwater acoustic models
1.4 Synthesized a variety of techniques used in propagation predictions into a modular program to capitalize on the advantages of each for various environmental conditions.
1.5 Employed a range dependent computer model based on the parabolic equation approximation to the wave equation to analyze underwater sound propagation in highly complicated environments
1.6 Conducted at-sea experiment designed to evaluate effects of large mesoscale systems on both tactical and surveillance ASW arrays
1.7 Developed methodology to account for system and area-specific differences in spatial and spectral characteristics of ambient noise
1.8 Experimentally measured very low frequency wind-wave and ship-radiated ambient noise components and related them to theoretical predictions
1.9 Developed technique to predict topographic reverberation from the ocean bottom

2. (U) FY 1982 Program

2.1 Restructuring of this project adds shallow water acoustics, bottom interaction, and high frequency acoustic studies
2.2 Focuses on undersea surveillance support, shipboard sonar support, and the understanding of limits of sonar performance
2.3 Upgrade acoustic model evaluation techniques
2.4 Examine the effects of acoustic fluctuations and signal coherence on mobile sonar system performance
2.5 Analyze experimental data on mesoscale ocean phenomena, long bottom surveillance array performance, and array shape compensation methods
2.6 Conduct experiments to investigate effect of towed array dynamics, boundary induced angular redistribution of energy, and multipath recombination techniques; all in support of future towed array sonar systems
2.7 Develop ambient noise data acquisition and processing procedures for existing surveillance systems
2.8 Gather data on long range storm noise and ocean mixed-layer phenomena
2.9 Investigate limitations of and implement cross sensor beamforming techniques in processing acoustic array data
2.10 Expand and improve predictive techniques for active sonar performance to assess system potential and limitations

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Perform measurements and experiments to define the limits on sensors/systems imposed by the physics of the ocean environment which will identify and describe the physical parameters that dictate optimum configuration and deployment of ocean sensor/systems

II. Project: F59-552 Title: Applied Ocean Acoustics
Program Element: 62759N Title: Ocean and Atmospheric Support Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3.2 Expand numerical modeling techniques to include more complicated descriptions of ocean frontal systems and ocean bottom effects, especially in sloping bottom regions
3.3 Analyze results of field experiment using deep moored receivers and explosive sources to determine sediment attenuation, arrival structure of signals via various paths, and coherence of energy
3.4 Analyze ambient noise experimental data and develop noise fluctuation characteristics
3.5 Demonstrate an acoustic, storm noise predictive capability
3.6 Derive the effect of ocean frontal systems on sonar performance
3.7 Complete a large scale lateral variability sediment thickness atlas for deep ocean sediments
3.8 Begin geoacoustic modeling effort for shallow water bottom
3.9 Complete coherent wave propagation model and continue geoacoustic modeling effort for specific situations
3.10 Expand study of bottom effects on specific system to include increasingly complex bottom structures
3.11 Identify system support deficiencies, particularly in the area of tactical sonar and torpedo weapon signal scattering
3.12 Conduct integrated acoustic/environmental field measurement program to collect scattering, propagation, and false target data to support associated modelling programs

Comparison with FY 1982 Program:

3.13 The funding decrease between FY 1982 and FY 1983 (-2,213 thousand) is primarily due to a transfer of funds to Project F59-554 to support a new effort in high frequency acoustics as well as overall budget reductions

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F59-552	Applied Ocean Acoustics	8,300	9,470	7,257	7,765	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62760N
DoD Mission Area: 523 - Engineering Technology

Title: Logistics Technology
Budget Activity: 1 - Technology Base

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

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	*	*	*		
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)

(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 novel-associated power sources to expedite ocean construction and underwater repair capabilities

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Complete evaluation of modular concepts for the repair and maintenance needs of Naval ships
- Initiate development of methodology to provide flow control, security, and routing for a stock point logistics integrated communications network
- Continue emphasis on the development of novel strategies to reduce the length of the acquisition cycle

Program Element: 62760N
DoD Mission Area: 523 - Engineering Technology

Title: Logistics Technology
Budget Activity: 1 - Technology Base

- Continue the evaluation of alternative expedient repair methods for accomplishing war damage repair to allow rapid return of damaged critical facilities to operational use
- Continue development of application of robotic technology to assist in aircraft maintenance tasks
- The increase in FY 1983 funding over FY 1982 funding (+$837 thousand) will permit acceleration of efforts to develop innovative techniques to effectively utilize commercial shipping assets for fleet support and to accelerate development efforts to significantly improve the Navy's over-the-beach cargo handling capability
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

(U) COMPARISON WITH FY 1981 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: +$104 in FY 1981; -$1,484 in FY 1982; and -$3,419 in FY 1983. These changes result from a decision not to initiate several efforts in FY 1982 which, in turn, reduced the FY 1983 fiscal requirements for the element
- Effort from Project F60-511 has been transitioned to a new Project, F60-533
- Additional changes from the element funding profile shown in the FY 1982 Descriptive Summary result from refined estimates of cost including escalation and other minor adjustments characteristic of research and exploratory development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	12,327	11,704	14,824	17,596	Continuing	Continuing
F60-511	Acquisition and Financial Management Technology	2,006	1,110	1,209	1,300	Continuing	Continuing
F60-531	Fleet Logistics Readiness Technology	4,836	5,034	6,592	8,171	Continuing	Continuing
F60-532	Development Engineering	766	806	**	**		
F60-534	Shore/Offshore Facilities Support Technology	1,769	1,717	2,811*	3,350*	Continuing	Continuing
F60-536	Amphibious/Advanced Base Technology	2,950	3,037	4,212*	4,775*	Continuing	Continuing

* Funding includes effort transferred from Program Element 62759N (Ocean and Atmospheric Support Technology)
** Effort incorporated into Project F60-531 (Fleet Logistics Readiness Technology)

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

° Supports improvements in logistic support of shore installations, over-the-shore landing systems, advanced base logistic facilities, packaging, preservation, and equipment employed in the depot-supply, ship-to-user logistic sequence, including underway replenishment. More specifically, work is directed at providing:

- Techniques, procedures, and methodology for improving the system acquisition process and modernizing the financial management system
- Improved techniques for the implementation of integrated logistic support and for the distribution of logistic supplies ashore and aboard ship under both normal and advanced base conditions
- An improved logistic contingency planning capability for rapid mobilization and deployment of operational forces
- Development of cable technology covering stress, displacement, and deformation characteristics and the development of techniques for improved capabilities in underwater repair and ocean construction

(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

(U) WORK PERFORMED BY

° In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; Naval Civil Engineering Laboratory, Port Hueneme, 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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Industrial - ADTEC, Oxnard, CA; Applicon, Burlington, MA; Arthur Young & Co., Washington, DC; Bendix Corporation, Hollywood, CA; CADCOM, Annapolis, MD; Digital Equipment Corporation, Marlboro, MA; Ed Kaitz & Associates, Arlington, VA; FUGRO, Inc., Houston, TX; Martin & Saunders, Costa Mesa, CA; Mathtech, Princeton, NJ; Midwest Research Institute, Kansas City, KS; Network Systems Corporation, Brooklyn Park, MN; Southwest Research, San Antonio, TX; and The Analytic Systems Corporation, Arlington, VA
- Academic - University of Arizona, Tempe, AZ; University of California at Berkeley, Los Angeles and Santa Barbara, CA; University of Cincinnati, Cincinnati, OH; Clemson University, Clemson, SC; University of Delaware, Newark, DE; Georgia Tech University, Atlanta, GA; MIT, Cambridge, MA; University of Michigan, Ann Arbor, MI; University of Minnesota, Minneapolis, MN; Naval Postgraduate School, Monterey, CA; and San Diego State University, San Diego, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Marine Corps Petroleum Pump Capacity

1.1 Marine Corps shoreside petroleum systems are required to accommodate increased flow capacity of new offshore Navy transfer capabilities
1.2 Developed a technique to increase the current 600 gallons per minute pump set to 800 gallons per minute
1.3 Demonstrated capability of 800 gallons per minute to efficiently handle the required Marine Amphibious Force fuel transfer rate inland from the beach

Spray-on Combat Vehicle Insulation

1.4 Developed a spray-on foam thermal insulation for combat vehicles (tanks)
1.5 Evaluation indicated significantly reduced internal temperatures by 13°F and improved crew operating efficiency
1.6 Technical manual covering spray-on procedures was prepared

Undersea Cable Structures

1.7 Lacked data to predict whether cable tensions would exceed breaking strength of the arrays
1.8 Developed a computer model which predicts the loads and motions in cable structures used to support underwater sensors
1.9 Model also predicts loads on large diameter cables used in salvage operations
1.10 Model data will permit more effective design of cable structures

I. *Program Element: 62760N
DoD Mission Area: 523 - Engineering Technology

Title: Logistics Technology
Budget Activity: 1 - Technology Base

Oil-in-Water Monitor

1.11 Navy identified oily wastes as the number one Navy generated pollutant
1.12 Developed a monitor instrument for measuring oil-in-water at a near real time basis
1.13 Monitor accurately identifies oil content in effluent waters from tank stripping operations, oil/water separators and oily ground and surface water run-off

2. (U) FY 1982 Program

Shipboard Logistics Technology

2.1 Continue evaluation of new equipment and techniques to improve the fuel transfer rate and reduce manning requirements for Naval oilers
2.2 Complete design of improved experimental fueling-at-sea system
2.3 Initiate verification of applicability of modular concepts to the repair and maintenance of Naval ships

Fleet Support Technology

2.4 Complete development of mini-computer specifications and automatic marking and reading equipment to improve accuracy and efficiency of inventory and location audits
2.5 Complete concept formulation of a multi-directional materials handling device suitable for operation in confined spaces
2.6 Initiate development of techniques for modifying an inexpensive, commercially available pressboard pallet to meet Navy requirements

Aviation Logistics Technology

2.7 Complete the evaluation of the retardation and flotation system concept for the recovery of high value cargo inadvertently dropped during vertical replenishment operations
2.8 Continue development of an automated methodology for formulating a maintenance concept during the early stages of aircraft procurement

Systems Acquisition Technology

2.9 Increase emphasis on the development of methodology to reduce the length of the acquisition cycle

I. *Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.10 Complete design and feasibility demonstration of an acquisition management decision support system which will provide the critical data needed for decision making
2.11 Initiate development of methodology for improving the source selection process

Financial Management Technology

2.12 Continue development of procedures for determining and verifying the accuracy of fiscal data in computer files
2.13 Initiate development of alternative concepts for an advanced automated budget system

Shore and Offshore Facilities Support Technology

2.14 Continue evaluation of advanced technology to improve the voltage regulation of power supplied to ships while in port
2.15 Establish criteria for eliminating vents in earth-covered magazines for arms, ammunition, and explosives
2.16 Complete development of design guidelines for an experimental 1.8 and 100 kilowatt ground fault interruption and sensing system
2.17 Evaluate alternative buoyancy control systems for underwater lift bags

Amphibious/Advanced Base Technology

2.18 Increase emphasis on development of techniques for providing logistic support in desert areas
2.19 Continue the development of techniques for improving the resistance to seawater environments and to reduce thermal and ultraviolet degradation of materials and components required for the transfer of petroleum products in support of Marine Corps amphibious operations
2.20 Complete field evaluation of a reverse osmosis pretreatment unit for providing potable water at advanced bases
2.21 Initiate development of penetration, anchoring, and mooring procedures for an advanced cargo transfer facility
2.22 Complete evaluation of a sectionalized arch-framed hangar suitable for housing P-3 aircraft and develop anchoring techniques for this expeditionary hangar
2.23 Complete development of an anchor holding capacity prediction methodology
2.24 Commence development of preliminary feasibility concepts for an advanced cargo transfer facility

1. *Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Shipboard Logistics Technology

3.1 Complete evaluation of modular concepts for the repair and maintenance needs of Naval ships
3.2 Validate feasibility of an experimental tanker/dry cargo augmentation concept
3.3 Initiate development of merchant ship systems for augmentation of crew accommodations

Fleet Support Technology

3.4 Continue development of alternative methodologies to simulate real world supply operations that can be used for logistical contingency planning
3.5 Initiate development of a model to evaluate material handling equipment allowances by type activity based on change in mission and increased workload
3.6 Initiate development of a methodology to provide flow control, security and routing for stock point logistics integrated communications network
3.7 Continue development of new, automated methodologies for designing and maintaining the very large data base information systems for inventory control points

Aviation Logistics Technology

3.8 Continue the development of an automated methodology for formulating a maintenance concept during the early stages of aircraft procurement
3.9 Continue development of applications of robotic technology to assist with aircraft maintenance tasks

System Acquisition Technology

3.10 Continue emphasis on development of novel strategies to reduce the length of the acquisition cycle
3.11 Continue development of criteria for determining optimal production rate data required for use in multi-year procurement contracts

Financial Management Technology

3.12 Complete efforts in property accounting and depreciation in the development of accrual accounting concepts for future Navy accounting systems

I. *Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3.13 Continue the development of methods for evaluating the effectiveness and efficiency of internal control and auditing concepts for advanced distributed computer systems

Shore and Offshore Facilities Support Technology

3.14 Develop and evaluate new shore to ship electrical transfer concepts which can be quickly connected and disconnected and are easy to maintain
3.15 Initiate development of design criteria for an experimental underwater buried cable detection and tracking sensor
3.16 Demonstrate technical feasibility of eliminating steam traps on piers to improve the quality of shore steam to meet the requirements for use in blanketing ships boilers
3.17 Continue development of an airfield pavement management system for evaluating the condition of airfield pavements and assessing the relative benefits of maintenance and repair alternatives

Amphibious/Advanced Base Technology

3.18 Initiate development of design criteria for use of high efficiency anchors in tandem
3.19 Continue the evaluation of alternative expedient repair methods for accomplishing war damage repair to allow rapid return of damaged critical facilities to operational use
3.20 Complete feasibility testing and evaluation of lightweight modular ramp designs for off-loading roll-on/roll-off ships in up to sea state three conditions as part of an advanced cargo transfer capability
3.21 Complete the development of techniques for improving the resistance to environmental factors of materials and components for the transfer of petroleum products in support of Marine Corps Amphibious operations and transition to Advanced Development
3.22 Continue the determination of desert water supply hardware requirements for supply storage and distribution
3.23 Initiate preliminary design and demonstration of critical component development for an advanced cargo transfer facility

Changes from FY 1982 to FY 1983

3.24 The increase in funding over FY 1982 ($837 thousand) will permit increasing emphasis on the development of techniques to effectively utilize commercial shipping assets for fleet support, to continue efforts to develop a Navy logistics plan for rapid mobilization/deployment operations, and to initiate preliminary design and demonstration of critical component development for an advanced cargo transfer facility

I. *Program Element: 62760N
Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable

II. Project: F60-531 Title: Fleet Logistics Readiness Technology
Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Provides support for the development and application of technology for provisioning, controlling, positioning, management, and movement of material
- Develops criteria to establish the feasibility of using merchant ships in naval support roles and the development of design techniques to provide Navy oilers and merchant tankers with a limited dry cargo storage and transfer capability
- Supports the development of methodology to improve the Navy's logistics contingency planning capability for rapid mobilization and deployment of operational forces
- Supports the development of techniques to identify logistics life cycle costs and to provide solutions to unique logistics problems pertinent to naval aviation

(U) RELATED ACTIVITIES

- Many elements of logistics are common to other Services; therefore, close coordination among the Services in seeking solutions to common problems is general policy and is in consonance with the intent of the Department of Defense to improve logistics within the Department of Defense
- The Department of Defense Logistics System Plan provides a continuing framework for development of logistics systems of the Services and requires component participation in its implementation

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda and Annapolis, MD; 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 - Applicon, Burlington, MA; Bendix Corporation, Hollywood, CA; Digital Equipment Corporation, Marlboro, MA; Midwest Research Institute, Kansas City, KS; Network Systems Corporation, Brooklyn Park, MN; PRESEARCH, Arlington, VA; and, Stanley Associates, Washington, DC
- Academic - University of Michigan, Ann Arbor, MI; University of Minnesota, Minneapolis, MN; Stanford Research Institute, Menlo Park, CA; and, Naval Postgraduate School, Monterey, CA

Project: F60-531
Program Element: 62760N
Mission Area: 523 - Engineering Technology

Title: Fleet Logistics Readiness Technology
Title: Logistics Technology
Budget Activity: 1 - Technology Base

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

(U) FY 1981 and Prior Accomplishments

Oil-in-Water Monitor

1.1 Navy identified oily wastes as the number one Navy generated pollutant
1.2 No instrumentation available to monitor whether effluents met Navy limit of maximum 10 parts per million oil in water
1.3 Developed an instrument that measures oil in water on a near real time basis
1.4 Accurately identifies oil content in effluent waters from tank stripping operations, oil water separators, and oily ground and surface water run-off

Transportation Operational Personal Property Standard System

1.5 Program includes all facets of operation of a Navy personal property transportation office
1.6 Developed automated methods for carrier tonnage distribution and shipment consolidation to be performed more accurately and economically than current labor intensive procedures
1.7 Field tested at Naval Supply Center, Charleston, SC and Naval Air Station, Pensacola, FL
1.8 Transition to operational status early in FY 1982

Navy Print-on-Demand System

1.9 Developed procedures for electronic printing of DoD specifications and standards from a digital data base
1.10 Minimizes the need for warehouse space normally required for retaining an operational supply of these documents
1.11 Being evaluated in Advanced Development
1.12 Concept can be broadened to include electronic printing on demand of training manuals and technical maintenance documents

II. Project: F60-531 Title: Fleet Logistics Readiness Technology
Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2. (U) FY 1982 Program

Shipboard Logistics Technology

2.1 Continue evaluation of new equipment and techniques to improve the fuel transfer rate and reduce manning requirements for Naval oilers
2.2 Complete design of improved experimental fueling-at-sea systems
2.3 Initiate verification of applicability of modular concepts to the repair and maintenance needs of Naval ships
2.4 Complete evaluation of performance requirements for handling heavy lifts and outsized cargo in an Amphibious Objective Area

Fleet Support Technology

2.5 Continue the development of a simulator to accommodate exercise transactions using peacetime transactions to formulate a logistical contingency response methodology
2.6 Complete concept formulation of a multi-directional materials handling device suitable for operation in confined spaces
2.7 Complete development of mini-computer specifications and automatic marking and reading equipment to improve accuracy and efficiency of inventory and location audits
2.8 Initiate development of techniques for modifying an inexpensive, commercially available pressboard pallet to meet Navy requirements
2.9 Initiate development of new level of repair requirements and Naval Electronic System procedures and incorporate them into a new level of repair computer model

Aviation Logistic Support

2.10 Complete the evaluation of the retardation and flotation system concept for the recovery of high value cargo inadvertently dropped during vertical replenishment operations
2.11 Continue the development of an automated methodology for formulating a maintenance concept during the early stages of aircraft procurement
2.12 Initiate development of a liquid spring accummulator utilizing aircraft system hydraulic fluid compressibility characteristics as an energy storage device to increase hydraulic system reliability

II. Project: F60-531 Title: Fleet Logistics Readiness Technology
Program Element: 6276UN Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Shipboard Logistic Technology

3.1 Complete investigation of modular concepts for the repair and maintenance needs of Naval ships
3.2 Accelerate the determination of the feasibility of an experimental tanker/dry cargo augmentation concept
3.3 Initiate development of merchant ship systems for improved crew accommmodations

Fleet Support Technology

3.4 Continue the development of alternate methodologies to simulate real world supply operations for a Navy logistics contingency response plan
3.5 Initiate development of a model to evaluate material handling equipment allowances by type activity based on change in mission and increased workload
3.6 Initiate experimentation with mass information storage devices which can be utilized in an advanced technical document storage and retrieval system
3.7 Initiate development of a methodology to provide flow control, security, and routing for a stock point logistic integrated communications network
3.8 Continue the development of new automated techniques for designing and maintaining the very large data base information system for inventory control points

Aviation Logistics Technology

3.9 Continue the development of an automated methodology for formulating a maintenance concept during the early stages of aircraft procurement
3.10 Continue development of applications for robotic technology to assist in aircraft maintenance tasks
3.11 Continue the determination of the feasibility of consolidating depot level support of ground support equipment in one or more dedicated ground support equipment facilities

Comparison with FY 1982 Program:

3.12 The increase in funding over FY 1982 ($393 thousand) will permit increasing emphasis on the development of techniques to effectively utilize commercial shipping assets for fleet support and to continue our efforts to develop a Navy logistics plan for rapid mobilization/deployment operations

II. Project: F60-531 Title: Fleet Logistics Readiness Technology
Program Element: 62760N Title: Logistics Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F60-531	Fleet Logistics Readiness Technology	5,026	6,354*	6,747*	7,898*	Continuing	Continuing

* Includes efforts incorporated from F60-532 (Development Engineering)

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: Materials Technology
Budget Activity: 1 - Technology Base

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

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	366	381	Continuing	Continuing

(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, and protective coatings
- External factors such as safety and environmental regulations and limitations on the availability of critical raw materials influence program direction

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Continue the development of metal matrix composites for a variety of potential naval applications and continue the development of all-weather, erosion hardened nosetip for missile reentry vehicles
- Continue development of new alloys to increase the operational capabilities of submarines
- Support improved and cost effective fabrication techniques for metal alloys and composite materials
- Continue FY 1982 initiated program in development of substitutes for critical materials used in naval systems
- Continue program thrust in rapid solidification materials technology and improve performance of strategic missiles
- Develop lightweight composites, high temperature materials, and fabrication techniques for new generation aircraft
- Develop materials and design guidance to counter directed energy threat against weapons systems and satellites

Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: Materials Technology
Budget Activity: 1 - Technology Base

- Continue development and evaluation of coatings and surface treatment techniques for maintenance reduction of ships and submarines
- The increase of $210K in Project F61-542 for FY 1983 over FY 1982 will be used to emphasize development of high temperature plastics and ceramics for air delivered tactical missile radomes weapon support applications
- 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 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The major changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows:
  - The change in FY 1981 (-$707) results from refinement of program costs and reduction in fracture control technology
  - The change in FY 1982 (+$193) reflects a combination of a congressionally approved $1,000 increase in the critical materials substitution effort and program refinements
- The change in FY 1983 (-$5,335) reflects refinement of program directions, reductions in nondestructive testing technology, fracture control technology, ship and aircraft composite materials, laser welding of ship hulls, and weapon support materials

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	20,457	30,484	32,928	38,354	Continuing	Continuing
F61-541	Seaborne Materials	6,082	9,647	10,000	11,850	Continuing	Continuing
F61-542	Airborne Materials	4,226	5,400	5,928	7,000	Continuing	Continuing
F61-543	Missile Materials	5,250	8,420	9,000	9,000	Continuing	Continuing
F61-544	System Support Materials	4,899	7,017	8,000	10,504	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

I. *Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: Materials Technology
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports a continuing effort in the materials technology base to advance naval air, sea, and land based weapons, platforms, and facilities
- Includes new materials which can offer increased capabilities and technological options for future systems
- Reliability, performance improvement, life cycle cost reduction, and increased survivability are stressed
- The impact of the Occupational Safety and Health Act and Environmental Protection Agency regulations has been factored into this program's thrust, as have been potential material shortages or embargos affecting the availability of raw materials and processing facilities
- Develops metal matrix composites for varied naval weapons systems platform applications
- Develops carbon-carbon technology, including an all-weather nosetip and propulsion components for strategic missiles
- Fabricates fiber reinforced organic composites as structural components of the next generation aircraft and ships
- Tests directionally solidified eutectic alloys and ceramic composites for aircraft engine components
- Develops and tests nonmagnetic alloys for submarine hulls and piping systems
- Develops materials to protect naval systems from the effects of high energy lasers and marine corrosion
- Develops and applies rapid solidification materials technology to Navy systems

(U) RELATED ACTIVITIES

- The Navy interacts through planning sessions, working and review groups, joint symposia, and related activities with the Army, Air Force, Defense Advanced Research Projects Agency, Defense Intelligence Agency, Central Intelligence Agency, 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, and the Metal Matrix Composite Program

(U) WORK PERFORMED BY

- In-House - 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 Ocean Systems Center, San Diego, CA;

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62761N
Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Dahlgren, VA and Silver Spring, MD; Naval Weapons Center, China Lake, CA

- Industrial - Among 73 contractors are: Aerospace Corporation, Los Angeles, CA; Allegheny Ludlum, Pittsburgh, PA; Babcock and Wilcox, Barberton, OH; Boeing Corporation, Seattle, WA; Carnegie Mellon Institute, Pittsburgh, PA; Fiber Materials, Inc., Biddeford, ME; Georgia Technical Research Institute, Atlanta, GA; Grumman Aerospace Corporation, Bethpage, NY; Lockheed California Company, Burbank, CA; Lockheed Missiles and Space Company, Sunnyvale, CA; Scripps Institute of Oceanography, La Jolla, CA; Titanium Metal Corporation, Henderson, NV
- 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

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Seaborne Materials

1.1 Established technical feasibility of deep penetration gas tungsten arc welding of 1-inch thick titanium
1.2 Completed development/evaluation of corrosion-free, low cost glass reinforced plastic piping
1.3 Completed development of on-line, citric acid cleaning procedure for ship fresh water distillers
1.4 Completed fabrication of large Alforge-processed 5456 alloy aluminum panels
1.5 Mechanical properties of Inconel 625 sea water piping determined and initiated technology transition to advanced development
1.6 Completed initial phase of automated geodesic composite construction for ship machinery shapes

Airborne Materials

1.7 Ambient storage, rapid cure resin system has been synthesized for timely repair of aircraft composite structures
1.8 Rapid solidified superalloys have been produced which demonstrate oxidation resistance and good high temperature mechanical properties
1.9 Hot pressed silicon nitride (HPSN) bearing materials have been developed for aircraft gas turbine engines with improved performance and reliability

I. *Program Element: 62761N
Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology
Budget Activity: 1 - Technology Base

Missile Materials

1.10 Carbon-carbon composite ball-and-socket thrust vector control concept which offers a potential 30 percent cost reduction was tested
1.11 A 50 percent improvement over baseline erosion performance with an improved erosion-resistant nosetip was demonstrated on a flight test
1.12 Fabricated graphite-aluminum tactical missile aerodynamic fin components
1.13 Full scale pressure bulkheads for Advanced Lightweight Torpedo (ALWT) and MK-48 torpedo structural configurations fabricated and undergoing evaluation

System Support Materials

1.14 Vulnerabilty of generic aircraft and missile structure to slewed laser irradiation examined
1.15 Initiated joint Navy-Air Force-DARPA program in non-destructive testing
1.16 Fusion welding of silicon-carbide/aluminum composite demonstrated
1.17 New experimental procedures for fatigue crack growth testing in marine environment developed

2. (U) FY 1982 Program

Seaborne Materials

2.1 Complete filament wound composite ship hull feasibility study
2.2 Conduct field trials of sealed, prelubricated anti-friction bearings for Marine Corps applications
2.3 Establish feasibility of Alforge aluminum joining process for transition to Manufacturing Technology

Airborne Materials

2.4 Determine significance of 2-D and 3-D composite defects in graphite fiber reinforced composites
2.5 Complete development of material degradation prediction methodologies for tactical missile plastic radome

Missile Materials

2.6 Test three full contour graphite/carbon-carbon tactical missile rocket nozzles
2.7 Carbon-carbon heat shield fabrication procedure selected and demonstrated
2.8 Graphite-aluminum metal matrix composite tactical missile fins to be flight tested

2.9 Complete definition of material requirements for tactical missile sensor windows

System Support Materials

2.10 Continue development of laser hardened coating systems for airframe composite materials
2.11 Continue field tests on surface profile and cleanliness parameters for latex paints and environmentally safe pigments
2.12 Fabricate and evaluate metal matrix composite Naval Extra High Frequency Satellite Communication Program (NESP) antenna

Small Business Materials

2.13 Select at least seven (7) small business contractors for participation in the DOD Small Business R&D participation program.

3. (U) FY 1983 and FY 1984 Planned Programs

Seaborne Materials

3.1 Complete development of low cost fabrication technology for thick-section titanium
3.2 Complete transition of superconducting multifilament wire technology to Manufacturing Technology

Airborne Materials

3.3 Characterize graphite fiber reinforced composites for simple repair of composites
3.4 Complete characterization of the advanced directionally solidified alloy, single crystal turbine blades
3.5 Transition corona-5 titanium alloy to Manufacturing Technology

Missile Materials

3.6 Select and test two erosion hardened nose tip concepts for reentry vehicle accuracy improvement
3.7 Conduct two in-the-water test runs of metal matrix composite torpedo hull sections
3.8 Design and fabricate carbon-carbon composites for "hot running" tactical missile components

1. *Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: Materials Technology
Budget Activity: 1 - Technology Base

System Support Materials

3.9 Efforts in directed energy hardened materials will address vulnerability of metallic aircraft and missile structures

3.10 Full scale High Energy Laser (HEL) mirror design analysis completed and metal matrix composite component fabrication initiated

Changes from FY 1982 to FY 1983

3.11 No significant changes in major thrusts

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

5. (U) Milestones: Not applicable

II. Project: F61-541 Title: Seaborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 520 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- 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 emhpasis is on the development of a submarine hull material, environmental resistant coatings, improved welding and quality control methods, low cost manufacturing techniques, metal and composite joining technology, and materials characterization methodology

(U) RELATED ACTIVITIES

- Monitors the efforts of universities and the independent research of major companies in materials and related areas
- The National Academy of Sciences and the National Materials Advisory Board are active in their participation in this program
- Conducts joint programs with the Defense Advanced Research Projects Agency
- Tracks ongoing projects with Defense Advanced Research Projects Agency, Air Force, Army, NASA, Maritime Administration, Electric Power Research Institute, Coast Guard, Environmental Protection Agency (EPA), and National Bureau of Standards to insure that their results are factored into project planning

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Air Development Center, Warminster, PA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Postgraduate School, Monterey, CA; U.S. Naval Academy, Annapolis, MD
- Industrial - Among the more than 20 contractors are: Aluminum Company of America, Alcoa Center, PA; Babcock and Wilcox, Barberton, OH; Battelle Memorial Institute, Columbus, OH; Dupont Chemical Corporation, Wilmington, DE; DWA Composites, Chatsworth, CA; Grumman Aerospace Corporation, Bethpage, NY; International Nickel Company, Wrightsville Beach, NC; Lockheed California Company, Burbank, CA; Southwest Research Inst., San Antonio, TX; Titanium Metal Corporation of America, TIMET Division, Henderson, NV; United Technology Research Center, East Hartford, CT
- Academic - Johns Hopkins University, Baltimore, MD; Ohio State University, Columbus, OH; Colorado School of Mines, Golden, CO; Massachusetts Institute of Technology, Boston, MA; Polytechnic Institute of New York, Brooklyn, NY

II. Project: F61-541 Title: Seaborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Surface Ship and Craft Materials

1.1 Completed development of narrow gap welding techniques to reduce cost of fabricating HY-100 steel flight decks
1.2 Completed development/evaluation of corrosion-free, low cost glass reinforced plastic piping
1.3 Completed development of on-line citric acid cleaning procedure for ship fresh water distillers
1.4 Completed fabrication of large Alforge processed 5456 alloy aluminum panels

Submarine Materials

1.5 Developed Gas-Metal-arc welding procedures for fabricating high strength submarine hull steel
1.6 Awarded contracts for development of fabrication methods of reduced cost titanium alloys
1.7 Mechanical properties of Inconel 625 sea water piping determined and initiated transition to 6.3 (Advanced Development)
1.8 Established feasibility of deep penetration gas-tungsten arc welding for one-inch titanium

Composite Materials

1.9 Completed filament wound hull feasibility analysis
1.10 Completed initial phase of automated geodesic composite construction for ship machinery components

Tribology

1.11 Produced manual of thin film lubrication design criteria
1.12 Draft specification for accelerated testing of long life grease completed

2. (U) FY 1982 Program

Surface Ship and Craft Materials

2.1 Develop specification guideline for stress corrosion resistant, high strength thin gauge CS-19 weldments

II. Project: F61-541 Title: Seaborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

2.2 Produce draft fabrication procedure for 2869 filament superconducting wire for application to shipboard Advanced Electrical Machinery
2.3 Complete adhesive bonded, thin-gauge panel draft fabrication procedure
2.4 Establish feasibility of the Alforge-process for transition to the Manufacturing Technology program for the production of aluminum shipboard structures

Submarine Materials

2.5 Document technology guidelines for improved subcritical crack resistant High Yield (HY) steel weldments
2.6 Initiate one-inch thick high strength, low alloy (HSLA) steel plate evaluations
2.7 Complete laboratory evaluation of nopcocide and organometallic polymer (omp) camouflage antifouling coatings
2.8 Establish repair methods for nickel-aluminum bronze castings

Composite Materials

2.9 Complete filament wound, composite ship hull feasibility study
2.10 Initiate Phase II of geodesic composite propeller shroud (fabrication and evaluation of test articles)

Tribology

2.11 Field trials of sealed, prelubricated, anti-friction bearings for Marine Corps applications

3. (U) FY 1983 and FY 1984 Planned Programs

Surface Ship and Craft Materials

3.1 Complete transition of superconducting multifilament wire technology to Manufacturing Technology
3.2 Evaluation of ceramic matrix composite material for shipboard incinerators
3.3 Complete major hydraulic system test and prepare draft specification for selected fire resistant hydraulic fluids
3.4 Complete fire resistant Poly Phosphazene-Nitrile (PN) cable insulation specification guidance
3.5 Develop plans for transition to Manufacturing Technology of Infra-Red nondestructive evaluation tool for plasma spray coatings

Project: F61-541 Title: Seaborne Materials
ram Element: 62761N Title: Materials Technology
Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Submarine Materials

3.6 Complete development of low cost fabrication technology for thick section titanium alloys
3.7 Prepare specifications/procedures for rapid solidification produced materials
3.8 Evaluate High Yield (HY) steel laser beam welds by fatigue testing, stress corrosion resistance evaluations, and explosion bulge tests

Composite Materials

3.9 Complete initial development of delamination resistant composites for ship machinery applications
3.10 Complete evaluation of geodesic designed composites and begin fabrication of ship test article

Tribology

3.11 Prepare draft specifications for wear-resistant mating ring face materials, microporous and polymer pack bearing lubricants
3.12 Selection and field trial of improved hydraulic systems filtration equipment for Marine Corps applications

Comparison with FY 1982 Program:

3.13 The reduction in funding from FY 1982 to FY 1983 (-$810 thousand) relates to refinement of costs characteristic of exploratory development

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

(U) Milestones: Not applicable

(U) Resources (Dollars in Thousands)

ect	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
541	Seaborne Materials	9,657	10,400	9,590	11,130	Continuing	Continuing

III. Project: F61-542 Title: Airborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- 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 and more fuel efficient engines, improved protective systems for better environmental resistance which will involve more demanding applications of advanced composites, new aluminum and titanium base alloys, and advanced high temperature alloys for airframe and propulsion applications

(U) RELATED ACTIVITIES

- Monitors the efforts of universities, independent research laboratories, major materials producers, and aerospace companies
- Consults national technical societies and the National Materials Advisory Board
- Tracks ongoing and future plans of the Air Force, Defense Advanced Research Projects Agency, Army, NASA, DOC, Bureau of Mines, National Bureau of Standards, etc., to insure that their technology development is part of the project planning

(U) WORK PERFORMED BY

- In-House - Naval Air Development Center, Warminster, PA; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Weapons Center, China Lake, CA; Naval Air Propulsion Center, Trenton, NJ
- Industrial - Some of the 15 contractors involved include: Aluminum Company of America Research Lab, Alcoa Center, PA; General Electric Company, Avondale, OH; International Nickel Company, Suffern, NY; McDonnell-Douglas Aerospace Corporation, St. Louis, MO; North American Rockwell, Los Angeles, CA; Pratt & Whitney Aircraft Division, UTC, West Palm Beach, FL; SKF Industries, Inc., King of Prussia, PA; TRW, Cleveland, OH; United Technology Center, East Hartford, CT
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Ambient storage, rapid cure resin system has been synthesized for timely repair of aircraft composite structures

III. Project: F61-542 Title: Airborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

1.2 Rapid solidified super alloys have been produced which demonstrate oxidation resistance and good high temperature mechanical properties
1.3 A cooperative test program of aircraft corrosion fatigue involving six countries and eight laboratories was initiated and the initial phase completed
1.4 Hot pressed silicon nitride (HPSN) bearing materials have been developed for aircraft gas turbine engines with improved performance and reliability

2. (U) FY 1982 Program

2.1 Determine significance of 2-D and 3-D composite defects in graphite fiber reinforced composites
2.2 Complete cooperative corrosion fatigue testing program with NATO allies
2.3 Conduct HARPOON J402 engine test with silicon-nitride bearings
2.4 Develop hydrogen-detecting "band-aid barnacle" electrode cell
2.5 Complete development of aircraft launched tactical missile plastic radome thermal and erosion prediction methodologies
2.6 Complete development of high temperature water based solid film lubricant

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Characterize graphite fiber composites for simple repair of composites
3.2 Transition high stiffness aluminum-lithium alloy to Manufacturing Technology
3.3 Transition corona-5 titanium alloy to Manufacturing Technology
3.4 Complete characterization of advanced directionally solidified single crystal alloys
3.5 Complete elevated temperature fracture and fatigue characterization of advanced turbine blade materials
3.6 Develop coatings for oxidation resistant single crystal super alloys
3.7 Complete optimization of titanium adhesive bonding process

Comparison with FY 1982 Program:

3.8 The change in funding in FY 1983 over FY 1982 (+$210 thousand) relates refinement of costs characteristic of exploratory development with increased emphasis on development of high temperature plastics and ceramics for air delivered tactical missile weapons

III. Project: F61-542 Title: Airborne Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F61-542	Airborne Materials	5,119	6,010	6,220	7,110	Continuing	Continuing

IV. Project: F61-543 Title: Missile Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Initiated this project in FY 1972 at the request of ODDR&E
- Initial program thrust, Reentry Vehicle Materials, was directed toward development of high performance reentry vehicle nosetips for Navy vehicles and involved 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
- Provided a high performance graphite, Graphnol, for use in ballistic reentry vehicle nosetips and rocket nozzles, an integral throat entrance cone design concept which increased reliability and reduced overall propulsion system cost, and a smoothly ablating fine weave carbon-carbon composite for increased performance of Navy maneuvering reentry vehicles
- 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
- Identified metal matrix composites as a potential replacement for a variety of navy structural applications
- The Deputy Under Secretary of Defense for Research and Engineering in FY 1978 recognized the potential of metal matrix composites and supported establishment of a Navy major technology thrust beginning in FY 1980
- At the same time, the Deputy Under Secretary of Defense for Research and Advanced Technology recognized that severe weather could cause strategic missile mission failure due to extensive reentry vehicle nosetip erosion and identified development of erosion hardened thermal protection materials as a technology thrust area

(U) RELATED ACTIVITIES

- Metal matrix composite materials are being developed by the Army for application to lightweight bridging, helicopter, and antenna components
- Metal matrix composites are being developed by the Air Force for aircraft and satellite applications
- The development programs of Army, Navy, and Air Force are coordinated by the Tri-Service Metal Matrix Composites Coordinating Committee chaired by the Office of the Under Secretary of Defense for Research and Engineering

(U) WORK PERFORMED BY

- In-House - Naval Ocean Systems Center, San Diego, CA; Naval Surface Weapons Center, White Oak Laboratory, Silver Spring, MD; Naval Underwater Systems Center, Newport, RI; Naval Research Laboratory, Washington, DC

IV. Project: F61-543 Title: Missile Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

- Industrial - Some of the 20 contractors involved include: Aerospace Corporation, Los Angeles, CA; Atlantic Research Corp., Alexandria, VA; AVCO, Waltham, MA; Composite Specialties, Chatsworth, CA; DWA Fiber Materials, Inc., Biddeford, ME; General Electric, Valley Forge, PA; Lockheed Missiles and Space Company, Sunnyvale, CA; Materials Concepts, Inc., Columbus, OH; McDonnell-Douglas, Los Angeles, CA; Union Carbide, Parma, OH; Vought Corporation, Dallas, TX
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Strategic Missile Materials

1.1 Carbon-carbon composite ball-and-socket thrust vector control concept which offers a potential cost reduction of 33 percent, was tested
1.2 Boron nitride/silicon oxide sensor window for improved reentry vehicle (RV) accuracy was successfully tested
1.3 A 50 percent improvement over baseline erosion performance with an improved erosion-resistant nosetip was demonstrated on a flight test
1.4 Suitability of carbon-carbon composites for reentry vehicle (RV) heat shield concepts has been demonstrated

Metal Matrix Composites

1.5 Fabricated graphite-aluminum tactical missile aerodynamic fin components
1.6 Fabricated silicon carbide-aluminum prototype reentry vehicle substructure configurations by back extrusion methods
1.7 Full scale pressure bulkheads for ALWT and MK-48 torpedo structural configurations have been fabricated and are undergoing testing

2. (U) FY 1982 Program

Strategic Missile Materials

2.1 Three "full contour" graphite/carbon-carbon tactical missile rocket nozzles tested
2.2 Complete full-scale flight test of high performance graphite for ballistic reentry vehicle nosetips
2.3 Carbon-carbon heat shield fabrication concept selected and demonstrated
2.4 Thin-walled pseudo-3D carbon-carbon extendable exit cone fabrication completed and testing scheduled

IV. Project: F61-543 Title: Missile Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Metal Matrix Composites

2.5 Fabrication method and material composition selected for reentry vehicle (RV) substructure
2.6 Baseline materials and fabrication processing established for 12 inch and 21 inch underwater pressure hulls
2.7 Full scale metal matrix composites MK-48 torpedo transducer webbing plate ready for test and evaluation
2.8 Graphite aluminum composite tactical missile fins flight tested

Surface Warfare Materials Technology

2.9 Complete definition of materials requirements for tactical missile sensor windows
2.10 Fabricate selected sensor window materials and evaluate thermal, mechanical, and electromagnetic properties
2.11 Evaluate oxidation resistant coating concepts for tactical missile propulsion systems components

3. (U) FY 1983 and FY 1984 Planned Programs

Strategic Missile Materials

3.1 Select, test, and recommend two erosion hardened nosetip concepts for reentry vehicle accuracy improvement
3.2 Conduct full scale demonstration of the throat and exit cone materials with an inflight missile test
3.3 Complete boron-nitride reinforced composite development for reentry vehicle sensor window application

Metal Matrix Composites

3.4 Conduct two in-the-water test runs of metal matrix composites torpedo hull sections
3.5 Design, fabricate, and laboratory test metal matrix composite tactical missile guidance bay
3.6 Complete missile structural components materials development and characterization

Surface Warfare Materials Technology

3.7 Design and fabricate carbon-carbon composite substrates for "hot running" tactical missile components
3.8 Demonstrate carbon-carbon fabrication feasibility for "dynamic" components in small turbine engines

IV. Project: F61-543 Title: Missile Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Comparison with FY 1982 Program.

3.9 The change in funding levels between FY 1983 and FY 1982 (+$476 thousand) reflects refinements in program directions and costs

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F61-543	Missile Materials	8,154	8,439	8,963	8,895	Continuing	Continuing

V. Project: F61-544 Title: System Support Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- 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 lightweight radar-absorbing coatings and structures
- Supports the reduction in the life cycle cost of Navy shore facilities
- Direct support of the Department of Defense materials thrusts in Metal Matrix Composites, Rapid Solidification technology materials and substitutes for critical materials used in Naval systems and platforms

(U) RELATED ACTIVITIES

- Coordinated with Army, Air Force, National Bureau of Standards, Defense Advanced Research Projects Agency, and the National Academy of Sciences by mutual planning groups, co-funded projects, Tri-Service working groups, and interservice and intragovernmental committees specifically established for this purpose
- Joint symposia are conducted through ad hoc committees, the Office of Naval Research, the Navy Council on Materials and Structures, and the National Materials Advisory Board of the National Academy of Sciences
- Exchanges reports with agencies having mutual interests and cooperative projects; a specific example of such coordination is the Tri-Service Laser Hardened Materials and Structures Group which coordinates the laser hardened materials efforts under Department of Defense sponsorship

(U) WORK PERFORMED BY

- In-House - David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Civil Engineering Laboratory, Port Hueneme, CA; 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; U.S. Naval Academy, Annapolis, MD
- Industrial - Among the 19 contractors are: Aerospace Corp., Los Angeles, CA; Atlantic Research Corp., Alexandria, VA; Chicago Bridge and Iron, Los Angeles, CA; DWA Composite Specialties, Inc., Chatsworth, CA; Fiber Materials, Inc., Biddeford, ME; General Electric Company, Valley Forge, PA; Harris Corp., Melborne, FL; Materials Concepts, Inc., Columbus, OH; National Bureau of Standards, Gaithersburg, MD and Boulder, CO; Silag, Inc., Greer, SC; Union Carbide, Tarrytown, NY
- Academic - Massachusetts Institute of Technology, Cambridge, MA; Oklahoma State University, Stillwater, OK; Washington University, St. Louis, MO

V. Project: F61-544
Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: System Support Materials
Title: Materials Technology
Budget Activity: 1 - Technology Base

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Directed Energy Hardened Materials Development

1.1 Susceptibility of forward-looking infrared (FLIR) systems [redacted]

1.2 [redacted]

1.3 Structural materials testing and computational modeling [redacted]

Materials Technology for Naval Facilities

1.4 Correlation between field and laboratory tests on coated wooden panels has established a relationship between field trials and laboratory adhesion tests

Weapon Support Materials

1.5 Fusion welding of silicon-carbide/aluminum composite demonstrated
1.6 Feasibility of casting graphite aluminum hardware in air demonstrated

Fracture Control Technology

1.7 Principal factors influencing fatigue crack growth in marine environments identified
1.8 New experimental procedures for fatigue crack growth testing in marine environments developed

Non-Destructive Testing

1.9 Initiated joint effort with DARPA and Air Force in development of generic non-destructive testing technology

V. Project: F61-544
Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: System Support Materials
Title: Materials Technology
Budget Activity: 1 - Technology Base

Low Radar Cross Section (RCS) Materials

1.10 A special adhesive system which is compatible with Radar Absorbing Materials (RAM) coatings for use on metallic substrates has been successful in laboratory tests

Emerging Naval Materials

1.11 Yields of more than 60% silicon-carbide ceramic product have been achieved in modified and new synthesis/processing methods for carbon-silicon polymers

2. (U) FY 1982 Program

Directed Energy Hardened Materials Development

2.1 Conduct experimental evaluation and perform [ ] analysis [ ]

2.2 Continue fabrication and testing of [ ] materials
2.3 Continue development of hardened coating system for airframe composite materials

Materials Technology for Naval Facilities

2.4 Continue field tests on surface profile and cleanliness parameters for latex paints and environmentally safe pigments for coatings
2.5 Continue development of candidate corrosion resistant reinforcing materials and corrosion inhibiting admixtures for marine concrete
2.6 Select candidate marine wood preservative materials and conduct laboratory screening

Weapon Support Materials

2.7 Fabricate pre-prototype metal matrix composite (MMC) High Energy Laser mirrors and test for beam characteristics
2.8 Fabricate and evaluate metal matrix composite Naval Extra High Frequency Satellite Communication Program (NESP) antenna
2.9 Select lightweight composite armor candidate for Marine Corps evaluation

V. Project: F61-544 Title: System Support Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Fracture Control Technology

2.10 Develop Navy MIL-STD test method for determination of fatigue crack growth rates of structural alloys in marine environments

Non-Destructive Testing

2.11 Demonstrate strategraphic scanning techniques on composite materials
2.12 Demonstrate eddy current technique on metal matrix wire quality assessment

Low Radar Cross Section (RCS) Materials

2.13

2.14

Emerging Naval Materials

2.15 Complete demonstration of Silicon Carbide (SiC) polymer synthesis and transfer to industry
2.16 Investigate alternative higher temperature glass matrix formulations for fabrication of silicon-carbide fiber reinforced glass composites

Critical Materials Substitution Technology

2.17 Substitution potential of rapidly solidified amorphous metals for magnetic alloys assessed
2.18 Material conservation demonstrated for post-boost-control system via powder metallurgy processing

3. (U) FY 1983 and FY 1984 Planned Programs

Directed Energy Hardened Materials Development

3.1

3.2

V. Project: F61-544
Program Element: 62761N
DoD Mission Area: 523 - Engineering Technology

Title: System Support Materials
Title: Materials Technology
Budget Activity: 1 - Technology Base

3.3 [redacted]

3.4 Determine the response of structural composites to High Energy Laser threats by investigating panel post-buckling behavior and joint vulnerability
3.5 Investigate laser hardened coating systems which include other electromagnetic protection technologies

Materials Technology for Naval Facilities

3.6 Complete field testing of coated panels and prepare preliminary specifications for steel surface profiles
3.7 Investigate techniques for treating wood pilings with selected preservatives
3.8 Complete development of over-rust primer formulations

Weapons Support Materials

3.9 Full-scale, Metal Matrix Composite, High Energy Laser mirror design analysis completed and fabrication initiated
3.10 Infrared seeker component fabricated and tested
3.11 Full-scale submarine battery prototype with lead metal matrix separators charge/discharge cyclic testing completed

Fracture Control Technology

3.12 Develop quantitative fracture mechanics analysis for evaluating crack tolerance of controllable pitch propeller crank ring materials

Non-Destructive Testing

3.13 Effectiveness of laser ultrasound scanning process established

V. Project: F61-544 Title: System Support Materials
Program Element: 62761N Title: Materials Technology
DoD Mission Area: 523 - Engineering Technology Budget Activity: 1 - Technology Base

Low Radar Cross Section (RCS) Material

3.14 Develop structural Radar Absorbing Materials (RAM) based on composites
3.15 Develop laser-resistant Radar Absorbing Materials (RAM) coating

Emerging Naval Materials

3.16 Use of silicon carbide fiber reinforced glass ceramic materials in gas-turbine oprations examined
3.17 Conduct complete dynamic characterization and ballistic damage tolerance of silicon-carbide fiber reinforced glass ceramic

Critical Materials Substitution Technolcgy

3.18 Feasibility of Rapid Solidification Technology (RST) to replace selected critical materials demonstrated

Comparison with FY 1982 Program:

3.19 The difference between the FY 1983 and the FY 1982 effort (-$100 thousand) results from refinement of program directions and escalation of costs

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

5. (U) Milestones: Not applicable

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F61-544	System Support Materials	6,847	7,980	7,880	8,359	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

ıram Element: 62762N
Mission Area: 521 - Electronic and Physical Sciences

Title: Electronic Device Technology
Budget Activity: 1 - Technology Base

RESOURCES (PROJECT LISTING): (Dollars in Thousands)

ject	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	24,010	26,076	27,134	29,341	Continuing	Continuing
-580	(Higher Classification Project)	0	300	400	350	Continuing	Continuing
-581	Microwave and Radio Frequency Technology	8,896	7,642	7,277	5,648	Continuing	Continuing
-582	Analog and Digital Integrated Circuit Technology	4,698	6,295	6,859	8,965	Continuing	Continuing
-583	Electro-Optical Technology	6,525	5,675	5,911	6,440	Continuing	Continuing
-584	Millimeter Wave Technology	400	2,545	3,470	3,945	Continuing	Continuing
-585	Special Avionic Devices	825	550	550	600	Continuing	Continuing
-586	Testing Technology	779	1,000	300	310	Continuing	Continuing
-587	Electronic Materials	1,887	2,069	2,467	3,083	Continuing	Continuing

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 GHz.
- Addresses the requirement to develop Millimeter Wave Technology (up to 140 GHz) for new Communication, Radar and Electronic Warfare capabilities at higher frequencies.
- 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 systems.

BASIS FOR FY 1983 RDT&E REQUEST

- Continue to increase the power, frequency, bandwidth and reliability of Microwave and Millimeter wave tubes to extend the capabilities of Radar, Communication and Electronic Warfare systems.

Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

- Continue to increase the power, frequency, bandwidth and reliablity of microwave and millimeter wave solid state devices, and hybrid and monolithic circuits to reduce the cost and size of Radar, Communication and Electronic Warfare systems.
- Continue to develop the technologies whereby signals derived from Radar, Communication and Electronic Warfare systems can be processed with increased speeds so as to meet the Command and Control needs of more complicated combat scenarios.
- Continue to develop optical and infrared technologies for more accurate, long range passive surveillance and tracking systems.
- Continue the development of automatic testing technology for improved reliability, maintainability and readiness of shipboard combat systems.
- Continue the development of materials in areas where advances would significantly improve device technology.
- The increase in total program funding request from $26,076 thousand in FY 1982 to $27,134 thousand in FY 1983 is to enhance two FY 1982 "Very High Speed Integrated Circuit" related starts and one FY 1982 Millimeter Wave start
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY

- (Dollars in Thousands) The major changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary (-17 in FY 1981, +345 in FY 1982 and -2,659 in FY 1983) were derived from the following project changes:

(FY 1981) - F62-581 (Microwave and Radio Frequency Technology) decreased by 294 because of minor program adjustments characteristic of Exploratory Development. Project title was changed from Microwave Devices and Technology.

- F62-582 (Analog/Digital Integrated Circuit Technology) decreased by 202 because of minor program adjustments characteristic of Exploratory Development. Project title was changed from Low Power Devices and Technology.

- F62-583 (Electro-Optical Technology) increased by 495 primarily because of increased emphasis on focal plane array technology. Project title was changed from Special Devices and Technology.

Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

- F62-584 (Millimeter Wave Technology) funding did not change. Project title was changed from Subsystem Electronic Devices Technology.

- F62-585 (Special Avionic Devices) was established at a funding level of 825.

- F62-586 (Testing Technology) decreased by 21 because of minor program adjustments. Project title was changed from Test Equipment Devices Technology.

- F62-587 (Electronic Materials) decreased by 820 because thrust of project changed from Very High Throughput Signal Processing Technology to encompass Electronic Materials and Marine Corps Technology. Project title was changed from Very High Throughput Signal Processing Technology.

(FY 1982) - F62-580 (Higher Classification Project) adds 300 to Program Element.

- F62-581 (Microwave and Radio Frequency Technology) decreased by 2,749 primarily because funding shifted to F62-584 (Millimeter Wave Technology). Relative to FY 1981, F62-581 is decreased by 1,254 because of this funding shift, the enhancement of Gallium Arsenide (GaAs) Monolithic Technology, and the Management Support Reduction against the RDT&E,N appropriation

- F62-582 (Analog/Digital Integrated Circuit Technology) increased by 1,455 to initiate POM 83 Special Focus Subprojects (WF62-582-3520 and XF6-582-3105) on "Very High Speed Integrated Circuit" Interface Technology. Relative to FY 1981, F62-582 is increased by 1,597 because of the Special Focus Subproject starts, transfer of project WF62584 (Modular Electronic Technology) to F62-582 from F62-584, and the Management Support Reduction.

- F62-583 (Electro-Optical Technology) decreased by 525 because 374 was transferred to project F62-586 (Testing Technology) and minor program changes were implemented. Relative to FY 1981, F62-583 is decreased by 850 primarily to enhance Project F62-586 (Testing Technology) and to implement minor program changes.

- F62-584 (Millimeter Wave Technology) increased by 2,145 because of transfer of 2,045 from F62-581, Special Focus Subproject XF62-584-3306 of +500, and transfer of WF62584 to F62582 (-400).

- FY62-585 (Special Avionics Devices) at a funding level of 550 to support a High Temperature Electronics Subproject and a High Density Power Supply Subproject for Avionic Applications. Relative to FY 1981, F62-585 is decreased by 275 because Analog Signal Processing Task transferred to F62-582.

Program Element: 62762N
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Title: Electronic Device Technology
Budget Activity: 1 - Technology Base

- F62-586 (Testing Technology) decreased by 200 because of minor program element changes. Relative to FY 1981, F62-586 increased by 221 to enhance Fault Tolerance Task in XF62-586.

- F62-587 (Electronic Materials) decreased by 631 because thrust of project changed from Very High Throughput Signal Processing Technology to Electronic Materials. Relative to FY 1981, F62-587 increased by 182 because Special Focus Subproject RF62-587-3321 (Electronic Device Reliability/Cost) (+329) was initiated and Subproject ZF62587 (Marine Corps Technology) was transferred to Element 62332N (Strike Warfare Weaponry Technology) (-960).

(FY 1983) - F62-580 (Higher Classification Project) adds 400 to Program Element

- F62-581 (Microwave and Radio Frequency Technology) decreased by 4,023 because 3,470 shifted to F62-584 (Millimeter Wave Technology) and because of FY 1983 budget reductions. Relative to FY 1982, F62-581 is decreased by 365 primarily because of FY 1983 budget reductions.

- F62-582 (Analog/Digital Integrated Circuit Technology) increased by 1,864 due to "Very High Speed Integrated Circuits" Special Focus Programs started in FY 1982. Relative to FY 1982, F62-582 increased by 564 to enhance FY 1982 "Very High Speed Integrated Circuit" related starts.

- F62-583 (Electro-Optical Technology) decreased by 1,989 because planned Special Focus Subproject Submission was delayed and because within budget constraints, growth of other projects predominated. Relative to FY 1982, F62-583, increased by 136 because of minor program adjustments characteristic of exploratory development.

- F62-584 (Millimeter Wave Technology) increased by 3,050 because F62-584 became the Millimeter Wave Technology Project in FY 1982. Relative to FY 1981, F62-584 increased by 925 to increase support for Special Focus Subproject XF62-584-3306

- F62-585 (Special Avionics Device) relative to FY 1982, F62-535 funding is constant

- F62-586 (Testing Technology) decreased by 978 because of FY 1983 budget reductions and Management Support Reductions against the RDT&E,N appropriation. Relative to FY 1982, F62-586 funding is decreased 700 because of FY 1983 budget reductions and Management Support Reductions against the RDT&E,N appropriation.

- F62-587 (Electronic Materials) decreased by 1,533 because thrust of project changed. Relative to FY 1982, F62-587 increased by 398 primarily to accelerate the development of high temperature (>15K) radiation hard superconducting thin film electronic devices

Program Element: 62762N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Electronic Device Technology
Budget Activity: 1 - Technology Base

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	23,325	24,027	25,731	29,793	Continuing	Continuing
F62-581	Microwave Devices and Technology	8,903	9,190	10,391	11,300	Continuing	Continuing
F62-582	Low Power Devices and Technology	3,820	4,900	4,840	4,995	Continuing	Continuing
F62-583	Special Devices and Technology	8,965	6,030	6,200	7,800	Continuing	Continuing
F62-584	Subsystem Electronic Devices and Technology	790	400	400	420	Continuing	Continuing
F62-586	Test Equipment Devices Technology	847	800	1,200	1,278	Continuing	Continuing
F62-587	Very High Throughout Signal Processing Technology	-0-	2,707	2,700	4,000	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Microwave and Radio Frequency Technology - 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 in the tubes and solid state devices used in these systems. Emphasis is on higher power and greater bandwidth that can be achieved with crossed-field amplifier (CFA) and travelling wave tubes (TWT) and on solid state Impact Avalanche Transit Time (IMPATT) sources and monolithic receiver elements.

- Analog and Digital Integrated Circuit Technology - 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 the processes. Areas of development include optical analog to digital signal converters, techniques for integrated circuit densities significantly greater than Very High Speed Integrated Circuit (VHSIC), technology fault tolerant circuit design to maximize reliability and minimize maintenance of systems, and integrated circuits from new materials such as indium phosphide (InP) to increase the speed of devices used in integrated circuits

- 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 the complete system. Areas of needed development and emphasis are single mode, low loss optical fibers, and the associated 1.5 micrometer infrared sources and detector, for long undersea data links in particular and for wideband high data rate links in general; one joule per pulse, 10^8-10^{10} pulse lifetime blue green lasers for communication and surveillance; and starring and scanning 3-5um and 8-12um infrared detector arrays and the associated focal plane signal processing technology for identification of friend or foe (IFF) improvements

- Millimeter Wave Technology - this project addresses the need to develop Radar, Electronic Warfare and Communication capabilities at higher frequencies (up to 140GHz) in order to reduce electronic countermeasure (ECM) susceptability prevalent in the microwave spectrum, to increase surveillance and tracking effectiveness via greater bandwidth, and to reduce system size for aircraft and missile seeker application. Needed areas of development are high power, large bandwidth gyrotron tubes, monolithic gallium arsenside (GaAs) receiver, high burnout diode mixers, protection device such as field effect transistor (FET) switches, and control components such as power combiners, circulators and isolators.

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

- Special Avionic Devices - 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.

- Electronic Materials - addresses the development of materials that have potential for significant impact on device technology

- 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 system.

(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). Advisory Group on Electronic Devices (AGED), 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.

- Improvements in interservice coordination of Electronic Device Technology were effected in FY 1981 by the establishment of Tri-Service Committees on Microwaves, Microelectronics and Electro-Optics. These committees meet periodically to integrate service contract activities so as to maximize the use of fiscal resources. Annual Tri-Service Integration Plans will be developed and made available the Advisory Group on Electronic Devices (AGED) and the Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E).

- Related Program Elements

62721N Command and Control Technology
62712N Surface/Aerospace Target Surveillance Technology
62734N Countermeasures Technology
62711N Undersea Target Surveillance Technology

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(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 Colorado, Boulder, CO; and University of California at San Diego, San Diego, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

The following are examples of the accomplishments that supported the Element and the Mission need in FY 1981

Microwave, Radio Frequency and Millimeter Wave Technology

1.1 First millimeter wave travelling wave tube (TWT), which uses COMB QUAD geometry to overcome dimensional problems in HELIX geometry, demonstrated at 90 GHz.
1.2 Demonstration of microwave travelling wave tube (TWT) using HELIX geometry with a bandwidth of 3 to 18 GHz and greater than 50 W of continuous wave power.
1.3 Demonstrated solid state, high speed, high power 8-12 GHz microwave switch.
1.4 Demonstrated 60 GHz low cost ferrite phase shifter.
1.5 Developed and fabricated wideband BARITT receiver mixers at 35 CHz with 20 Watts of radio frequency (RF) burnout capacity. Order of magnitude improvement over average Schotthy mixer.
1.6 Competitive contract for 150kw, 35GHz gyrotron amplifier for high resolution shipboard fire control was let according to FY 1980 plan.
1.7 Completed development of long life, high current density (>4AMPS/CM^2) controlled porosity dispenser (CPD) cathode for tubes; a major advance in cathodes that will transfer to manufacturing technology in FY 1982.
1.8 Development of 44 GHz Silicon Impact Avalanche Transit Time (IMPATT) amplifier/combiner completed and transitioned to the Navy "Extra High Frequency" Satellite Program (NESP)

1.9 Completed development of 26.5 - 40 GHz indium phosphide (InP) Transferred Electron Device (TED) amplifier and transitioned to Naval Electronics Systems Command (PME 107) for electronic warfare application.
1.10 Identified gallium arsenide (GaAs) Field Effect Transistor (FET) failure mechanism. Transferred result to industrial manufacturing program.
1.11 Completed development of 7-18 GHz Voltage Controlled Oscillator (VCO) as source of electronic countermeasure (ECM) jamming radar.

Analog and Digital Integrated Circuit Technology

1.12 Demonstration of high speed electro-optical signal analyzer. Present capacity is a billion multiplications per second.
1.13 Developed frequency synthesizer that tunes to any frequency between 2 and 1300 MHz in 5 microseconds and satisfies the local oscillator requirement for the Joint Tactical Information Distribution System (JTIDS) communication system.
1.14 First fully operational indium phosphide (InP) Charge Coupled Device (CCD) developed. Because of the material characteristics of indium phosphide (InP), it is anticipated that Charge Coupled Devices (CCD) will easily satisfy the requirements for analog to digital signal conversion rates in excess of 100 MHz.
1.15 First demonstration of the applicability of metal-insulator-semiconductor device technology to indium phosphide (InP). Provides the basis for significant advances in the speed of logic circuits.
1.16 Invention of the Crosstie Random Access Memory. Important military characteristics are: non-volatility, low power requirements, radiation resistance, high bit density ($3x10^6/CM^2$) and wide temperature range (50^o to 150^oC).
1.17 Draft of avionics module, integrated rack procurement specification distributed to industry for comments. Effort transitioned to Advanced Development.

Electro-Optical Technology

1.18 For application to the blue-green laser communication system, achieved 400 millijoules per pulse and 1 joule per pulse from ultra-violet preionized and x-ray preionized mercury bromide (Hg Br) lasers respectively. Achieved 400 millijoule per pulse from a xenon chloride (XeCl) laser down converted with lead (Pb) vapor.
1.19 Completed development of blue-green copper vapor laser for bathymetry applications.
1.20 Procurement package for the development of the more versatile Two Color Forward Looking Infrared (FLIR) imaging system was prepared. A Two Color Forward Looking Infrared (FLIR) system would provide a major advance in infrared target acquisition.
1.21 An integrated hybrid 64 - 64 mercury-cadmium-telluride (HgCdTe) Infrared (IR) detector array/Silicon Charge Coupled Device (CCD) Signal Processor delivered for reliability testing to the Naval Research Laboratory (NRL) by Texas Instruments.
1.22 Developed and successfully tested an eight terminal fiber optic, 500 megabit/sec data bus for ship command, control and communications application.

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.23 The feasibility of adequate reduction of fiber optic fatigue due to moisture has been demonstrated through the use of silicon nitride or carbon elastic hermetic coatings.
1.24 Demonstration that in-situ photobleaching can significantly enhance the radiation hardness of fiber optics.
1.25 Indium gallium arsenide phosphide (InGaAsP), light emitting diode fiber optic sources at 1.3 m were tested continually for 4000 hours with less than 10% degradation. These are the best reliability results obtained to date.
1.26 Prototype fiber optic bulkhead penetrators with integrity to pressure exceeding 10,000 PSI, have been developed.

Testing Technology

1.27 Transition of the Operational Readiness Monitoring System (ORMS) concept to Advanced Development under the ships Automatic Testing Equipment (ATE) Program. The Operational Readiness Monitoring System (ORMS) concept is to use automatic testing equipment and a multiterminal communication/display system to continually monitor the combat readiness of ship systems.
1.28 Final report of the requirements for automatic testing of Gun Fire Control Systems was prepared.
1.29 Transitioned Communications Readiness test breadboard to the Operational Readiness Monitoring System (ORMS) Test Bed.

Special Avionic Devices

1.30
1.31

Electronic Materials

1.32
1.33
1.34

2. (U) FY 1982 Program

The following are examples of activities that will support the Element and the Mission need in FY 1982.

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Microwave, Radio Frequency and Millimeter Wave Technology

2.1 Begin phase I of 3-year development of an 80-100GHz, 100 Watt continuous wave, COMB QUAD geometry millimeter wave travelling wave tube (TWT).
2.2 100 Watt, 2-18 GHz HELIX geometry travelling wave tube (TWT) will be packaged as an expendable for missile seeker application.
2.3 Modify existing COUPLED CAVITY geometry travelling wave tube (TWT) to produce 10 kw of pulsed or continuous power over a 500 MHz bandwidth at X-band (8-12GHz). Dual mode of operation allows both surveillance and tracking.
2.4 Continue development of Field Emitter Array (FEA) cathodes for heaterless, instant on tubes.
2.5 Develop two watt, 43.5 to 45.5 GHz gallium arsenide (GaAs) Impact Avalanche Transit Time (IMPATT) diodes for Navy "Extra High Frequency" Satellite Program.
2.6 Develop gallium arsenide (GaAs) Field Effect Transistor (FET) for 26.5 - 40 GHz Field Effect Transistor (FET) amplifier.
2.7 Initiate the development of a gallium arsenide (GaAs) Random Access Memory (RAM) with the storage capacity and speed necessary for 1-2GHz radio frequency signals.
2.8 Continue development of nodal-less distributed integrated circuit architecture to overcome parasitics in high density, high frequency (30 GHz) circuits.

Analog and Digital Integrated Circuit Technology

2.9 Continue the development of the Electro-Optical Signal Processors to increase speed and accuracy beyond FY 1981 accomplishments.
2.10 Assess the potential of indium phosphide (InP) Charge Coupled Device (CCD) for applications to high speed analog to digital conversion at frequencies in excess of 100 MHz.
2.11 Identify the cost/reliability tradeoffs of the application of Fault Tolerant integrated circuit architecture to Navy reliability/maintainability needs and prepare a report documenting future directions.
2.12 Submicron Focused Ion Beam Technology for Very Large Scale Integration (VLSI) beyond Very High Speed Integrated Circuit (VHSIC) technology will be used to fabricate simple logic circuits.
2.13 The feasibility of the Crosstie Random Access Memory will be demonstrated.
2.14 Award additional (relative to Tri-Service Very High Speed Integrated Circuit (VHSIC) awards) Very High Speed Integrated Circuit (VHSIC) Brassboard for Avionics application in January 1982.
2.15 Complete development of the low noise cryogenic Josephson Junction analog to digital converter with a simultaneous speed of 4 GHz and conversion accuracy of 6 bits.

I. *Program Element: 62762N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Electronic Device Technology
Budget Activity: 1 - Technology Base

Electro-Optical Technology

2.16 Initiation of the design and construction of a 5 joule per pulse, 20 pulses per second (goal of 10^8-10^{10} pulses lifetime) mercury bromide (Hg Br) blue-green laser.
2.17 Initiation of the development of a blue-green surveillance laser exhibiting 1 joule, 25 nanosecond pulses. Emphasis is on reducing 100n sec pulse width typical of present blue-green communication laser.
2.18 Characterization of a 32 x 32 monolithic mercury-cadmium-telluride (HgCdTe) Charge Coupled Device focal plane array for scanning Forward Looking Infrared (FLIR) System.
2.19 Design of focal plane array architecture to incorporate both 3-5 micrometer and 8-12 micrometer mercury-cadmium-telluride (HgCdTe) diodes in a Two Color Forward Looking Infrared (FLIR).
2.20 Improve performance characteristics of the wide band Integrated Optic Microwave Spectrum Analyzer. Increase dynamic range of analyzable signals from 25 to 40 db and simultaneously reduce the integration time from 8 microseconds to 2 microseconds.
2.21 Award contracts to produce hermetically coated fibers by plasma deposition and to optimize such fibers for military application.
2.22 Investigation of photobleaching at wavelengths beyond 1 micrometer to reduce radiation damage in optical fibers.
2.23 Complete the development of single mode optical fiber bulkhead penetrator for application to towed acoustic array and optical fiber guided torpedo.
2.24 Complete the development of 1.6 micrometer gallium indium arsenide (GaInAs) Avalanche Photodetector for integration with low loss single mode fibers.

Special Avionic Devices

2.25
2.26
2.27

Electronic Materials

2.28
2.29
2.30
2.31

Testing Technology

2.32 Demonstrate a fault tolerant memory.
2.33 Complete investigation of man-display interaction for shipboard electronics system readiness using the Operational Readiness/Monitoring System (ORMS) test bed.
2.34 Define the requirements for monitoring underwater fire control system readiness.

3. (U) FY 1983 and FY 1984 Planned Programs

Microwave, Radio Frequency and Millimeter Wave Technology

3.1 Phase II of 3-year development of a 90-100 GHz, 100 watt continuous wave COMB QUAD geometry, millimeter travelling wave tube.
3.2 Continue development of 2-18 GHz HELIX geometry travelling wave tube (TWT) for expendable missile seeker applications.
3.3 Continue development of Dual Mode travelling wave tube (TWT) at 8-12 GHz for Agile Beam Fire Control System.
3.4 Emphasize the development of gyrotron and travelling wave tube (TWT) concepts as low cost solutions to the need for higher frequency, high power millimeter wave tubes.
3.5 Develop and test 20-40 Amp/cm^2 Controlled Porosity Dispenser (CPD) cathodes for millimeter wave tubes. Would increase the current density and lifetime by factor of five over state of the art.
3.6 Complete development of 43.5 to 45.5 GHz gallium arsenide (GaAs) Impact Avalanche Transit Time (IMPATTS) for Navy "Extra High Frequency" Satellite Program.
3.7 Complete 26.5 to 40GHz gallium arsenide (GaAs) Field Effect Transistor (FET) amplifier development.
3.8 Continue development of 50 to 60 GHz and 95 GHz indium phosphide (InP) Transferred Electron Amplifier (TEA) devices for low noise millimeter wave receivers.
3.9 Complete development of Universal Monolithic Modulator for quantum jump improvement in electronic warfare capability.

Analog and Digital Integrated Circuit Technology

3.10 In collaboration with a DARPA effort, the Electro-Optical Signal Processor will incorporate real time changes in signal processing.
3.11 Feasibility of indium phosphide (InP) integrated circuit high speed logic operation at 1 GHz level will be evaluated. Order of magnitude increase over anticipated Very High Speed Integrated Circuit (VHSIC) phase I logic speeds is possible.
3.12 Complete development of technology for Surface Acoustic Wave (SAW) radio frequency spectrum analyzer.
3.13 Extend Submicron Focused Ion Beam Technology to fabrication of a complex logic function.

I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.14 Establish the viability of metal-organic versus conventional thick-film inks for hybrid circuits. If viable, identify the procedures for transistion to the hybrid circuit industry.

Electro-Optical Technology

3.15 Continue to improve the lifetime of communication blue-green lasers toward the lifetime goal of 10^8-10^{10} pulses, and address the design of laser system for aircraft mounting.
3.16 Continue to reduce the pulse width of blue-green lasers for surveillance application toward the goal of 10 nanosecond pulses.
3.17 Continue to improve the resolution and analog image to digital signal processing capability of infrared focal plane arrays.
3.18 Continue the evaluation of the stability of single mode solid state lasers and the influence of stability on fiber optic sensor and communication systems.

Special Avionic Devices

3.19
3.20

Electronic Materials

3.21
3.22

3.23
3.24

Testing Technology

3.25 Insert Shipboard Communications System Monitoring into Operational Readiness Monitoring System.
3.26 Complete Definition of Design for Testability figures of merit for integrated circuits.
3.27 Complete requirements definition for guided missile fire control system monitoring.

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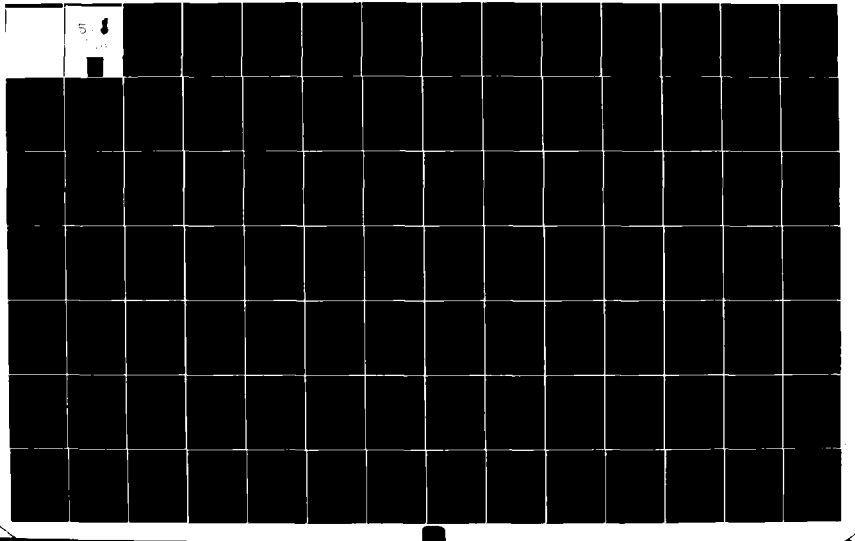

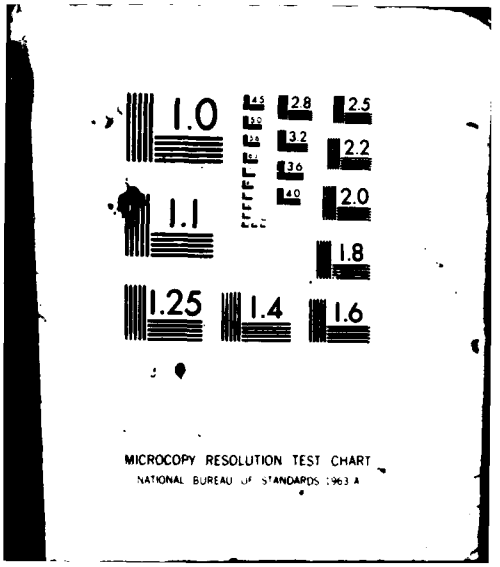
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I. *Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

Changes from FY 1982 to FY 1983

3.28 The increase in total program element funding of $1,058 thousand from FY 1982 to FY 1983 is to enhance two FY 1982 "Very High Speed Integrated Circuit" related starts and one FY 1982 Millimeter Wave start.

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

5. (U) Milestones: Not applicable.

II. Project: F62-581 Title: Microwave and Radio Frequency Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

° Most of the Navy's Radar, Communication, and Electronic Warfare Systems presently operate at frequencies below 26 GHz. Significant technology improvements are needed and can be achieved in the tubes and solid state devices used in these systems. Emphasis is on higher power and greater bandwidth that can be achieved with cross-field amplifier (CFA) and travelling wave tubes (TWT) and on solid state Impact Avalanche Transit Time (IMPATT) sources and monolithic receiver elements.

(U) RELATED ACTIVITIES

° The Army and Air Force are conducting R&D programs which are closely coordinated by the Under Secretary of Defense for Research and Engineering through the Advisory Group on Electron Devices, and by the Tri-Service Committee on Microwaves.

(U) WORK PERFORMED BY

° In-House - Naval Avionics Center, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA
° Industrial - General Electric, Syracuse, NY; Hughes Aircraft Company, Torrancee, CA; Litton Industries, San Carlos, CA; Microwave Associates, Burlington, MA; Radio Corporation of America, Camden, NJ; Raytheon Company, Waltham, MA; Texas Instruments, Dallas, TX; TRW, Redondo Beach, CA; Varian Associates, Beverly, MA, Westinghouse Research Labs, Pittsburgh, PA
° Academic - Cornell University, Ithaca, NY and Georgia Institute of Technology, Atlanta, GA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 First millimeter wave travelling wave tubes (TWT), which use COMB QUAD geometry to overcome dimensional problems in HELIX geometry, demonstrated at 90 GHz.
1.2 Demonstration of microwave travelling wave tubes (TWT) using HELIX geometry with a bandwidth of 3 to 18 GHz and greater than 50 W of continuous wave power.
1.3 Demonstrated solid state, high speed, high power 8-12 GHz microwave switch.
1.4 Demonstrated 60 GHz low cost ferrite phase shifter.

II. Project: F62-581 Title: Microwave and Radio Frequency Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.5 Developed and fabricated wideband BARITT receiver mixer at 35 GHz with 20 Watts of radio frequency burnout capacity. Order of magnitude improvement over average Schottky diode mixer.
1.6 Competitve contract for 150 kw, 35 GHz gyrotron amplifier for high resolution shipboard fire control was let according to FY 1980 plan.
1.7 Completed development of long life, high current density (4AMPS/CM^2) controlled porosity dispenser (CPD) cathode for tubes; a major advance in cathodic that will transfer to manufacturing technology in FY 1982.
1.8 Development of 44 GHz Silicon Impact Avalanche Transit Time (IMPATT) amplifier/combiner completed and transitioned to the Navy EHF Satellite Program (NESP).
1.9 Completed development of 26.5 - 40 GHz indium phosphide Transferred Electron Device (TED) amplifier and transitioned to Naval Electronics Systems Command (PME 107) for electronic warfare application.
1.10 Identified gallium arsenide (GaAs) Field Effect Transistor (FET) failure mechanism. Transferred result to industrial manufacturing program.
1.11 Completed development of 7-18 GHz Voltage Controlled Oscilator (VCO) as source of electronic couter measure (ECM) jamming radar.

2. (U) FY 1982 Program

2.1 Begin phase I of 3-year development of an 80-100 GHz, 100 Watt continuous wave, COMB QUAD geometry millimeter travelling wave tube (TWT).
2.2 100 Watt, 2-18 GHz HELIX geometry travelling wave tube (TWT) will be packaged as an expendable for missile seeker application.
2.3 Modify existing COUPLED CAVITY geometry travelling wave tubes (TWT) to produce 10 KW of pulsed or continuous power over a 500 MHz bandwidth at 8-12 GHz. Dual mode of operation allows both surveillance and tracking.
2.4 Continue development of Field Emitter Array (FEA) cathodes for heaterless, instant on tubes.
2.5 Develop 2 watt, 43.5 to 45.5 GHz gallium arsenide (GaAs) Impact Avalanche Transit Time (IMPATT) diodes fo Navy EHF Satellite Program.
2.6 Develop gallium arsenide (GaAs) Field Effect Transistors (FET) for 26.5 - 40 GHz Field Effect Transistors (FET) amplifiers.
2.7 Initiate the development of a gallium arsenide (GaAs) Random Access Memory (RAM) with the storage and sp necessary for 1-2 GHz radio frequency signals.
2.8 Continue development of nodal - less distributed integrated circuit architecture to overcome parasitics in hi density, high frequency (30 GHz) circuits.

11. Project: F62-581 Title: Microwave and Radio Frequency Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Phase II of 3-year development of a 80-100 GHz, 100 watt continuous wave COMB QUAD geometry millimeter travelling wave tube (TWT).
3.2 Continue development of 2-18 GHz HELIX geometry travelling wave tubes (TWT) for expendabe missile seeker applications.
3.3 Continue development of Dual Mode travelling wave tube (TWT) at 8-12 GHz for Agile Beam Fire Control System.
3.4 Emphasize the development of gyrotron and travelling wave tube (TWT) concepts as low cost solutions to the need for higher frequency, high power millimeter wave tubes.
3.5 Develop and test 20-40 AMP/CM^2 Controlled Porosity Dispenser (CPD) cathodes for millimeter wave tubes. Would increase the current density and lifetime by factor of five over state of the art.
3.6 Complete development of 43.5 to 45.5 GHz gallium arsenide (GaAs) Impact Avalanche Transit Time (IMPATT) for Navy EHF Satellite Program.
3.7 Complete 26.5 to 40 GHz gallium arsenide (GaAs) Field Effect Transistor (FET) amplifier development.
3.8 Continue development of 50 to 60 GHz and 95 GHz indium phosphide Transferred Electron Amplifier (TEA) devices for low noise millimeter wave receivers.
3.9 Complete development of Universal Monolithic Modulator for quantum jump improvement in electronic warfare capability.

Comparison with FY 1982 Program:

3.10 Relative to FY 1982, F62-581 is decreased by $365 thousand because of overall FY 1983 budget reductions.

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F62-581	Microwave and Radio Frequency Technology	8,896	7,642	7,277	5,648	Continuing	Continuing

III. Project: F62-582 Title: Analog and Digital Integrated Circuit Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- 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 optical analog to digital signal convertors, techniques for integrated circuit densities significantly greater than Very High Speed Integrated Circuit (VHSIC), fault tolerant circuit designs to maximize reliability and minimize maintenance of systems, and integrated circuit from new materials such as indium phosphide InP to improve intrinsic device speed.

(U) RELATED ACTIVITIES

- The Army and Air Force are conducting R&D programs which are closely coordinated by the Under Secretary of Defense for Research and Engineering through the Advisory Group on Electron Devices and by the Tri-Servie Committees on Microelectronics.

(U) WORK PERFORMED BY

- In-House - Naval Avionics Center Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA
- Industrial - General Electric, Syracuse, NY; Hughes Aircraft Company, Torrance, CA; Litton Industries, San Carlos, CA; Microwave Associates, Burlington, MA; Radio Corporaton of America, Camden, NJ; Raytheon Company, Waltham, MA; Texas Instruments, Dallas, TX; TRW, Redondo Beach, CA; Varian Associates, Beverly, MA; Westinghouse Research Labs, Pittsburgh, PA
- Academic - Cornell University, Ithaca, NY and University of Colorado, Boulder, CO

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Demonstration of high speed electro-optical signal processor concept. Present capacity is a billion multiplications per second.

III. Project: F62-582 Title: Analog and Digital Integrated Circuit Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.2 Developed frequency synthesizer that tunes to any frequency between 2 and 1300 MHz in 5 microseconds and satisfies the local oscillator requirements for the Joint Tactical Information Distribution System (JTIDS) communication system.
1.3 First fully operational indium phosphide (InP) Charge Coupled Device (CCD) developed. Because of the material characteristics of indium phosphide (InP), it is anticipated that indium phosphide (InP) charged coupled devices (CCD) will easily satisfy the requirements for analog to digital signal conversion rates in excess of 100 MHz.
1.4 First demonstration of the applicability of metal-insulator-semiconductor device technology to indium phosphide (InP). Provides the basis for significant advances in the speed of logic circuits.
1.5 Invention of the Crosstie Random Access Memory. Important military characteristics are: non-volatility, low power requirements, radiation resistance, high bit density ($3x10^6/CM^2$) and wide temperature range (50^oC to 150^oC).
1.6 Draft of avionics module, integrated rack procurement specification distributed to industry for comments. Effort transitioned to Advanced Development

2. (U) FY 1982 Program

2.1 Continue the development of the Electro-Optical Signal Processor to increase speed and accuracy beyond FY 1981 accomplishments.
2.2 Assess the potential of indium phosphide (InP) Charge Coupled Devices (CCD) for applications to high speed analog to digital conversions at frequencies in excess of 100 MHz.
2.3 Identify the cost/reliability tradeoffs of the application of Fault Tolerant integrated circuit architecture to Navy reliability/maintainability needs and prepare a report documenting future direction.
2.4 Submicron Focused Ion Beam Technology for VLSI beyond Very High Speed Integrated Circuit (VHSIC) will be used to fabricate simple logic circuits.
2.5 The feasibility of the Crosstie Random Access Memory will be demonstrated.
2.6 Award additional (relative to Tri-Service Very High Speed Integrated Circuit (VHSIC) awards) Very High Speed Integrated Circuit (VHSIC) Brassboard for Avionic application in January 1982.
2.7 Complete development of a cryogenic Josephson Junction analog to digital converter with a simultaneous speed of 4GHz and conversion accuracy of 6 bits. Procedures for transitions to the hybrid circuit industry.

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Incorporate real time signal processing into the Electro-Optical Signal Processor. Collaboration with DARPA.
3.2 Feasibility of indium phosphide (InP) integrated circuit high speed logic operation at 1 GHz level will be demonstrated. Order of magnitude increase over anticipated Very High Speed Integrated Circuit (VHSIC) Phase I logic speeds is possible.

III. Project: F62-582 Title: Analog and Digital Integrated Circuit Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

3.3 Complete development of technology for Surface Acoustic Wave (SAW) radio frequency spectrum analyzer.
3.4 Extend submicron Focused Ion Beam Technology to fabrication of a complex logic function.
3.5 Establish the viability of metal-organic versus conventional thick-film inks for hybrid circuits. If viable, identify the procedures for transition to the hybrid circuit industry.

Comparison with FY 1982 Program:

3.6 Relative to FY 1982, F62-582 is increased by $564 thousand to enhance FY 1982 "Very High Speed Integrated Circuit"

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F62-582	Analog and Digital Integrated Circuit Technology	4,698	6,295	6,859	8,965	Continuing	Continuing

IV. Project: F62-583 Title: Electro-Optical Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- 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 the complete system. Areas of needed development and emphasis are single mode, low loss optical fibers and the associated 1.5 micrometer infrared sources and detectors, for long undersea data links in particular and for wideband links in general; one joule per pulse, 10^8-10^{10} pulse lifetime blue-green lasers for communications and surveillance; and starring and scanning 3-5 and 8-12 um infrared detector arrays and the associated focal plane signal processing technology for Identification Friend or Foe (IFF) improvements.

(U) RELATED ACTIVITIES

- The Army and Air Force are conducting R&D programs which are closely coordinated by the Under Secretary of Defense for Research and Engineering through the Advisory Group on Electron Devices, and by the Tri-Service Committees on Electro-Optics and Fiber Optics.

(U) WORK PERFORMED BY

- In-House - Naval Avionics Center, Indianapolis, IN; Naval Ocean Systems Center, San Diego, CA; Naval Research Laboratory, Washington, DC; Naval Weapons Center, China Lake, CA
- Industrial - General Electric, Syracuse, NY; Hughes Aircraft Company, Torrance, CA; Litton Industries, San Carlos, CA; Microwave Associates, Burlington, MA; Radio Corporation of America, Camden, NJ; Raytheon Company, Waltham, MA; Texas Instruments, Dallas, TX; TRW, Redondo Beach, CA; Varian Associates, Beverly, MA; Westinghouse Research Labs, Pittsburgh, PA
- Academic - University of California at San Diego, San Diego, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

IV. Project: F62-583 Title: Electro-Optical Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.1 For application to the blue-green laser communication system, achieved 400 millijoules per pulse and 1 joule per pulse from UV preionized and x-ray preionized mercury bromide laser respectively. Achieved 400 millijoules per pulse from a xenon chloride laser down converter with lead vapor.
1.2 Completed development of blue-green copper vapor laser for bathymetry applications.
1.3 Procurement package for the development of the more versatile Two Color Forward Looking Infrared (FLIR) imaging system was prepared. A Two Color Forward Looking Infrared (FLIR) system would provide a major advance in infrared target acquisition.
1.4 An integrated hybrid 64 x 64 mercury-cadmium-telluride Infrared (IR) detector array/Silicon Charged Coupled Device (CCD) Signal Processor was delivered for reliability testing to the Naval Research Laboratory (NRL) by Texas Instruments.
1.5 Developed and successfully tested an eight terminal fiber optic, 500 megabit/sec data bus for Ship Command, Control and Communications applications.
1.6 The feasibility of adequate reduction of fiber optic fatigue due to moisture has been demonstrated through the use of silicon nitride or carbon elastic hermetic coatings.
1.7 Demonstration that in-situ photobleaching can significantly enhance the radiation hardness of fiber optics.
1.8 Indium-gallium-arsenide-phosphide light emitting diode fiber optic sources at 1.3 um were tested continually for 4000 hours with less than 10% degradation. These are the best reliability results obtained to date.
1.9 Prototype fiber optic bulkhead penetrators, with integrity to pressure exceeding 10,000 PSI, have been developed.

2. (U) FY 1982 Program

2.1 Initiation of the design and construction of a 5 joule per pulse, 20 pulses per second (goal of 10^8-10^{10} pulse lifetime) mercury bromide blue-green laser.
2.2 Initiation of the development of a blue-green surveillance laser exhibiting 1 joule, 25 nanosecond pulses. Emphasis on reducing 100 sec pulses width typical of present blue-green communication laser.
2.3 Characterization of a 32 x 32 monolithic mercury-cadmium-telluride Charge Coupled Device focal plane array for scanning Forward Looking Infrared (FLIR).
2.4 Design of focal plane array architecture to incorporate both 3-5 micrometer and 8-12 micrometer mercury-cadmium-telluride diodes in a two color Forward Looking Infrared (FLIR).
2.5 Improve performance characteristics of the wide band Integrated Optics Microwave Spectrum Analyzer. Increase dynamic range of analyzable signals from 25 to 40 db and simultaneously reduce the integration time from 8 microseconds to 2 microseconds.
2.6 Award contracts to produce hermetically coated fibers by plasma deposition and to optimize such fibers for military applications.
2.7 Investigation of photobleaching at wavelengths beyond 1 micrometer to reduce radiation damage in optical fibers.

IV. Project: F62-583 Title: Electro-Optical Technology
Program Element: 62762N Title: Electronic Device Technology
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.8 Complete the development of single mode optical fiber bulkhead penetrator for application to towed acoustic array and optical guided torpedo.
2.9 Complete the development of 1.6 micrometer gallium-indium-arsenide Avalanche Photodetectors for integration with low loss single mode fibers.

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue to improve the lifetime of communication blue-green lasers toward the goal of 10^8-10^{10} pulses and address design of blue-green laser system for aircraft mounting.
3.2 Continue to reduce the pulse width of blue-green lasers for surveillance applications toward the goal of 10 nanosecond pulses.
3.3 Continue to improve the resolution and analog-image to digital-signal processing capability of infrared focal plane arrays.
3.4 Continue the evaluation of the stability of single mode solid state lasers and the influence of stability on fiber optic sensor and communication systems.

Comparison with FY 1982 Program:

3.5 Relative to FY 1982, F62-583 increased by $136 thousand because of minor program adjustments characteristic of exploratory development.

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F62-583	Electro-Optical Technology	6,525	5,675	5,811	6,440	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62763N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Personnel and Training Technology
Budget Activity: 1 - Technology Base

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

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	5,734	6,377	7,259	7,736	Continuing	Continuing
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 Technology	1,445	1,777	2,046	2,276	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Cost of military manpower exceeds 50% of the defense budget
- Trained personnel are required to operate increasingly complex fleet equipment.
- Supports the development of more efficient and effective methods for the recruiting, management and motivation of personnel.
- Supports 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Complete methodology aimed at identifying prior-service-personnel with a high propensity to enlist.
- Increase emphasis on the development of techniques for predicting job performance at the task level from aptitude and other selection tests.
- Develop procedures for evaluating alternative training programs with respect to resultant operational readiness
- Initiate the development of guidelines to provide the optimal instruction in mathematical skills required for a Navy electronics maintenance technician.
- The increase in FY 1983 funding over that for FY 1982 (+882 thousand) results from increasing emphasis on techniques for widening the manpower base, broadening the effort on enhancing basic skills to compensate for the low recruit skill levels, from the refined estimates of costs including escalation, and from other minor adjustments between projects which are characteristic of Exploratory Development efforts.
- Since this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

Program Element: 62763N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Personnel and Training Technology
Budget Activity: 1 - Technology Base

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY

- (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: 0 in FY 1981; -230 in FY 1982; and -368 in FY 1983. These changes result from refined estimates of cost, including escalation, and other minor adjustments characteristic of research and exploratory development.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,529	5,734	6,607	7,627	Continuing	Continuing
F63-500	USMC Personnel Resources Management	0	0	1,520	1,859	Continuing	Continuing
F63-521	Manpower and Personnel Technology	3,659	4,274	3,310	3,768	Continuing	Continuing
F63-522	Computer-Aided Education and Classroom Training Technology	1,870	1,460	1,777	2,000	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

rogram Element: 62763N
ssion Area: 522 - Environmental and Life Sciences

Title: Personnel and Training Technology
Budget Activity: 1 - Technology Base

TAILED BACKGROUND AND DESCRIPTION

Cost of military manpower exceeds 50% of the defense budget.
Navy and Marine Corps manpower requirements continue to call for high quality trained personnel to operate and maintain the complex fleet equipment
Element supports the development of more efficient and effective methods for recruiting, selecting, distributing, and managing personnel
Element supports the development of computer-aided and computer-managed training, new personnel training techniques, and improved methodology for measuring and evaluating training effectiveness of individual, team and unit performance.

.ATED ACTIVITIES

Government agencies, private industry, Technical Advisory Groups and academic institutions continuously exchange information to avoid duplication or overlap
Reports are broadly distributed and information exchange is additionally facilitated through research advisory councils, workshops, DOD Technology Advisory Groups, and conferences
Related program elements are:
63707N, Manpower Control Systems Development
63720N, Education and Training
62205F, Training and Simulation Technology
62703F, Personnel Utilization Technology
62717A, Army Personnel and Manpower Technology
62722A, Army Training Technology
62727A, Non-System Training Development

in numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS I.1.1 refers to the first item in paragraph 1. of the Program Element PEDS. Similarly, a Roman numeral II, III, etc. will l in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 first Project PED for this Program element.

I. *Program Element: 62763N Title: Personnel and Training Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

(U) WORK PERFORMED BY

- In-House - Navy Personnel Research and Development Center, San Diego, CA
- Industrial - Applied Psychological Services, Wayne, PA; Institute for Organizational Behavior Research, Houston, TX; Human Resources Research Organization, Alexandria, VA; Potomac Institute of Economic Research, Washington, DC; Systems Exploration, Inc., San Diego, CA; Institute of Research Studies, Athens, OH.
- Academic - University of South Carolina, Columbia, SC; University of Pennsylvania, Philadelphia, PA; University of Minnesota, Minneapolis, MN; Georgia Institute of Technology, Atlanta, GA; University of Michigan, Ann Arbor, MI; Ohio State University, Columbus, OH

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Recruiter Assignment Battery

1.1 Recruiter performance vital if Navy is to meet its manning goals of 106,000 accessions in 1981
1.2 Selection of recruiters with high potential for productive performance most cost effective means for assuring a high quality recruiter force.
1.3 Developed a selection battery consisting of an interest inventory, self-description check-lists, and a background questionnaire and demonstrated battery validity for predicting recruiter performance.
1.4 Approved for operational use.

Video Disc Training Technology

1.5 Increasing use of individual training necessitates low cost audio-visual training systems.
1.6 Video disc technology offers massive audio-visual storage, rapid random access, and potential cost savings.
1.7 Feasibility demonstrated for configuring into a portable, intelligent instructional delivery system.
1.8 Effort transitioned to Advanced Development P.E. 63720N for further development.

Marine Corps Air Navigation Training

1.9 In ship to shore assault, air navigation is typically accomplished over unfamiliar terrain in a high threat environment.

1. *Program Element: 62763N Title: Personnel and Training Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

1.10 Developed a part-task high fidelity training technique using cinematic and sensor simulation.
1.11 Demonstrated that terrain orientation techniques could be adapted to the high speed, fixed wing aircraft used in low-altitude ingress-egress operations.
1.12 Improves efficiency of low-altitude training for fixed-wing aviators in high threat environments

Impact of Military Pay on Retention

1.13 Navy is not retaining sufficient numbers of its experienced petty officers.
1.14 Developed data on the relationship between military pay and "quit rate" of skilled petty officers.
1.15 Demonstrated that changes in basic pay had a greater effect on retention than do equivalent value changes in benefits such as allowances and commissary privileges.
1.16 Developed data for compensation presentation to Congress for pay adjustments.

2. (U) FY 1982 Program

Manpower and Personnel Technology

2.1 Continue tracking a selected group of Marines to determine reasons influencing their decision to stay in or leave the service.
2.2 Complete development of an accession model to determine levels of recruitment necessary to satisfy operational billets, training billets, and manpower overhead.
2.3 Complete validation of predictive utility of computerized adaptive tests with a sample of students from selected Marine Corps training courses.
2.4 Initiate development of techniques aimed at identifying prior-service-personnel with a high propensity to enlist.
2.5 Complete evaluation of potential of lateral entry techniques for widening the manpower base for naval service.

Computer-Aided Education and Classroom Training Technology

2.6 Complete development and evaluation of the ASW Qualification Pretraining Guide for Trainees which provides training objectives and performance expectations.
2.7 Complete development of an advanced tactical knowledge training methodology for the Tactical Action Officer course.
2.8 Continue the development of an objective base for specifying the mathematical skills required to become a competent Navy electronics maintenance technician.
2.9 Continue development of an ASW shipboard team test that will provide readiness related performance data to the fleet and training commands.

I. *Program Element: 62763N Title: Personnel and Training Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3. (U) FY 1983 and FY 1984 Planned Programs

Manpower and Personnel Technology (Marine Corps efforts included)

3.1 Complete the development of methodology aimed at identifying prior-service-personnel with a high propensity to enlist.
3.2 Increase emphasis on the development of a methodology to predict job performance at the task level from aptitude and noncognitive selection tests.
3.3 Initiate development of procedures to validate training requirement scales to determine the extent to which a training objective is required for successful task performance

Computer-Aided Education and Classroom Training Technology

3.4 Develop decision aiding procedures that can be used to provide an objective economic evaluation of alternative training programs with respect to resultant improved operational readiness.
3.5 Develop and evaluate courseware for Landing Force urban close air support training
3.6 Complete the development of guidelines to provide the optimal instruction in mathematical skills required for a Navy electronics maintenance technician.
3.7 Continue development of procedures to better design training and to structure job conditions to minimize performance deterioration due to forgetting.
3.8 Initiate evaluation of procedural training techniques for students in the Tactical Action Officer course.

Changes from FY 1982 to FY 1983

3.9 The 882K increase in the element total will permit increasing emphasis on developing techniques for widening the manpower base; broadening the effort in enhancing basic skills in math, reading, and retention of knowledge to compensate for the low recruit skill levels; and to initiate an effort to validate training requirements by determining the extent to which a training objective is actually required for successful task performance.

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

5. (U) Milestones: Not applicable.

FY 1983 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

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

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	730	1,754	1,789	2,545	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

(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, 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

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Insure that requirements unique to the Navy are included in the planning of RDT&E programs of the other services as appropriate
- Maintain cognizance of new developments to determine the impact on Navy requirements, and insure appropriate testing and evaluation for fleet operations
- Establish priorities, and provide technical representation and information exchange to interservice and international groups involved with planning, development, coordination, and testing
- Determine requirements for naval vessels operating in a Chemical, Biological and Radiological warfare (CBR) environment
- Determine requirements for adequate warning of a Chemical, Biological and Radiological warfare attack, for decontamination systems to eliminate Chemical, Biological and Radiological agents or minimize effects, and treat casualties
- As this is a continuing program. The above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

Program Element: 62760N — Title: Chemical, Biological and Radiological Defense Technology
DoD Mission Area: 6.2 Environmental and Life Sciences — Budget Activity: 1 - Technology Base

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are a decrease of $5 in FY 1981, an increase of $213 in FY 1982, and a decrease of $127 in FY 1983, and are the result of cost refinements and program changes imposed during the FY 1983 budget development.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	346	735	1,541	1,916	Continuing	Continuing
F64-561	*Chemical/Biological Defense Technology*	346	735	886	1,028	Continuing	Continuing
F64-562	Radiological Defense Technology	---	---	655	888	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62764N Title: Chemical, Biological and Radiological Defense Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Funds the Navy's efforts in a joint service chemical, biological and radiological defense technology program
- Supports the formulation of Navy and Marine Corps operational requirements, and the coordination of these requirements with other services
- Supports RDT&E relative to unique Navy and Marine Corps problems in chemical, biological and radiological warfare defense including:
  - Chemical and biological personnel protective equipment, detection and warning equipment, decontamination equipment, and diagnosis of biological agent caused disease
  - Scaler/timer radiation monitoring instrumentation
  - Pulsed electromagnetic and nuclear radiation effects on electronic and electrical equipment for nuclear hardening of ships
  - Blast protection technology

(U) RELATED ACTIVITIES

- Coordination with the U.S. Army and the U.S. Air Force, NATO quadripartite nations, the American Defense Preparedness Association, and the civilian industry

(U) WORK PERFORMED BY

- In-House - The Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; Naval Explosive Ordnance Disposal Facility, Indian Head, MD

* Roman numeral I. identifies the numbered items in paragraphs 1., 2., and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the first item in paragraph 1. of the Program element PEDS. Similarly, a Roman numeral II, III, etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the first item in paragraph 1 of the first Project PEDS for this Program Element.

I. *Program Element: 62764N Title: Chemical, Biological and Radiological Defense Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

- Industrial - Brunswick Corp., Philadelphia, PA; Ingalls Shipbuilding, Pascagoula, MS
- Academic - University of Arizona, Tucson, AZ; Los Alamos National Laboratory, Los Alamos, NM

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Chemical/Biological Defense Technology

1.1 Developed a sacrificial coating material for decontamination
1.2 Demonstrated the feasibility of using a portable collective protection system developed by the U.S. Army for use aboard ships

Radiological Defense Technology

1.3 Electromagnetic pulse radiation tests have been completed on five naval ships, and the results used to retrofit harden seven classes of ships
1.4 Demonstrated a low vulnerability level to electromagnetic pulse of the SM-2 guided missile
1.5 A circuit hardening technique called "Side-Car Memory" has been developed for microprocessor based equipment that must operate in a nuclear environment
1.6 Data analysis of underwater reverberation and system response problems has shown the underwater blackout phenomena to be frequency dependent (impact on future designs of underwater sensors)
1.7 Technology for neutron spectrum measurements of Navy nuclear weapons has been developed
1.8 A trace radioactive contaminant, cesium-137, has been identified as the cause for abnormal responses of Thermoluminescent Dosimeters
1.9 An airblast design guide has been developed for ship structures and is ready for validation

2. (U) FY 1982 Program

Chemical/Biological Defense Technology

2.1 Begin evaluation of available synthetic absorbents to replace activated charcoal in air purifiers
2.2 Begin development of test methodology/procedures for non-destructive testing of collective protection filter systems

2.3 Establish aerodynamic flow patterns over a ship's exterior and determine the resultant exterior static pressure gradient necessary for the efficient operation of a collective protective system
2.4 Evaluate available commercial gas separation membranes for application to collective protection systems
2.5 Develop new technology for point detection of chemical agents
2.6 Analyze and define shipboard chemical protective clothing requirements
2.7 Develop hybridoma (monoconal antibody) technology to detect disease caused by biological warfare agents
2.8 Begin a coordinated program with the U.S. Army for standoff detection of biological warfare agents
2.9 Develop laser technology for identification of chemical agents
2.10 Develop lightweight equipment and procedures for decontamination of Marine Corps personnel and equipment exposed to chemical agents in a forward area

Radiological Defense Technolgy

2.11 Continue investigation of CaF_2:Mn thermoluminescent dosimeters to identify impurities in the surface layer
2.12 Complete prototypes for a new beta radiation counting system
2.13 Develop a new reference light source for standardizing and calibrating the CaF_2:Mn thermoluminescent dosimeters
2.14 Complete evaluation of effectiveness of current concepts in nuclear hardening for the total ship platform
2.15 Complete instrumentation and software support for an improved data acquisition and analysis system for hardening against electromagnetic pulses
2.16 Complete calculation of neutron and gamma radiation transport over seawater for ship systems and missiles in flight
2.17 Complete determination of neutron and gamma shielding factors for protection of personnel and equipment aboard ship
2.18 Complete development of a design capability for combined nuclear, blast and thermal hardening, and determine thermal failure levels for selected coatings and materials suitable for ship construction
2.19 Complete determination of intrinsic radiation characteristics from new nuclear weapons

3. (U) FY 1983 and FY 1984 Planned Programs

Chemical/Biological Defense Technology

3.1 Complete analyses of new absorbents for air purification
3.2 Complete development of an in situ test method for determining useful life of air filters used in collective protective systems
3.3 Complete development of a computer code to analyze system vulnerabilities that cannot be measured directly in order to estimate confidence limits on survivability levels

1. *Program Element: 62764N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Chemical, Biological and Radiological Defense Technology
Budget Activity: 1 - Technology Base

Radiological Defense Technology

3.4 Complete development of realistic environment criteria for high altitude electromagnetic pulse exposure
3.5 Design and procure an automatic test system for performing tests of thresholds of electromagnetic pulse exposure for sensitive electronic components
3.6 Complete determination of failure levels of the SM-2 guided missile, the TOMAHAWK cruise missile Vertical Launch System, the RAM weapon system and fire control computers
3.7 Complete superstructure design guide to include blast and thermal hardening considerations
3.8 Complete definition of airblast induced shock environment, and begin development of hardening methods
3.9 Complete evaluation of impact of reduced radiation exposure limits defined by the Bureau of Medicine and Surgery in terms of retrofits for existing ship shielding configurations
3.10 Complete update of ship shielding code to include scattering and self-absorption secondary to new exposure levels as set forth by the Bureau of Medicine and Surgery
3.11 Continue support of Nuclear Program Office

Changes from FY 1982 to FY 1983

3.12 No significant change in funding occurred

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

5. (U) Milestones: Not applicable.

FY 1983 RDT&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

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

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

(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 operational resources
- Includes small programs in cartridge-actuated devices and pyrotechnics

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Reduce energy usage in ships, aircraft and Navy shore facilities
- Develop criteria for the test, evaluation, and use of broadened specification petroleum-based fuels and fuels derived wholly or in part from synthetic crudes
- Increase work on cartridge-activated devices and pyrotechnic technology for personnel safety and protection and high energy density batteries
- Develop environmentally compatible reclamation and disposal techniques for pyrotechnics, explosives, and propellants
- Identify/analyze shipboard noise sources and develop suppression techniques and new design criteria
- Develop pollution abatement techniques for unique shore facility problems such as dry dock wastes, noise, and jet engine test cell air pollutants
- Identify sources of Navy hazardous industrial wastes and develop source reduction and treatment technologies to minimize harmful effects
- As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only. The decrease of $992 thousand from FY 1982 to FY 1983 is a result of transitioning the Ship On-Board Pollution Recovery System to Advanced Development

Program Element: 62765N
DoD Mission Area: 522 - Environmental and Life Sciences

Title: Energy and Environmental Protection Technology
Budget Activity: 1 - Technology Base

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows:

- Reductions of $1,005 in FY 1981, $858 in FY 1982 and $2,066 in FY 1983 reflect a restructuring of Research Development Test and Evaluation efforts in Energy Technology and cost refinements
- Project F65-573 has been renamed and includes the cartridge-activated device and pyrotechnic technology program transferred from Program Elements 62241N and 62734N
- Project F65-572 effort has been transferred to F65-559

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,400	7,555	8,301	8,517	Continuing	Continuing
F65-571	Energy Technology	0	2,659	2,727	2,617	Continuing	Continuing
F65-572	Environmental Protection	2,400	4,399	4,219	4,500	Continuing	Continuing
F65-573	Electro-Chemistry Technology	0	497	1,355	1,400	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

1. *Program Element: 62765N Title: Energy and Environmental Protection Technology
DoD Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports requirements to assess and adapt energy conservation techniques and to utilize alternative sources of energy to satisfy current and future Navy energy needs and to meet environmental legislation without mission degradation or undue drain on operational resources
- Solves Navy-unique problems in early designs of new weapons systems with regard to environmental and energy concerns
- Develops technology for Navy-unique electro-chemical energy sources to support advanced weapons systems and safety devices
- Provides the technology base necessary to support the National Energy Program and the National Environmental Policy Act

(U) RELATED ACTIVITIES

- Technology adapted in this element transitions to Advanced and Engineering Development efforts in Program Element 63724N, 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

(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

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III, ... etc. will be used in front of the word "Project" on the first page of each Project PEDS e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this P.E.

I. *Program Element: 62765N
Title: Energy and Environmental Protection Technology
DoD Mission Area: 522 - Environmental and Life Sciences
Budget Activity: 1 - Technology Base

PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 Completed and updated a total energy/life-cycle cost computer model for use in ship design
1.2 Completed the technical assessment of procedures to reduce fuel consumption in P-3 and F-4 aircraft, with potential savings of between 250 and 500 thousand barrels of fuel per year, without impairing operational effectiveness
1.3 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
1.4 Completed validation of an Air Quality Assessment Model at two air bases

2. (U) FY 1982 Program

2.1 Accelerate projects examining technology systems to improve energy efficiency and fuel flexibility of future naval systems to further improve mission capability during a period of high energy cost and availability problems
2.2 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
2.3 Evaluate the impact of broadening Navy fuel specifications, considering the performance/durability impacts on operational equipment versus gains in fuel availability/costs
2.4 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
2.5 Complete the development of on-line, continuous, quantitative oil/water monitoring systems for shipboard use
2.6 Initiate a toxic substances control program in response to Environmental Protection Agency regulations
2.7 Complete classification of combustion products from the burning of large rocket motors
2.8 Evaluate noise control technology advances for application to Naval aircraft/helicopters and develop a noise-abatement/cost-benefit model for shipboard noise problems
2.9 Complete a design feasibility demonstration of a new cartridge primer system

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Continue joint development with the Environmental Protection Agency, Army and Air Force on water/waterwaste reuse concepts for shore installation
3.2 Complete development of on-line continuous, quantitative oil/waste monitoring systems for shipboard use

Program Element: 62765N Title: Energy and Environmental Protection Technology
Mission Area: 522 - Environmental and Life Sciences Budget Activity: 1 - Technology Base

3.3 Initiate a toxic substances control program in response to Environmental Protection Agency regulations and Navy inventory survey
3.4 Continue an exploratory development program to pre-treat Navy-unique industrial wastes from shore facilities
3.5 Evaluate noise control technology advances for application to Naval aircraft and helicopters
3.6 Develop noise abatement cost-benefit model for shipboard noise problem
3.7 Identify the environmental hazards from colored flares and other pyrotechnics and complete classification of the smokes from burning large rocket motors
3.8 Accelerate projects 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 cabability in spite of anticipated severe energy cost and availability problems
3.9 Complete technology assessment to improve the energy efficiency of the current fleet of Navy aircraft and transition promising concepts to advanced and engineering development
3.10 Evaluate impact of broadening Navy fuel specifications, considering the performance and durability impacts on operational equipment versus gains in fuel availability and costs
3.11 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.
3.12 Continue investigation of stability and technology base aspects of current lithium batteries

Changes from FY 1982 to FY 1983

3.13 The decrease of $992K from FY 1982 to FY 1983 is a result of transitioning the Ship On-Board Pollution Recovery System to Advanced Development

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

(U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62766N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Laboratory Independent Exploratory Development
Budget Activity: 1 - Technology Base

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

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	847	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Provide means for 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

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Complements the directed exploratory development program
- Increased funding in 1983 will influence in-house projects at the Chief of Naval Material R&D Centers, specifically in the area of naval vehicles
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

Program Element: 62766N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Laboratory Independent Exploratory Development
Budget Activity: 1 - Technology Base

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Changes between the funding profile shown in the FY 1982 Descripive Summary and that shown in this Descriptive Summary (+$1,780 in 1982 and +$1,564 in FY 1983) are the result of refined estimates of cost, including escalation and the inclusion of the Navy Scientific Assistance Program (NSAP) and the Naval Postgraduate School Independent Exploratory Development program in this element

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9,002	8,859	10,187	10,527	Continuing	Continuing
F66-112	Target Surveillance	2,201	2,350	2,500	2,600	Continuing	Continuing
F66-212	Command and Control	465	500	640	720	Continuing	Continuing
F66-312	Weaponry	2,920	2,800	2,640	2,700	Continuing	Continuing
F66-412	Naval Vehicles	1,611	1,550	2,175	2,250	Continuing	Continuing
F66-512	Support Technology	1,805	1,659	2,232	2,257	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62766N
Title: Laboratory Independent Exploratory Development
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Established in FY 1963 to implement the Secretary of the Navy instruction which directed that a portion of each Center's program in exploratory development be supported on a sustaining basis and programmed by the Center
- Provides the Technical Directors of the R&D Centers with a means to exploit new in-house ideas and to investigate the feasibility of high-risk concepts
- Allows in-house scientists and engineers to apply advances in the state-of-the-art to the development of new concepts to meet current and projected threats
- Covers surveillance, command and control, weaponry, naval vehicles, and support technology

(U) RELATED ACTIVITIES

- [ ] developed under this program, is now undergoing operational analysis of its effectiveness in certain tactical situations (Program Element 62543N)
- Pyroelectric vidicon cameras are now scheduled to be deployed in the Mediterranean onboard LAMPS helicopters
- Developed methods for implementing a procedure for real-time optimal selection of radar operating frequency which takes into account the variation of antenna sidelobe levels with azimuth angle (Program Element 62712N)
- Other projects that were initiated through Laboratory Independent Exploratory Development are: 62702E, X-Wing Aircraft; 62332N, Coherent Frequency Multiplexed Radar; 64543N, Standard Ship Motion Prediction Program; 62711N, Piezoelectric Polymer Transducer; 62759N, Shallow-Water Acoustic Theory; 62762N and 62711N, Green Laser Investigations

(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 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 Cener, China Lake, CA; Naval Postgraduate School, Monterey, CA

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1. *Program Element: 62766N
Title: Laboratory Independent Exploratory Development
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

- Industrial - None
- Academic - None

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1 [redacted]

1.2 A nonresonant mechanical source in the 5-50Hz spectral region was designed, fabricated and tested with encouraging results

1.3 An [redacted]

1.4 Developed and tested a technique for increasing the maximum range two to four times at which a target can be identified and acquired by any conventional TV guidance system when used under hazy atmospheric conditions

1.5 Developed [redacted] potential replacements for current electronic modules

1.6 Successfully completed design, construction, and calm-water trials for a subscale manned model of a promising new high speed, ship-to-shore mobility concept that involves trapping the exhaust from propulsion turbofans to provide lift and reduce drag

1.7 [redacted] -- the full scale prototype has been successfully tested

1.8 Assessing the damage caused by long range anti-ship missiles (HARPOON and TOMAHAWK) by inspecting the signatures received by currently deployed acoustic sensors was investigated -- data was collected from several exercises involving target hulls and analysis showed the method to be potentially useful

2. (U) FY 1982 Program

Technical Directors of the R&D Centers select projects to be pursued in FY 1982 based on the progress of ongoing projects during FY 1981 and the potential payoff of new ideas. Examples of work underway are:

2.1 [redacted]

2.2 Continue development of [redacted] potential replacements for the electronic modules presently required in passive towed arrays

I. *Program Element: 62766N Title: Laboratory Independent Exploratory Development
DoD Mission Area: 521 - Electronic and Physical Sciences Budget Activity: 1 - Technology Base

2.3 Use [redacted] and continue development of analytical methods permitting early-design tradeoffs involving applied force, pressure, temperature change, etc.
2.4 Continue investigations of the applications of millimeter wave technology
2.5 Continue investigations in the field of sonar detection of aircraft sources
2.6 Demonstrate an improved target acquisition system based on combining the optimized performance characteristics of coherent radio frequency and infrared devices

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Based on program's success to date, it will continue as a means of capitalizing on technical advances in Navy R&D Centers

Changes from FY 1982 to FY 1983

3.2 Increased funding in FY 1983 will influence in-house projects at the Chief of Naval Material R&D Centers, specifically in the area of naval vehicles

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

5. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62768N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Directed Energy Technology
Budget Activity: 1 - Technology Base

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

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

*This was a new program element for FY 1982. Work on these projects for FY 1981 was funded under other elements. See Comparison with FY 1982 Descriptive Summary for details.

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED

- Supports advanced technologies and systems concepts that involve the projection of either intense electromagnetic energy or charged atomic/subatomic particles for a variety of military applications [illegible] tracking/surveillance, and countermeasures
- P.E. 62735N is a separate program element which is focused to demonstrate [illegible]
- Supports the pulsed power and component technology required for directed energy devices
- Revolutionary capabilities inherent in directed energy systems in terms of speed of light delivery of energy, high [illegible] Anti-ship missile defense is a primary candidate for early application of directed energy technology

Program Element: 62768N
DoD Mission Area: 521 - Electronic and Physical Sciences

Title: Directed Energy Technology
Budget Activity: 1 - Technology Base

(U) BASIS FOR FY 1983 RDT&E REQUEST

- Increased Navy Research and Development commitment to high risk/high payoff programs in directed energy is necessary to realize potentially dramatic advances in fleet defense capability and to offer a viable augmentation to conventional weaponry
- In view of the potential of directed energy] the Department of Defense has identified directed energy technology as a priority Research and Development area
- Develops alternative technologies to reach a decision point in terms of trade-off and utility
- Pursues advanced technology in: high energy laser devices
- The FY 1983 budget represents an enhanced effort
- The FY 1983 budget reflects an increased Navy level of effort The Navy program is predicated on positive results of the DARPA-funded propagation experiments
- The FY 1983 budget also reflects an enhanced program
- As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY (Dollars in Thousands)

- Changes in the funding profile shown in the FY 1982 Descriptive Summary as compared to this Descriptive Summary are as follows:
- The increase in FY 1981 of $1,233 results from increased emphasis in the Pulsed Power Technology effort and refinement of cost estimates
- The reduction of $6,176 in FY 1982 results from a Congressional reduction of $5,993 and adjustments for deescalation
- The FY 1983 increase reflects the decision of the Navy and the Defense Resources Board to increase research, development, test and evaluation efforts in directed energy technologies
- FY 1982 reductions result in the Navy Program being reduced to a level that supports in-house expertise only in FY 1982

Program Element: 62768N
Title: Directed Energy Technology
DoD Mission Area: 521 - Electronic and Physical Sciences
Budget Activity: 1 - Technology Base

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY

Project No.	Title	Total FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,700*	6,100*	12,173	13,461	Continuing	Continuing
F68-311	Systems Investigations for Directed Energy Weaponry	0	0	500	650	Continuing	Continuing
F68-342	Laser Weaponry Technology	3,200*	3,000*	4,875	5,761	Continuing	Continuing
F68-343	Charged Particle Beam Technology	0	500*	2,500	2,650	Continuing	Continuing
F68-344	High Power Microwave Technology	500*	600*	950	1,000	Continuing	Continuing
F68-345	Pulsed Power and Component Technology	1,000*	2,000*	3,348	3,400	Continuing	Continuing

* This is a new program element in FY 1982, work on these projects for FY 1980 and FY 1981 was funded under other elements.

(U) OTHER APPROPRIATIONS FUNDS: None.

I. *Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Supports and is supported by technologies that involve the projection of intense electromagnetic energy or charged atomic/subatomic particles for a variety of military applications such as tracking/surveillance, countermeasures, and communications
- Continues development of [ ] lasers which are expected to be more effective than their continuous wave counterparts in terms of propagation and damage and may provide a second generation laser for the SEA LITE program in Program Element 62735N
- Although less mature than chemical lasers, advanced [ ] lasers offer accessibility [ ] not available to chemical lasers with applications to [ ] communications, and surveillance as well as weapons
- [ ] in directed energy with expected [ ] due to in-depth energy deposition
- *Explores the propagation theory, damage mechanisms*, beam steering, and tracking mechanisms of charged particle beams
- [ ] which can exploit this technology
- All directed energy weapons require large amounts of power over short time periods; projects within this program element provide pulsed power supply technology, components, and application studies for directed energy weapons as well as other applications
- Investigates laser cavities, mirror coatings, beam handling, advanced laser nozzles and adaptive optics
- Investigates Navy requirements of directed energy weapons for space and other long range applications

* Roman numeral I. identifies the numbered items in paragraphs 1., 2. and 3. below as belonging to the Program Element PEDS, e.g., I.1.1 refers to the 1st item in paragraph 1. of the Program Element PEDS. Similarly a Roman numeral II, III,...etc. will used in front of the word "Project" on the first page of each Project PEDS, e.g., II.1.1 refers to the 1st item in paragraph 1. of the 1st Project PED for this Program Element

I. *Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

(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 the National Charged 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
- 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
- All DOD-directed energy programs are coordinated and reviewed by the Directed Energy office of the OUSDRE(RA&ST)

(U) WORK PERFORMED BY

- Academic - Old Dominion University, Norfolk, VA; Lawrence Livermore Laboratory, Livermore, CA; U.S. Naval Academy, Annapolis, MD; Texas Tech University, Lubbock, TX; University of Texas, Austin, TX
- Industrial - Boeing, Seattle, WA; EG&G, Salem, MA; Physics International, Palo Alto, CA; STD, Pasadena, CA; TRW, Inc., Los Angeles, CA
- In-House - Los Alamos Scientific Laboratory, Los Alamos, NM; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, White Oak, MD

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

Laser Weaponry Technology

1.1 [ ] A gas mixer has been fabricated for scaling to.

1.2 The [ ] laser at TRW has demonstrated [ ] high efficiency and has demonstrated [ ] laser [ ].

1.3 [ ] has been observed at an unusually high power level [ ]

1. *Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

High Power Microwave Radiation

(U) 1.4 The magnetron has been operated with outpowers [redacted] a code for analysis has been written

Pulsed Power and Component Technology

1.5 In prime power, a unique seven-part combustor test chamber for a propellant-driven magneto hydrodynamic generator has been tested and combustor products characterized
1.6 In switching, a two-pulse technique has been implemented to determine the voltage hold-off recovery of a gas switch as a function of time
1.7 In energy storage, demonstrated a dielectric recovery time for water greater than one millisecond
1.8 Demonstrated breakdown thresholds at 180 kilowatts/cm for water at 2.4 degrees centigrade at 10-100 hertz repetition rates
1.9 [redacted]

2. (U) FY 1982 Program

Laser Weaponry Technology

2.1 Measure the beam quality for the TRW [redacted] laser and measure damage effects in a wind tunnel
2.2 Continue construction of the Boeing [redacted] laser
2.3 Continue development of the [redacted] laser with work [redacted] and improvement of coherence, output power, and efficiency.

Charged Particle Beam Technology

2.4 [redacted]

2.5 [redacted]

1. *Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

High Power Microwave Technology

2.6 In collaboration with IR&D effort at General Dynamics, develop a

2.7
2.8
2.9

Pulsed Power Technology

2.10 In prime power, initiate development of a solid fuel, liquid oxidizer, 10 megawatt magneto-hydrodynamic generator and assemble the combustor, channel and coils
2.11 In energy storage, perform experiments on water breakdown and develop a rotary flux compressor to charge a storage capacitor in 100 microseconds
2.12 Complete breakdown and recovery work on repetitively pulsed, small spark-gap switches

3. (U) FY 1983 and FY 1984 Planned Programs

Performance Evaluations for Directed Energy Devices

3.1 Apply
3.2 Determine and compare

3.3 Evaluate the critical technology issues

Laser Weaponry Technology

3.4 Incorporate results into capability predictions
3.5 Continue device development and initiate work in mirrors, windows and beam directors
3.6 Complete study of laser with input and efficiency enhancement by contouring the wiggler magnet parameters
3.7 Complete initial experimental evaluation of feasibility of a infrared free electron laser driven by a linear accelerator (LINAC) with a

I. *Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521 - Electronics and Physical Sciences Budget Activity: 1 - Technology Base

Charged Particle Beam Technology

3.8 The Navy support of the National Charged Particle Technology Beam Program will establish

3.9 Transition Category 6.1 accelerator technology starting in FY 1984

High Power Microwave Technology

3.10 Complete development of a device wth pulse length
Assemble a facility including both Perform experiments on air breakdown, the absorption and and emission of radiation from the resulting plasma and the transfer of energy to nearby materials including electromagnetic sensing systems
3.11 Examine the technological aspects required for realization of a

Pulsed Power Technology

3.12 In prime power complete the prototype 10 megawatt magneto-hydrodynamic generator
3.13 Investigate the use of an electron beam for rapid repetitive pulsing of a high pressure opening gas switch

Changes from FY 1982 to FY 1983

3.14 The FY 1982 budget was reduced by 50 percent due to Congressional and Navy actions. In FY 1982, ongoing work was incrementally and subcritically funded and new starts were deferred to FY 1983.
3.15 The FY 1983 budget represents effort in pulsed chemical lasers with new work in laser optics, pointer/trackers and spectral line control
3.16 The FY 1983 budget reflects Navy level of effort in Charged Particle Beams. The Navy program is predicated on positive results of the DARPA funded propagation experiments
3.17 The FY 1983 budget also reflects program in high power microwaves

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

5. (U) Milestones: Not applicable.

11. Project: F68-342 Title: Laser Weaponry Technology
Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521- Electronic and Physical Sciences Budget Activity: 1 - Technology Base

(U) DETAILED BACKGROUND AND DESCRIPTION

- Continues development
- for the SEA LITE program in Program Element 62735N
- The objectives of the
- Develop both Raman and Compton regime free electron lasers for initial applications to

(U) RELATED ACTIVITIES

- The Office of Naval Research continues to fund long-term efforts to resolve propagation problems and develop technology for compact accelerators for particle beam and free electron laser applications
- The Office of Naval Research funds free electron laser research on Raman scattering and funds a scaling demonstration experiment for Excimer Lasers

(U) WORK PERFORMED BY

- In-House - Los Alamos Scientific Laboratory, Los Alamos, NM; Naval Research Laboratory, Washington, D.C.
- Industrial - Aerospace Corp., Los Angeles, CA; Boeing Aerospace Corp., Seattle, WA; TRW, Inc., Los Angeles, CA

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments

1.1

1.2 The laser at TRW has demonstrated efficiency and has demonstrated

1.3 Measurements taken

II. Project: F68-342 Title: Laser Weaponry Technology
Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521- Electronic and Physical Sciences Budget Activity: 1 - Technology Base

1.4 laser output power has been observed at an unusually high power level of and an efficiency of which larger than efficiencies achieved in previous free electron laser experiments

1.5 The output power from a Raman free electron laser agrees with recently developed theories of operation in a constant axial magnetic field

2. (U) FY 1982 Program

2.1 Measure the beam quality for the TRW laser and measure

2.2 Complete construction of the Boeing laser and cold-flow test the fuel feed system and flow uniformity

2.3 Take measurements

2.4 Initiate program to develop high reflectance coatings for pulsed chemical laser optics

2.5 Investigate methods of spectral control for pulsed chemical lasers for improved propagation characteristics

2.6 Initiate studies

2.7 Continue development of the laser with work on distributed feedback and improvement of coherence, output power and efficiency

2.8 Complete the design and fabrication of the laser to be driven by the Naval Research Laboratory's linear accelerator (LINAC)

3. (U) FY 1983 and FY 1984 Planned Programs

3.1 Incorporate results from the first tests lasers into capability predictions

3.2 Continue laser device development at high powers and show scalability

3.3 Continue laser optics with development of appropriate windows

3.4 Initiate program for a safe storeable source for lasers

3.5 Continue pointer-tracker development for lasers

3.6 Complete study of efficiency enhancement by utilizing a tapered wiggler field in a Raman regime laser

3.7 Complete study of the Raman laser with input

3.8 Complete efficiency enhancement study of laser with uniform and non-uniform wiggler fields

II. Project: F68-342 Title: Laser Weaponry Technology
Program Element: 62768N Title: Directed Energy Technology
DoD Mission Area: 521- Electronic and Physical Sciences Budget Activity: I - Technology Base

3.9 Initiate study investigating the feasibility of a [redacted] laser
3.10 Complete initial experimental evaluation of feasibility of an infrared free electron laser driven by a linear accelerator (LINAC) with a [redacted]

Comparison with FY 1982 Program:

3.11 The FY 1982 budget was reduced by 50 percent due to Congressional and Navy actions. In FY 1982, ongoing work was incrementally and subcritically funded and new starts were deferred to FY 1983
3.12 The FY 1983 budget represents [redacted]

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

5. (U) Milestones: Not applicable.

6. (U) Resources (Dollars in Thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
F68-342	Laser Weaponry Technology	4,175	3,000	7,200	6,600	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63202N
Title: Avionics
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	Adv Technology Demonstration Laser Gyro	3,314	2,499	2,658	5,167	Continuing	Continuing
W0577	Adv Aircraft Electrical System	0	0	0	0	Continuing	Continuing
W0597	Adv 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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced avionic 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: W0525 Adv Technology Demonstration Laser Gyro Project - Continue design and fabrication of integrated/redundant sensor assembly for inertial navigation and flight control. Develop high accuracy laser gyro design. W0597, Advanced Integrated Display System Project - Continue technology developments leading to fabrication and specification of representative advanced aircraft cockpit displays. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: A reduction of -886 in FY 1981 results from restructuring of the Advanced Technology Demonstration Laser Gyro project due to decreased allocation of funds. A decrease of -3,197 in FY 1982 results from Navy Budget reductions in the Advanced Technology Demonstration Laser Gyro project (-2,071), the Advanced Aircraft Electrical System project (-1,110), and the Advanced Integrated Display System project (-16). A decrease of -5,937 in FY 1983 results from additional Navy Budget reductions in the Advanced Technology Demonstration Laser Gyro project (-2,340), the Advanced Aircraft Electrical System project (-2,228), and the Advanced Integrated Display System project (-1,369).

Program Element: 63202N
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: Avionics
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	11,860	4,200	6,942	9,759	Continuing	Continuing
W0525	Adv Technology Demonstration Laser Gyro	8,237	4,200	4,570	4,998	Continuing	Continuing
W0577	Adv Aircraft Electrical System	2,123	0	1,110	2,228	Continuing	Continuing
W0597	Adv Integrated Display System	1,500	0	1,262	2,533	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63202N Title: Avionics
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The Advanced Technology Demonstration Laser Gyro program is using new inertial sensor capabilities to develop a low-cost series of standardized systems for a broad base of navigation and strike avionics applications. The development program has two primary thrusts: 1) gyro cost reduction technology and reliability demonstration, and 2) quick reaction (rapid warmup and alignment) navigation/guidance system demonstration. The Advanced Integrated Display System project is developing advanced cockpit instrumentation systems with versatile multifunction controls and information displays to provide a state-of-the-art cockpit 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.). The Weapon Control System project will develop, integrate and demonstrate an advanced expendable terminal to provide for weapon control, guidance and targeting of missiles. It will exploit the capabilities of the Joint Tactical Information Distribution System program technology.

(U) RELATED ACTIVITIES: Advanced Technology Demonstration Laser Gyro - Related exploratory development work is being performed under Program Element 62721N, Command and Control Technology, and Program Element 62204F, Aerospace Avionics. Coordination is maintained with related guidance developments under the Medium Range Air-to-Surface Missile program. Advanced Integrated Display System - Related to USAF Advanced Development program, Digital Avionics Information System. Weapon Control System - Related to the Joint Tactical Information Distribution System program under P.E. 25604N.

(U) WORK PERFORMED BY: Advanced Technology Demonstration Laser Gyro, In House: Naval Weapons Center, China Lake, CA; Naval Air Development Center, Warminster, PA; and Naval Avionics Center, Indianapolis, IN. Contractors: Honeywell, Inc., Minneapolis, MN: Litton Industries, Woodland Hills, CA and McDonnell-Douglas Corporation, St. Louis, MO. Advanced Integrated Display System In House: Naval Air Development Center, Warminster, PA (Lead Laboratory); Naval Air Test Center, Patuxent River, MD. Contractors: General Electric Aircraft Equipment Division, Utica, NY; Hughes Aircraft Co., Aerospace Group, Culver City, CA; Intermetrics Corporation, Cambridge, MA. Weapon Control System In-House: Naval Weapons Center, China Lake, CA. Contractors: IBM, Owega, NY.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments:

(U) Advanced Technology Demonstration Laser Gyro - Program was started in FY 1976. Low-cost, high-reliability gyros have been designed and developmental models have been fabricated for both aircraft navigation and missile guidance performance domains. Developmental Laser gyro navigation systems were sucessfully evaluated in A-7, F-14, C-141 and P-3 testbed aircraft. During FY 1981, the alternate source program contract was awarded for Phase II (producibility developments); proposals were evaluated for design and fabrication of the Integrated Inertial Sensor Assembly for flight control and navigation.

Program Element: 63202N
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: Avionics
Budget Activity: 2 - Advanced Technology Development

(U) Advanced Integrated Display System - Applies state-of-the-art avionics to the man-machine interface in the aircraft cockpit. It utilizes multifunction displays and an all-digital system along with multiplexing and programmable electronics for the following improvements over current cockpit systems: (1) flexibility (easy initial integration and easy modification); (2) 50% reduction in spare parts; (3) eliminates 80% of cockpit wiring; (4) reduces weight by 25% and (5) maximizes pilots capability by integrating engine, navigation, communication, weapon system, and flight parameters into an easily assimilated visual Heads Up Display which enables the pilot to simultaneously look outside the cockpit. The Advanced Development Model system design has been completed. Preliminary specifications are complete. Hardware fabrication and software design have been initiated. Initiate development of final hardware specification. Initiate integration of engine, navigation, communication, weapon system, and flight parameters into the Heads Up Display and/or other visual displays.

2. (U) FY 1982 Program:

(U) Advanced Technology Demonstration Laster Gyro - Complete producibility program for Honeywell gyro. Continue development of at-sea alignment software. Continue design and fabrication of system applying laser gyro strapdown technology to integrated redundant sensor assembly for navigation, flight control and fire control (Integrated Inertial Sensor Assembly). Begin Phase II of alternative source developments.

(U) Advanced Integrated Display System - Complete final hardware specification development. Complete coding and debugging of laboratory simulation software. Continue hardware integration. Continue system integration.

3. (U) FY 1983 Planned Program:

(U) Advanced Technology Demonstration Laser Gyro - Perform at-sea alignment software demonstration. Delivery of Advanced Development Model Integrated Inertial Sensor Assembly. Continue development of high accuracy laser gyro developmental models.

(U) Advanced Integrated Display System - Continue system integration and evaluation.

4. (U) FY 1984 Planned Program:

(U) Advanced Technology Laser Gyro - Continue development and laboratory test of Integrated Inertial Sensor Assembly. Begin integration into testbed aircraft. Evaluate high accuracy laser gyros in strapdown system configurations for Cruise Missiles and tactical aircraft.

Program Element: 63202N Title: Avionics
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) Advanced Integrated Display System - Initiate systems applications stage of program. Initiate final software specifications. Continue laboratory evaluations.

(U) Weapon Control System - Award contracts for Advanced Development Model hardware/software based on results of prior exploratory development work.

5. (U) Program to Completion:

(U) Advanced Technology Demonstration Laser Gyro - Complete flight test and evaluation of Integrated Inertial Sensor Assembly model. Develop high performance, quick reaction accelerometers. Perform laboratory and flight test evaluations of missile guidance and aircraft navigation systems new low-cost gyros. Analyze test results at the gyro and system levels and perform redesign/retest as needed. Complete high accuracy gyro program and integrate results into planning for subsequent Engineering Development programs. Develop modular laser gyro sensors and high accuracy strapdown inertial systems to satisfy the majority of military inertial requirements. This is a continuing program.

(U) Advanced Integrated Display System - Continue systems applications and publish final software specifications. Apply flat panel and color display technology to display system design.

(U) Weapon Control System - Complete system fabrication, delivery and testbed installation. Perform flight test and evaluation. Transition to Engineering Development phase.

6. (U) Milestone: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63207N
Title: Environmental Applications
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	1,543	1,240	1,684	2,370	Continuing	Continuing
X0948	Precise Time and Time Interval	120	112	258	276	Continuing	Continuing
S1586	Future Integrated Navigation System	0	0	49	418	Continuing	Continuing

(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, emerging 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 conventional navigation systems.

(U) BASIS FOR FY 1983 RDT&E REQUEST: W0512, Tactical Environmental Support System: Continue shipboard evaluation of Interim Integrated Refractive Effects Prediction Systems, a subsystem of the Tactical Environmental Support System. Continue development of the Tactical Environmental Support System prototype. Increase of $1,411 thousand over FY 1982 is the result of restoral of constrained FY 1982 funding levels. W0513, Automated Environmental Prediction System: Continue development of a computerized global atmospheric and oceanographic prediction capability. Increase of $297 thousand over FY 1982 is for model output statistics and regional oceanographic modeling efforts. W0514, Meteorological Measuring System: Conduct operational test and evaluation of airborne and shipboard environmental sensors, and microprocessor-driven terminals for communication, storage and display of environmental products. Increase of $63 thousand over FY 1982 results from inflation. W0527, Remote Ocean-Surface Measuring System: Develop technology options for satellite techniques for measuring oceanographic and marine boundary layer parameters from satellites and associated data processing. Increase of $444 thousand over FY 1982 is to prepare for handling of GEOSAT data prior to launch in early FY 1984. X0948, Precise Time and Time Interval: Improve flexibility of data handled in an automatic mode and

Program Element: 63207N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Environmental Applications
Budget Activity: 2 - Advanced Technology Development

increase the accuracy of the present Naval Observatory hydrogen maser clock. Increase of $146 over FY 1982 is for purchase of super conducting cavity oscillator. S1586, Future Integrated Navigation System: Begin design and system specification for modernization of conventional shipboard navigational system. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: The decrease of 1,350 in FY 1981 results from Navy Budget adjustments to Project W0512, Tactical Environmental Support System (-150); addition of 100 to Project W0514 to investigate improved methods of measuring wind aboard aircraft carriers; addition of 301 to Project W0527 for additional work to determine how weather prediction by numerical models is improved by additional satellite data over the oceans; cancellation of Project W1399 (-1,601). No changes in the FY 1982 funding amounts. The FY 1983 funding To Be Determined in the FY 1982 Descriptive Summary is now estimated to be funded at 7,094.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY (Amended):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,772	6,004	4,684	TBD	Continuing	Continuing
W0512	Tactical Environmental Support System	459	1,318	942*	TBD	Continuing	Continuing
W0513	Automated Environmental Prediction System	1,121	1,180	1,319	TBD	Continuing	Continuing
W0514	Meteorological Measuring System	829	543	1,071*	TBD	Continuing	Continuing
W0527	Remote Ocean-Surface Measuring System	1,253	1,242	1,240	TBD	Continuing	Continuing
X0948	Precise Time and Time Interval	110	120	112	TBD	Continuing	Continuing
W1399	National Oceanic Satellite System	0	1,601	0	TBD	0	0

*622 will be reprogrammed from Project W0514 to Project W0512 to support accelerated engineering development.

(U) OTHER APPROPRIATIONS FUNDS: Not Applicable.

Program Element: 63207N
Title: Environmental Applications
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The Program Element consists of four related projects involving environmental data acquisition, analysis and prediction of the ocean/atmosphere environment, and the prediction of weapon system performance variation due to changes in the environment, one project to increase the accuracy of the Department of Defense time standard; and one project to improve conventional navigation systems. W0512, Tactical Environmental Support System: Develop an automated shipboard system to predict the influence of the environment on the performance of shipboard weapon and sensor systems. Provide Command and Control with environmental tactical decision aids to select the most effective weapon/sensor system deployment methods. W0513, Automated Environmental Prediction System: Develop a shorebased automated numerical system which will provide accurate global environmental predictions to Navy operating forces. The area of interest extends from the operational depths of the ocean to the upper limits of the atmosphere. Emphasis in this project is on the development of computerized global oceanographic and atmospheric prediction models for accurate forecasts anywhere in the world. W0514, Meteorological Measuring System: Develop 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 displaying/storing and communicating environmental information and weapon systems performance indices. W0527, Remote Ocean-Surface Measuring System: Satellite sensor technology is being evaluated for measuring marine boundary layer characteristics from space under all weather conditions to support Anti-Submarine Warfare, amphibious landings, opposed transit operations and other surface and airborne naval operations. The additional quantity of data available from satellites is urgently needed to supplement current observations which are sparse and confined primarily to shipping lanes. Present operational sensors either lack the ability to see through clouds and/or have inadequate resolution. X0948, Precise Time/Time Interval: Provides a worldwide Department of Defense time standard to meet the increasingly precise time requirements of advanced communications, weapons and navigation systems. S1586, Future Integrated Navigation System: Provides upgrades to navigation systems aboard ships and aircraft.

(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.

(U) WORK PERFORMED BY: In-House: Naval Ocea 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.

Program Element: 63207N
Title: Environmental Applications
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: W0512, Tactical Environmental Support System: Tested interim Integrated Refractive Effects Prediction System aboard aircraft carriers. Completed Tactical Operational Requirement and developed systems analysis/rationale for the Tactical Environmental Support System advanced development model software and hardware. W0513, Automated Environmental Prediction System: Commenced operational evaluation of the global atmospheric prediction system. Completed development of the regional atmospheric prediction system and prepared for system evaluation. Continued evaluation of the nested tropical cyclone model. Continued development of a polar ice forecast model. Continued testing of a mixed-layer ocean prediction model and prepared a development plan for the model output statistics program. W0514, Meteorological Measuring System: Started production of the E-2 Airborne Microwave Refractometer. Completed the P-3/S-3 Dropsonde technical evaluation . Completed advanced development of the Mini-refractionsonde incorporating wind measurement. Completed and demonstrated the firmware package for the Naval Environmental Display Station 1A/1R prototype operating system. W0527, Remote Ocean-Surface Measuring System: Investigated cost effective systems for providing remotely sensed oceanographic data to include sensor, satellite and ground processing options. Completed the alternative concepts for joint National Aeronautics and Space Administration/National Oceanic and Atmospheric Administration/Department of Defense oceanographic satellite program. X0948, Precise Time and Time Interval: Initiated upgrade to the Naval Observatory's Data Acquisition System hardware. The data Acquisition System monitors and consolidates 20 Cesium beam standards which comprise the Master Clock System. W1399, National Oceanic Satellite System: Cancelled during development of the FY 1981 supplemental budget.

2. (U) FY 1982 Program: W0512, Tactical Environmental Support System: Continue evaluation of the interim Integrated Refractive effects Prediction System. Continue advanced development model development. Procure advanced development model hardware, including central processing unit disk, display, and hard copy devices. Initiate development of executive and support software. W0513, Automated Environmental Prediction System: Complete operational evaluation of the global atmosphere prediction system. Conduct evaluation of the regional and local atmospheric prediction systems. Complete operational evaluation of the tropical cyclone model. Conduct operational evaluation of the mixed-layer ocean prediction model. Conduct technical evaluation of the polar ice forecast subsystem. W0514, Meteorological Measuring System: Begin engineering development of the minisonde. Complete the Naval Environmental Display Station Improved Operating System development. Investigate alternative solutions to deficiencies in the Naval Environmental Display Station-1A/1R and its applications software. W0527, Remote Ocean Measuring System: Develop algorithms and software to process GEOSAT altimeter data into oceanographic parameters at Fleet Numerical Oceanography Center. X0948, Precise Time and Time Interval: Continue development of Data Acquisition System software to accept and process larger quantities of data. Provide environmentally controlled vaults for Department of Defense time standard.

3. (U) FY 1983 Planned Program: W0512, Tactical Environmental Support System: Complete Advanced Development Model integration and demonstration. W0513, Automated Environmental Prediction System: Complete operational evaluation of the global prediction model

and evaluation of the local (1-D) model and develop and evaluate the regional atmospheric prediction system. Complete evaluation of the mixed-layer ocean prediction model. Conduct operational evaluation of the Northern Hemisphere polar ice prediction model and commence evaluation of the Southern Hemisphere model. WU514, Meteorological Measuring System: Continue with implementation of the Naval Environmental Display Station 1A/1R plans. Design, fabricate and test the minisonde system prototype. WU527, Remote Ocean-Surface Measuring System: Continue development of sotware to process GEOSAT data. Test and evaluate techniques using various satellite sensors for obtaining wind data and sea surface temperature. X0948, Precise Time and Time Interval: Develop software to integrate regional time scales into one system based on improved Naval Observatory time scales. S1586, Future Integrated Navigation System: Commence project planning and system definition.

4. (U) FY 1984 Planned Program: WU512, Tactical Environmental Support System: Initiate hardware/software integration and prototype test and evaluation. WU513, Automated Environmental Prediction System: Incorporate stratospheric-tropospheric interactions into the global atmospheric prediction system. Commence evaluation of regional dynamic ocean models, i.e. Mediterranean, Indian Ocean, etc. Commence development of regional ice forecast models, e.g. Bering Sea. Commence development extending the one-dimensional local scale meteorology model to three-dimensional capabilities. WU514, Meteorological Measuring System: Obtain Approval for Service Use for the minisonde. Undertake advanced development of a laser atmospheric profiler. Undertake advanced development of a shipboard meteorological/oceanographic measuring system. WU527, Remote Ocean-Surface Measuring System: Commence fleet utilization and evaluation of oceanographic data from satellite altimetry data. Continue testing of techniques for obtaining wind data from geostationary and Defense Meteorological Satellite Program satellites. X0948, Precise Time and Time Interval: Commence integration of superconducting cavity oscillator into the Naval Observatory master clock system. S1586, Future Integrated Navigation System: Continue system design and prototype development.

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

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63210N
Title: Advanced Aircraft Propulsion Systems
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	328,448	331,265
W1631	Increased Capacity APU	0	0	2,190	791	2,800	5,781

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element contains a joint Air Force/Navy project that enhances the services' propulsion capability through advanced technology demonstrator engines which provide a realistic integrated performance and structural assessment of advanced components, applicable to broad classes of future aircraft systems, as well as a project by which advanced components applicable to Navy needs are developed. It also contains a joint Air Force/Navy program for the design and fabrication of early prototype versions of the next generation of large, high-thrust engines, using, as far as possible, a common, multiple application engine core. The fourth project provides for development of a longer capcity auxiliary power unit (APU) for the S-3A aircraft, to cool and power the aircraft independent of the ground support equipment (GST).

(U) BASIS FOR FY 1983 RDT&E REQUEST: The funds requested will be used for continuation of technology programs initiated under multi-year incrementally funded contracts including full scale testing of Joint Technology Demonstrator Engines; continued development of full authority digital electronic controls, advanced high pressure turbines and additional advanced technology engine components; fabrication and extended life testing of promising new components, all under the Propulsion Component Technology project for continuing planning and concept definition under the Multiple Application Core Engine program; and for continuing development of the increased capacity S-3A APU. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only, except for Projects W1548 an W1631, for which the above funding includes all work or development phases now planned or anticipated.

(U) COMPARISON WITH THE FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: -92 in FY 1981, -889 in FY 1982, and -652 in FY 1983, reductions due to overall Navy Budget decreases and refinements in escalation estimates; and by first time funding for the Increased Capacity APU and the Multiple Application Core Engine projects.

am Element: 63210N
ission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Propulsion Systems
Budget Activity: 2 - Advanced Technology Development

UNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY:

ct	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	17,836	14,596	9,879	10,765	Continuing	Continuing
	Joint Technology Demonstrator Engine	15,874	9,587	7,054	7,683	Continuing	Continuing
	Propulsion Component Technology	1,962	5,009	2,825	3,082	Continuing	Continuing

THER APPROPRIATION FUNDS: Not Applicable.

Program Element: 63210N
Title: Advanced Aircraft Propulsion Systems
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: W0580, Joint Technology Demonstrator Engine - Under this project, advanced technology components developed in the Navy's Propulsion Component Technology project, as well as under the Air Force's Advanced Turbine Engine Gas Generator and Aircraft Propulsion Subsystem Integration projects, are integrated, at contractor plants, into complete technology demonstrator engines which are used to define integrated engine technology. Successful implementation of this effort will provide the foundation for entering a sound engineering development program for future Navy engines. Technology being developed is part of, and is used in implementing, the Joint Navy/Air Force Turbine Engine Advanced Development Plan. W0582, Propulsion Component Technology - This program provides technical impetus to contractor's in-house efforts on advanced component technology for future propulsion systems which will accelerate technological availability by 15 to 20 years. Current efforts are directed toward variable geometry, high work extraction turbines (such as Navy Advanced High Pressure Turbine) and Full Authority Digital Electronic Controls. Turbines provide 50% reduction in number of stages; 100 lb weight reductions, and $20 thousand to $40 thousand cost reductions per engine, when compared to current engines. Variable geometry provides 30% reduction in cruise Specific Fuel Consumption; 50% shorter transient response; and 15% improvement in surge margin. The Digital Electronic Control can handle twice the number of variables with reduced equipment complexity, plus 60% weight reduction and 40% cost reduction over current engine controls.

(U) W1538, Multiple Application Core Engine - Provides a formal program, in response to Congressional direction, for the design and fabrication of early prototype versions of the next generation of large, high-thrust engines, which will fulfill the needs of the Naval Aviation Plan, Sea Based Air Master Study and other related studies. This program is directed at achieving significant increases in reliability and durability relative to current fighter and attack engines and at specifically reducing life cycle costs by as much as 30%. This is a joint program with the Air Force.

(U) W1031, Increased Capacity APU - This project will provide for development and integration of a larger capacity Auxiliary Power Unit (APU) in the S-3A aircraft, to cool and power the airplane independent of other Ground Support Equipment (GSE). The added capacity will also provide increased airborne redundance, safety, and reliability. Integration of the new unit into the S-3A will require some airframe and Environmental Control System (ECS) changes. The expected changes in APU performance will nearly double airflow (48 ppm to 80 ppm) and increase electrical output from 2KVA to 6GKVA. The addition of a larger, more reliable unit will allow ground operation of avionics/electrical equipment in a cooler environment thus increasing their reliability. The new APU will support the Weapon System Improvement Program (PE 64217N) avionics.

(U) RELATED ACTIVITIES: W0580, Joint Technology Demonstrator Engine - Contains related work in W0582-SL, Propulsion Component Technology, PE 63202F, Aircraft Propulsion Subsystem Integration, and PE 63216F, Advanced Turbine Engine Gas Generator. W0582, Propulsion Component Technology - The Air Force has the Advanced Turbine Engine Gas Generator, PE 63216F, and Aircraft Propulsion Subsystem Integration, PE 63202F, underway, which are developing and evaluating advanced 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 Air Force. Air Force Aero Propulsion Laboratory representatives have reviewed and concurred in

the component work statements, and have also participated in the evaluation of proposals and selection of contractors. A Joint (Navy/Air Force) Turbine Engine Advanced Development Plan has been developed which defines both Air Force and Navy technology and demonstrator engine programs and advanced propulsion component technology for joint or single service support. The Air Force out-year plans reflect and include joint service requirements. W1548 - Multiple Application Core Engine - This is a joint program with the Air Force. W1631 - Increased Capacity APU - No related Air Force activities.

(U) WORK PERFORMED BY: W0580, Joint Technology Demonstrator Engine - In-House: Naval Air Propulsion Center, Trenton, NJ; Naval Air Systems Command, Washington, DC. Contractors: General Electric Company, Cincinnati, OH; Detroit Diesel Allison Division, Indianapolis, IN; Teledyne CAE, Toledo, OH; Pratt and Whitney Aircraft, West Palm Beach, FL. W0582, Propulsion Component Technology - In-House: Naval Air Development Center, Warminster, PA; Naval Air Propulsion Center, Trenton, NJ; Naval Air Systems Command, Washington, DC; United States Naval Academy, Annapolis, MD; Naval Postgraduate School, Monterey, CA; National Aeronautics and Space Administration, Dryden Flight Test Center, Edwards Air Force Base, CA. Contractors: Pratt and Whitney Aircraft, West Palm Beach, FL; General Electric Company, Evendale, OH. W1548 - Multiple Application Core Engine - In-House: Naval Air Propulsion Center, Trenton, NJ; Naval Air Systems Command, Washington, DC. Contractors: To be determined. W1631 - Increased Capacity APU - In-House: Naval Air Propulsion Center, Trenton, NJ; Naval Air Development Center, Warminster, PA; Naval Air Systems Command, Washington, DC. Contractor: Garrett Turbine Engine Company, Pheonix, AZ.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: W0580, Joint Technology Demonstrator Engine - The program was initiated early in FY 1976. Contracts were let with two of the three major engine manufacturers, General Electric and Detroit Diesel Allison Division, to incorporate Navy/Air Force components into Joint Technology Demonstrator Engines. A contract was also let to Teledyne/CAE for fan and fan nozzle adaptive hardware for their small demonstrator engine. During FY 1980, a contract was let with Pratt and Whitney to involve them in the program. Detailed engine design, fabrication and/or tesing is in progress. Also during FY 1980, Congress mandated enhanced engine/component reliability, and additional items of work were contracted for at Pratt and Whitney, General Electric and Teledyne/CAE to support this mandate. W0582, Propulsion Component Technology - Boilerplate engine ran for five hours at turbine inlet temperatures over 3,000 degrees F and two hours over 3,400 degrees Fahrenheit. Initial contracts for Advanced Development programs executed June 1972 - numerous additional contracts since. Specific past accomplishments have included (a) Shingle Liner Combustor: General Electric Company - Completed full scale annular rig tests; completed combustor/variable area turbine nozzle tests; (b) Advanced High Temperature combustor: Detroit Diesel Allison Division - completed full scale high temperature rig tests; completed Advanced Turbine Engine Gas Generator tests; (c) Variable area high pressure turbine: Pratt-Whitney Aircraft Division - Completed full-scale cooled rotating rig test, completed Engine Gas Generator Performance Test; (d) Variable area high pressure turbine: Detroit Diesel Allison Division - Completed full-scale cooled aerodynamic rig test; (e) Variable area low pressure turbine: Pratt-Whitney Aircraft Division - Initial program terminated (no additional costs) due to poor cooled efficiency results determined in high pressure turbine program and was replaced by a newer

second generation program; (f) Variable area low pressure turbine. Detroit Diesel Allison Division - Demonstrated satisfactory manufacturing procedures for high pressure turbines and combustors, and the hardware is being incorporated into the contractor's engine designs for full-scale engine testing. A second generation variable area high pressure turbine was initiated. Development and testing was continued on the Full Authority Digital Electronic Control capable of controlling complex, variable cycle engines for advanced Vertical/Short Take-Off and Landing and Conventional Take-Off and Landing aircraft. During FY 1981 Navy Advanced *High Pressure Turbine program was continued , and Swirl Augmentor program was continued. The Directionally Solidified Eutectic* Turbine Blade program was successfully completed and results are being adapted for production development.

2. (U) FY 1982 Program: W0580, Joint Technology Demonstrator Engine - Complete testing planned under Phase I program. Continue further development at Teledyne, General Electric, Pratt and Whitney and Detroit Diesel under Phase IA program. Initiate additional cyclic/structural testing programs at each manufacturer, in support of FY 1980 Congressional mandate. W0582, *Propulsion Component Technology* - Ongoing programs will continue. Augmented Deflector Exhaust Nozzle flight test program planning will continue as will NASA/Navy FADEC/F-14 flight testing planning. Additional component technology development programs will be initiated (to include Lamilloy Combustor/HP turbine, more cyclic rig test, pressure bonded blade and disc, Re/50 turbine coating cyclic/oxidation test, single piece/single crystal high pressure turbine blade testing, and rear bearing/seal rig test). W1548, Multiple Application Core Engine - USN/USAF Memorandum of Understanding and Memorandum of Agreement signed. Initial concept definition effort on sixteen different systems in 30 configurations to be completed in early FY 82. W1631, Increased Capacity APU - Preliminary requirements and specifications are being generated for the competitive procurement of an APU to meet the interface and output requirements.

3. (U) FY 1983 Planned Program: W0580, Joint Technology Demonstrator Engine - Continue Phase IA development and testing. Initiate Fuel conservative Propulsion System development. W0582, Propulsion Component Technology - The Full Authority Digital Electronic Control and high pressure turbine programs will be completed. Navy/NASA program planning will continue and should result in a definitized plan. W1548, Multiple Application Core Engine - Initiate validation phase with effort in core engine detail design. W1631, Increased Capacity APU - Development, fabrication of test articles, and qualification of a unit.

4. (U) FY 1984 Planned Program: W0580, Joint Technology Demonstrator Engine - Phase IA testing will be completed. Fuel Conservative Propulsion System development will continue. Tandem fan Propulsion System development will be initiated. W0582 Propulsion Component Technology - Navy/NASA programs will continue. New compressor program will be initiated, as well as other components. W1548, Multiple Application Core Engine: Complete detailed design competition. W1631, Increased Capacity APU: Qualification testing and flight test article clearance will be completed. Technical Evaluation and Operational Evaluation will be completed leading to Approval for Service in FY 84.

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

Program Element: 63210N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Propulsion Systems
Budget Activity: 2 - Advanced Technology Development

6. (U) Milestones: Not applicable.

Project: W0580 Title: Joint Technology Demonstrator Engine
Program Element: 63210N Title: Advanced Aircraft Propulsion Systems
DoD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: - Under this project, advanced technology components developed in the Navy's Propulsion Component Technology project, as well as under the Air Force's Advanced Turbine Engine Gas Generator and Aircraft Propulsion Subsystem Integration projects, are integrated, at contractor plants, into complete technology demonstrator engines which are used to define integrated engine technology. The first class of these Joint Technology Demonstrator Engines, designed for the transonic-supersonic flight regime, is currently completing fabrication. Initial testing has been completed. These tests have substantiated performance and reliability of advanced gas generator and low pressure spool component hardware in realistic engine test environment. Successful implementation of this effort will: 1) substantially lower risks associated with component hardware and 2) determine practical envelope, weight, and cost requirements for future engine, thereby providing the foundation for entering a sound engineering development program for future Navy weapon systems. Technology being developed is part of, and is used in implementing the Joint Navy/Air Force Turbine Engine Advanced Development Plan.

(U) RELATED ACTIVITIES: - Contains related work in W0582, Propulsion Component Technology; PE 63202F, Aircraft Propulsion Subsystem Integration; and PE 63216F, Advanced Turbine Engine Gas Generator.

(U) WORK PERFORMED BY: - In-House: Naval Air Propulsion Center, Trenton, NJ; Naval Air Systems Command, Washington, DC. Contractors: General Electric Company, Cincinnati, OH; Detroit Diesel Allison Division, Indianapolis, IN; Teledyne CAE, Toledo, OH; Pratt and Whitney Aircraft, West Palm Beach, FL.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The program was initiated early in FY 1976. Contracts were let with two of the three major engine manufacturers, General Electric and Detroit Diesel Allison Division, to incorporate Navy/Air Force components into Joint Technology Demonstrator Engines. Contract also let to Teledyne CAE for fan and fan nozzle adaptive hardware for their small demonstrator engine. Engine testing was continued at all contractor facilities during FY 1980. During FY 1980, a contract was let with Pratt and Whitney to involve them in the program. Detailed engine design, fabrication and/or testing is in progress. Also during FY 1980, Congress mandated improved/enhanced engine/component reliability, and additional items of work were contracted for at Pratt and Whitney, General Electric and Teledyne/CAE to support this mandate. These include: (1) General Electric - dynamic intershaft engine seal development; Stage 1 fan pressure bonded disk; coated low pressure turbine blade evaluation; engine demonstrator test of advanced augmentor flameholder; improved durability high pressure turbine blade materials; and tip-treatment evaluation of high pressure turbine sloped tip blades; (2) Pratt and Whitney - assemble, instrument, rig test and analyze data for 5-stage high-through-flow high-pressure compressor; develop single crystal alloy 560 for high pressure turbine vane application and substantiate a fabricated turbine vane ring approach; design, fabricate and test a rig to verify operating characteristics and durability of rotor, lubrication, bearing and seal designs; and procure and rig test a set of single-crystal high pressure turbine blades; and (3) Teledyne/CAE - conduct roller bearing and seal development and rig tests to

Project: W0580 Title: Joint Technology Demonstrator Engine
Program Element: 63210N Title: Advanced Aircraft Propulsion Systems
DoD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

optimize design and incorporate full life hardware for Joint Technology Demonstrator Engine; procure spare set of high pressure compressor hardware and conduct a rig test to define variable geometry compressor performance; and procure hot section refurbishment hardware and conduct accelerated mission testing of Joint Technology Demonstrator Engine build number six.

2. (U) FY 1982 Program: Complete testing planned under Phase I program. Continue further development at Teledyne, General Electric, Pratt and Whitney and Detroit Diesel under Phase IA program. Initiate additional cyclic/structural testing programs at each manufacturer, in support of FY 1980 Congressional mandate.

3. (U) FY 1983 Planned Program: Continue Phase IA development and testing. Initiate Fuel Conservative Propulsion System development.

4. (U) FY 1984 Planned Program: Phase IA testing will be completed. Fuel Conservative Propulsion System development will continue. Tandem Fan Propulsion System development will be initiated.

5. (U) Program to Completion: This is a continuing technology development program.

6. (U) Milestones: Not Applicable.

7. (U) Resources:

Project No.	Title	FY1981 Actual	FY1982 Estimate	FY1983 Estimate	FY1984 Estimate	Additional to Completion	Total Estimated Cost
W0580	Joint Technology Demonstrator Engine	9,419	6,033	5,364	6,309	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63216N
Title: Airborne Life Support System
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	Helo A/C Survivability Enhancement Project	0	796	1,279	0	0	2,075

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element provides for the development of integrated, advanced airborne life support systems designed to protect aircrews from all natural and induced environmental/physiological stresses and/or hazards encountered during military flight operations without encumbering inflight performance. Typical efforts include protection of aircrewmen from inflight physiological or environmental stresses (e.g. acceleration/G forces, vibration, buffet, debilitating temperatures) and all other protective clothing and devices related to inflight/underwater escape and postflight survivable/rescue.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Develop protective clothing and device subsystems for helicopter, fighter/attack, and patrol/transport missions. Complete developmental test and evaluation of figher/attack subsystems. Establish design concepts for patrol/transport systems. Initiate requirements analysis for related aircrew protective devices (restraint, anti-exposure, cooling, etc.). Completed subsystems will transition to Engineering Development (PE 64264). Complete fabrication of lighting subsystems for Helicopter Aircrew Survivability Enhancement project; install and initiate testing. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only, except for projects W0888 and W1401, for which the above funding includes all work or development phases now planned or anticipated.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are a reduction of 21 in FY 1981 in the Maximum Performance Ejection system as a result of the application of the inflation index and an increase of 133 in the Aircrew Protective Clothing and devices to accommodate the start-up and completion of the Offensive/Defensive Multiwavelength Laser project; in FY 1982 a reduction of 10 in Helo Aircrew Survivability and 24 in Aircrew Protective Clothing and Devices are a result of application of the inflation index and a reduction of 2797 in the Maximum Performance Ejection Systems from Congressional reductions and resulted in the termination of this project. In FY 1983 a reduction of 37 in Helo Aircrew Survivability and 575 in Aircrew Protective

Program Element: 63216N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Airborne Life Support System
Budget Activity: 2 - Advanced Technology Development

Clothing and Devices as a result of Navy Budget refinement. The FY 1983 reduction of 5224 in the Maximum Performance Ejection System is due to termination of the project.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,847	4,409	5,971	9,319	Continuing	Continuing
W0584	Aircrew Protective Clothing and Devices	756	2,065	1,878	2,779	Continuing	Continuing
W0888	Maximum Performance Ejection System	1,089	2,344	3,287	5,224	1,861	14,047
W1401	Helo A/C Survivability Enhancement Project	0	0	806	1,316	0	2,122

(U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 63216N
Title: Airborne Life Support System
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Aircrew Protective Clothing and Devices is an advanced development program which will provide each aircrewman with a functionally integrated system of protective clothing and equipment which ensures protection against natural and induced environmental or physiological hazards encountered during routine, combat and emergency flight operations, and during escape, survival and rescue following loss of the aircraft. Current equipments issued for aircrewman protection may be considered generally adequate when assessed on the individual component level. However, when these equipments are worn and utilized collectively during the routine performance of a mission, the aircrewman experiences significant penalties in thermal comfort, and mobility due to the weight, bulk, and misintegration of the equipment. The net results are numerous adverse effects on aircrewman performance, endurance, and efficiency which seriously hamper overall mission effectiveness. In order to implement a total system concept, this program develops and integrates mission specific aircraft life support and escape subsystems with personal items of life support equipment typically worn by the aircrewman. All subsystem elements are fabricated and extensively tested and evaluated in flight. Typical subsystems include protective clothing and devices such as lightweight head and body protection, crashworthy seats, encapsulating flotation, automatic parachute releases, automatically inflated survival gear, oxygen breathing systems, lightweight restraint and retention systems and laser beam eye protection. Helicopter Fighter/Attack and Anti-Submarine Warfare/Patrol life support systems will be developed. The Maximum Performance Escape System provides high speed escape, inflight or ejection positioning and restraint, and also permits ejection from an inverted aircraft at altitudes as low as 50 feet. The Helicopter Aircrew Survivability Enhancement Project is a natural outgrowth of helicopter aircrew protective and survival technology, first developed under Aircrew Protective Clothing and devices. Prior efforts developed crash impact energy attenuating seats, automatically expelled life raft design, fuel fire suppression and automatic hatch severance principles. The present project concentrates on helicopter hatch lighting to enhance aircrew egress. Existing technology will be exploited to develop perimeter lighting of all escape hatches. Present plans call for the progressive incorporation of advanced development subsystems, upon completion, into fleet helicopters via aircraft Operational and Safety Improvement Programs.

(U) RELATED ACTIVITIES: Efforts are coordinated with Army and Air Force through meetings of the Tri-Service Life Support Equipment Steering Group and exchange of data in accordance with existing Tri-Service Agreements.

(U) WORK PERFORMED BY: In House: Naval Air Development Center, Warminster, PA (lead laboratory); Naval Weapons Center, China Lake, CA; Naval Ordnance Station, Indian Head, MD; Naval Air Test Center, Patuxent River, MD; Pacific Missile Test Center, Pt Mugu, CA. Contract: JMR Inc., Salem, NH: Energy Systems Co., Nashua, NH; Gentex Co., Carbondale, PA; David Clark Co., Worchester, MA: Aerotherm Corp., Mountain View, CA; ILC Industries, Dove DE; Lear-Siegler Corp., Los Angeles, CA; V-Tec Corp., Dayton, OH; East West Industries, Long Island, NY; Ling Tempco Vought (LTV), Inc., Dallas, TX.

Program Element: 63216N
Title: Airborne Life Support System
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: For the Helo Aircrew Survivability Program, crashworthy helicopter seats and restraint systems for all helicopter stations have been successfully tested. Under the Aircrew Protective Clothing and Devices project, high Q ejection tower tests were successfully completed for the Advanced Restraint System. Contract awarded for fabrication of Multiwavelength Laser protective visor. Cordless communication prototypes for helicopter air and ground crews have been developed and procured for advanced development testing. The inflator system for the Inflatable Body-Head Restraint System successfully completed developmental testing. The Maximum Performance Ejection System entered advanced development in FY 1979. Successful rocket powered ejections from a statically suspended aircraft cockpit section have been demonstrated at both 90 and 180 degrees off the vertical. The vertical seeking subsystem propelled the seat in a controlled upward trajectory with a maximum altitude loss of less than 50 feet. Subsystem hardware has been fabricated and 100 knot dynamic tests successfully tested for the Restraint/Catapult/Structure Subsystems.

2. (U) FY 1982 Program: For Aircrew Protective Clothing and Devices: Award fabrication contract and prepare test plans for the Heat Sealed Multi-place Life Raft. Fabricate system prototypes for the Offensive/Defensive Multiwavelength Laser, Servo Anti-G Valve and the 600 Knot Helmet. Initiate laboratory test and evaluation for the Helicopter Helmet Transceiver and Cooling Systems, Servo Anti-G Valve, 600 Knot Helmet and Advanced Restraint Subsystem components. Complete laboratory test and evaluation for the Encapsulating Life Raft with self closure system. Complete requirements analysis for Patrol/Transport missions. Complete flight tests for the Inflatable Body-Head Restraint System. For Maximum Performance Escape System: Project funding withdrawn. Close out contracts, complete documentation and specifications as of FY 1982. For Helicopter Aircrew Survivability Enhancement Project: Receive and test hatch lighting models.

3. (U) FY 1983 Planned Program: For Aircrew Protective Clothing and Devices: Initiate developmental test and evaluation for Heat Sealed Multi-place Life Raft and the Offensive/Defensive Multiwavelength Laser. Complete test and evaluation for the Helicopter Helmet Transceiver and Cooling Systems, Multiwavelength Laser, Servo Anti-G Valve and the 600 Knot Helmet Protection System. Complete Advanced Restraint design trade-off studies. Validate Inflatable Body-Head Restraint Systems. Initiate new starts, as required, from requirements identified in Patrol/Transport mission analysis. For Helicopter Aircrew Survivability Enhancement Project: Install hatch lighting models. Conduct developmental testing of system. Evaluate test results. Final systems complete advanced development FY 1983.

4. (U) FY 1984 Planned Program: For Aircrew Protective Clothing and Devices: Fabricate Advanced Restraint Subsystems. Complete development test and evaluation for Heat Sealed Multiplace Life Raft. Complete Requirements Analysis for Related Protection systems. Continue development cycle for new starts resulting from Patrol/Transport Mission Analysis. Transition laser protection to engineering development. For Helicopter Aircrew Survivability Enhancement project: Program completes FY 1983. Improvement products ready for engineering development, FY 1984.

Program Element: 63216N
Title: Airborne Life Support System
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

5. (U) Program to Completion: For Aircrew Protective Clothing and Devices: Continuing program provides state-of-the-art protection for aircrewmen during flight, bailout, survival and rescue. Tasks remaining to be completed are the design and fabrication of Related Protection systems and the developmental test and evaluation of multifunctional protection equipments for Helicopter, Fighter/Attack Related Protection and Patrol/Transport type missions. Complete respective Integrated Logistics Support Plans, Reliability and Maintenance Plans, and the System Safety Plans. Individual items transition into engineering development upon completion.

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPIVE SUMMARY

Program Element: 63217N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Subsystems
Budget Activity: 2 - Advanced Technology Development

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

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 Airborne Early Warning Radar	0	1,144	1,187	5,134	Continuing	Continuing
W0516	Advanced Avioptics	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 System	0	1,003	1,241	2,646	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced aircraft avionic subsystems are developed under this program element with the objectives of upgrading system performance, reliability, and survivability while reducing weight, volume, and cost. The projects have a common emphasis on the utilization and insertion of new technologies in ongoing systems as well as their avionic system architectures. Related physical and electrical standard interfaces developments adaptable to different platform types and which will facilitate the introduction of new technologies and subsystems are developed.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Advanced Airborne Early Warning Radar Project - Conformal wing array demonstration utilizing adaptive techniques to counter multiple jammers and high clutter environments. Initiation of L-band body mounted array demonstration. Avioptics Project - Continuation through flight test of advanced data bus and discreet fiber optic links developed under previous contracts. Modular Avionics Packaging Project - Continue advanced development of family of avionics modules with standard packaging approach for module frames, connectors, and cooling. Information Handling System Project - Complete Avionic Processing System Design Methodology development. Apply methodology to proposed distributed processing system. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousand) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: Modular Avionics Package Project: There is no change in the total estimated cost of the project, but the project will take an additional year to complete due to decreases in funding FY 82 and 83 as follows: FY 82 -16, FY 83 -749. Information Handling System - FY 1982 -13; FY 1983 -595: Advanced Avioptics - FY 1982 -319, FY 1983 -1,026. Advanced Early Warning Radar - FY 1982 -421, FY 1983 -1,953. The changes are due to Navy budget adjustments in favor of higher priority programs.

Program Element: 63217N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Subsystems
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,332	0	5,269	9,251	36,261	56,160
W0446	Advanced Airborne Early Warning Radar	3,682	0	1,565	3,140	10,668	19,055
W0516	Advanced Avioptics	0	0	1,420	2,239	8,023	11,708
W0607	Digital Flight Control Subsystem	1,650	0	0	0	0	1,650
W0885	Modular Avionics Packaging	0	0	1,268	2,036	9,279	12,604
W0892	Information Handling System	0	0	1,016	1,836	8,291	11,143

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63217N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Subsystems
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The Advanced Airborne Early Warning Radar Project is developing an Advanced Airborne Early Warning Radar with advanced adaptive Electronic Counter-Counter Measures techniques which will meet the 1990 threat encountered by Navy aircraft in performing Airborne Early Warning and surveillance missions. The primary emphasis is directed toward substantial reductions in weight, volume, power, and improved performance under Electronic Counter Measures conditions. Advanced Avioptics project is applying fiber optics technology to present and projected avionics data buses. Systems architecture and hardware development through flight test are being performed. The Modular Avionics Packaging project has the primary objectives of establishing lightweight, thermally efficient packaging suitable for multiplatform applications and a standard module concept for commonly used avionics hardware. The Information Handling System project is developing systems architectural concepts to provide the capability required for integrated core and mission avionics systems in post-1985 platforms. Emphasis will be placed on development of Avionic System Design Methodology, fault tolerant designs, and automated decision aids for improved mission performance.

(U) RELATED ACTIVITIES: USAF Digital Flight Control System Program at Wright Patterson Air Force Base Flight Dynamics Laboratory; US Army Avionics Group, Ft. Monmouth, NJ (Airborne Crash Recorders); Navy's Standard Electronic Module Program; United Kingdom Data Exchange Agreement; Fiber Optics DoD/Navy Avionics Components and Subsystems (AVCS) Program 64203N Defense Standardization; Very High Speed Integrated Circuit Program; Advanced Memory Module, S3A Computer Memory Loader Update Program.

(U) WORK PERFORMED BY: In-House: Naval Research Laboratory, Washington, DC; Naval Air Development Center, Warminster, PA; Naval Ocean Systems Center, San Diego, CA. Contractors: IBM, Owego, NY; LTV, Dallas, TX; Hughes Aircraft, Los Angeles, CA; General Dynamics, Fort Worth, TX; McDonnell Douglas, St. Louis, MO.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Advanced Airborne Early Warning Radar - The Advanced Airborne Early Warning Radar was integrated with solid state Ultra High Frequency transmit/receive modules with 512:1 pulse compression. Module operation was tested and evaluated and recommendations were made for design improvements. A Brassboard Signal Processor was constructed and successfully integrated for a feasibility demonstration of the Wing Array as an Airborne Early Warning Receiver Surveillance Radar Antenna. Full power tests were conducted from a rooftop facility. Advanced Avioptics - The Avioptics Program was initiated in FY 79 and has resulted in four major contracts: (a), YAV-8B Data Link Electromagnetic Interference and Lightning Developments with Flight Test which has resulted in the selection of a fiber optic link for the production AV-8B (McDonnell Douglas); (b), Development of a MIL-STD 1553B 16 Terminal Fiber Optic Data Bus and design of a 50 MEGA BIT/sec High Speed Data Bus (IBM); (c) stores management interface data link development; and (d), development of a fiber optic radar delay line installed in the YAV-8B composite wing. A simulated Fiber Optic Stores Management System was flight tested in the prototype aircraft. Hardware has been delivered under the remaining contracts. Modular Avionics Packaging - An avionics module family has been identified and documentation for the integrated enclosure has been prepared. A system demons tration candidate has been identified on the A-6E.

Program Element: 63217N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Subsystems
Budget Activity: 2 - Advanced Technology Development

Information Handling System - Fault-tolerant Design Requirements for the Distributed Processing Systems Architecture for proposed future Naval Aircraft established. Reports delivered. Advanced Demonstration Model Solid State Recorder was installed at Naval Air Test center F-18 system integration lab and Test and Evaluation completed. Advanced Airborne Early Warning Radar - System Integration and performance tests will be initiated using prior developed hardware. Electronic Counter Counter Measures evaluation will be concurrently initiated with the system tests. Initial Radar/Wing Antenna Physical Specifications will be developed for use in Aircraft Installation Impact Definition. Digital Flight control subsystems flyable hardware delivered.

2. (U) FY 1982 Program: (C) Advanced Airborne Early Warning Radar - Development of a passive airborne wing array test bed will be initiated. [ ]

3. (U) FY 1983 Planned Program: (C) Advanced Airborne Early Warning Radar - Brassboard radar equipment will be procured, and ground tested for performance evaluation in Electronic Countermeasures environment. Flight vehicle design impact will be further defined, based on achieved equipment maturity. Advanced Avioptics - Continue development and flight test of MIL-STD-1553B data bus, fabricate a brassboard 50 Mega bit per second data bus. Design of video bus and discrete radar and electronic countermeasures links. Modular Avionics Packaging - Continue development and testing of hardware associated with this project (modules, connectors, standard enclosures, and integrated racks) and continue support of system demonstration candidates.

4. (U) FY 1984 Planned Program: Advanced Airborne Early Warning Radar - Start flight test for passive Electronic Counter-Countermeasures wing array. Add solid state ultra high frequency transmitters to breadboard modules. Continue development of L-band body mounted array. Advanced Avioptics - Demonstrate flight worthiness of 50 mega bit per second fiber optic data bus. Fabricate a brassboard video data bus. Modular Avionics Packaging - Prepare change of existing MIL standards or specifications for utilization of Modular Packaging Technology. Incorporate new technology advances into the project. Continue support of system demonstration candidates. Information Handling - Define post-1985 avionics digital processing system functions and their subsystem interfaces. Continue system architectural trade-off studies.

5. (U) Program to Completion: Advanced Airborne Early Warning Radar - Complete development of lightweight multifrequency surveillance radar and prepare engineering development specifications for selected options. Advanced Avioptics - Hardware demonstration of video and high speed data buses including development and flight test of radar, Electronic Warfare, video, Electronic Countermeasures and high speed digital internal links. Development of critical components and procurement specifications. Modular Avionics Packaging - Demonstration of hardware to accomodate, speed, power, and functional density of Very High Speed Integrated Circuit devices. Design and incorporation of packaged devices in improved and/or newly developed avionics systems. Information Handling - Simulation of alternative system architectures resulting in laboratory implementation of a selected system architecture for tactical aircraft. Flight demonstrations of selected architectural concepts and decision algorithms.

Program Element: 63217N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Advanced Aircraft Subsystems
Budget Activity: 2 - Advanced Technology Development

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63251N
DoD Mission Area: 553 - Engineering Technology (ATD)
Title: Aircraft Systems (Advanced)
Budget Activity: 2 - Advanced Technology Development

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

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 (VFMX)	925	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	VPX	0	0	0	0	Continuing	Continuing

(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 Lightweight Hydraulic System Project (funded in FY 1980 and prior years and with planned funding for FY 1985) will provide smaller, more compact and lighter hydraulic systems to accommodate future hydraulic power requirements of advanced airframes. The Composite Structures project will provide major primary composite structures for tactical aircraft offering reduced weight, improved corrosion resistance, and increased battle damage tolerance.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Funds requested are required for continued development and test of the Composite Aircraft Structures Project. This technology project is applicable to all future tactical aircraft developments and includes design, fabrication and test of composite aircraft fuselage components. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipted through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are +989 in FY 1981, -1166 in FY 1982, and -4,803 in FY 1983. In FY 1981 the Composite Structures for Advanced Aircraft Project was increased +263 due to CNO direction to accelerate development of damage tolerant advanced composite fuselage structure. The reduction of -1,166 from the Composite Structures for Advanced Aircraft Project in FY 1982 results from Navy distribution of an overall budget reduction. The reduction of -4,803 in FY 1983 occurred as a result of rescheduling (stretch-out) of the Lightweight Hydraulics effort and distribution of Navy Budget reductions to the Composite Structures program, which will also result in stretch-out of that effort.

Program Element. 63251N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Aircraft Systems (Advanced)
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,989	4,941	4,910	8,233	Continuing	Continuing
W0586	Lightweight Hydraulic System	3,341	0	0	2,746	Continuing	Continuing
W0647	Composite Structures for Adv Aircraft	3,451	4,742	4,910	5,487	Continuing	Continuing
W0588	Advanced Aircraft Concept Formulation	197	199	0	0	0	0

(U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: 63251N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Aircraft Systems (Advanced)
Budget Activity. 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: WO586, Lightweight Hydraulic System: This project will provide for the hydraulic power requirements of future advanced aircraft. The increasing demand for greater aircraft mission performance in addition to aerodynamic requirements of thin wing, high density airframes has accentuated the need for a less voluminous hydraulic power system. The concept using high pressure fluid technology, hydraulic seal technology and titanium welding techniques to achieve large reductions in system weight (30%), space (40%), and maintenance requirements (25%), increased reliability and survivability over existing hydraulic power systems. WO647, Composite Structures for Advanced Aircraft: This project will develop and evaluate major primary composite structures for tactical aircraft applications. In general, composite structures provide the most economical path to major reductions in aircraft weight while reducing maintenance and increasing structural service life. Composite materials are highly desirable for all future Naval aircraft, essential to Vertical/Short Take off and Landing aircraft and helicopters where weight and fatigue life are critical items. The initial development article, to obtain system gains of reduced weight, increased corrosion resistance and battle damage tolerance, while maintaining or reducing costs, was the composite wing for the Advanced Harrier (AV-8B).

(U) RELATED ACTIVITIES: 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 R&D in program elements 62761N and 62241N provide the technology base for the Composite Structures for Advanced Aircraft Program.

(U) WORK PERFORMED BY: Lightweight Hydraulic System In-House: Naval Air Development Center, Warminster, PA. Contractors: Rockwell International, Columbus, OH; Vickers, Jackson, MS, and Vought Aircraft, Dallas, TX. Composite Structures for Advanced Aircraft. 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, and Lockheed California Company, Burbank, CA; and Boeing Military Airplane Company, Seattle, WA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Lightweight Hydraulic System accomplishments include the establishment of feasibility for high fluid pressure operation, determination of system performance characteristics, development and testing of an 8,000 psi pump, actuator and other Lightweight Hydraulic System components, development and sizing of titanium tubing, permanent tube connectors, fittings and hoses, completion of selection and endurance testing of seals and hydraulic fluid component design for simulation; and fabrication of simulation initiated. The Composite Structures for Advanced Aircraft project completed the design for the AV-8B composite wing and forward fuselage. Results indicate a producible, economic design with a predicted 26% weight savings. Progress through this program element supports wing weight and producibility projections, and also includes fabrication, assembly, and structural test of the full scale AV-8B composite wing main torque box. Evaluation is underway of aircraft critical

assemblies for fuselage structures, commencing with patrol aircraft application and progressing to fighter/attack aircraft construction. Post-buckled structural concepts have been shown to be feasible, and acoustic fatigue has been shown to be of minor consequence for this type of construction.

2. (U) FY 1982 Program: Composite Structures for Advanced Aircraft. Initiate design information and criteria verification for advanced composite fighter/attack fuselage structure, including intermediate-temperature and survivable fuel-containing concepts. Complete structural testing of patrol aircraft mid and aft fuselage structures; complete F-404 Duct and Nacelle structural design and ground test and evaluation. Continue design criteria development for post-buckled fuselage construction under combined loads. Initiate durability testing of advanced lifting surface and ballistic damage tolerance assessment of composite fuselage panels.

3. (U) FY 1983 Planned Program: Composite Structures for Advanced Aircraft. Continue development of advanced composite fighter/attack fuselage structures with potential application for composite integral fuselage fuel tank for AV-8B aircraft. Conduct flight testing of Duct/Nacelle structure and continue durability testing of advanced lifting surface. Continue post-buckled fuselage design criteria development and ballistic damage tolerance assessment.

4. (U) FY 1984 Planned Program: Composite Structures for Advanced Aircraft. Complete structural testing of advanced lifting surface and initiate testing of subcomponent hardware for composite fighter/attack fuselage structure. Initiate service evaluation of Nacelle structure on carrier-based patrol aircraft. Complete post-buckling criteria development and survivability evaluation.

5. (U) Program to Completion: Lightweight Hydraulic System. Complete prototype system testing; initiate fabrication of hardware for flight test; complete full system flight test and final system design specification. Composite Structure for Advanced Aircraft. Continue composite technology efforts for Navy advanced aircraft/load/configuration requirements. Conduct design, tooling, fabrication and test of major composite structural subassemblies to provide the technical base for greater/more efficient composite use in advanced aircraft.

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63303N
Title: Electromagnetic Radiation Source Elimination System Technology
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	4,277	5,963	5,849	6,635	Continuing	Continuing
W0447	Electromagnetic Radiation Source Elimination Technology	4,277	5,963	5,849	6,635	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Electromagnetic Radiation Source Elimination Project has been the principal source of Anti-Radiation Missile guidance/ autonomous emitter location technology for the Navy. The technology used in High Speed Anti-Radiation Missile is a recent example. Electromagnetic Radiation Source Elimination is a project which demonstrates advanced lethal defense suppression techniques and concepts that can transition to existing or planned systems; or establish the basis for the start of a new weapon system program. Examples are, A-6E All Weather Stand-off Attack Control System and High Speed Anti-Radiation Missile. The principal mission needs and objectives addressed are: (1) Develop techniques which provide effective lethal defense suppression from standoff ranges [(2) Develop techniques and concepts which could provide Anti-Radiation Missiles a countermeasure against decoys, jamming, etc.; (3) Develop techniques and concepts for destroying the Command, Control and Communications networks used in integrated enemy surface-to-air missile systems; (4) Expand existing technology base to include low frequency [ ]

(U) BASIS FOR FY 1983 RDT&E REQUEST: Based on technology realized from the Missile Sight location system development and testing, select the best antenna [ ] design for the Fighter Attack Emitter Strike System. Develop and fabricate critical components/systems necessary to conduct design validation experiments. Integrate subsystems [ ] and conduct captive flight tests. Continue the development and demonstration [Complete seeker hardware integration and demonstrate] in static site and flight tests. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: An increase in FY 1981 of 1,979, a decrease in FY 1982 of 87, and a decrease in FY 1983 of 743 are the result of refined estimates of costs including escalation.

Program Element: 63303N
Title: Electromagnetic Radiation Source Elimination System Technology
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,484	2,298	6,050	6,592	Continuing	Continuing
W0447	Electromagnetic Radiation Source Elimination Technology	1,484	2,298	6,050	6,592	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63303N
Title: Electromagnetic Radiation Source Elimination System Technology
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Analysis and recent trends show that the current and projected surface-to-air threat will inflict unacceptable attrition on Navy aircraft if not countered by defense suppression systems. At a 25% attrition rate, over 75% of the original force would be lost after only 5 sorties. Because of the limited number of aircraft in a carrier task force, attrition is critical and must be kept low in order to sustain operations. The techniques for reducing attrition are widely varied and consist of tactics, electronic countermeasures, and anti-radiation missiles. The Electromagnetic Radiation Source Elimination Project [ ] provides a means for developing lethal defense suppression technology to counter new types of enemy electromagnetic radiation and countermeasure techniques. This technology is also a means of proving technical feasibility prior to commitment to higher cost and schedule constrained system development programs. Once demonstrated, the technology passes to a system program such as High Speed Anti-Radiation Missile, or A-6E All Weather Standoff Attack Control System for continued development. The mission needs and objectives being addressed by this program are: (1) Develop techniques which provide effective lethal defense suppression [ ] (2) Develop techniques and concepts which could provide Anti-Radiation Missiles a countermeasure against decoys, jamming, etc.; (3) Develop techniques and concepts for decoying and destroying the Command, Control and Communications networks used in integrated surface-to-air missile systems; (4) Expand existing technology base to include low frequency [ ] threats. Current Electromagnetic Radiation Source Elimination tasks are: (a) Fighter Attack Emitter Strike System: A [ ] system capable of destroying enemy Surface-to-Air Missile systems [ ] Combines technology from the Missile Site Location System developed under the Electromagnetic Radiation Source Elimination Project. (c) Advanced Receiver Techniques: Advanced receiver technology being developed for radar warning receiver application to handle the emitter pulse densities and advanced wave forms projected for the future. (d) [ ] Seeker: An advanced, highly accurate seeker [ ] Evaluate alternative [ ] Concepts to determine performance potential. [ ]

(U) RELATED ACTIVITIES: High-Speed Anti-Radiation Missile. Electromagnetic Radiation Source Elimination is also coordinated closely with Air Force and Army defense programs. A tri-service Industry review of on-going and planned lethal defense suppression programs was held in October 1979 and in January 1982 in the interest of coordination and to avoid unwarranted duplication of effort. Supporting exploratory development effort provided under PE 62332N, Strike Warfare Weaponry Technology.

Program Element: 63303N
Title: Electromagnetic Radiation Source Elimination System Technology
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) WORK PERFORMED BY: In-House: Naval Weapons Center, China Lake, CA; Naval Ocean Systems Center, San Diego, CA. Contractors: Texas Instruments, Inc., Dallas, TX; Motorola Inc., Scottsdale, AZ; Norden Div., United Technologies, Norwalk, CT; Airborne Instruments Lab (AIL), Deerpark, NY; Hughes Aircraft, Canoga Park, CA; Litton Amecom, College Park, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Seekers, broadband antennas, receivers, and processors developed under the Electromagnetic Radiation Source Elimination project are used in Standard Anti-Radiation Missile and SHRIKE Missiles. The fixed-body Phase II seeker provided the basis for the High Speed Anti-Radiation Missile system. [redacted] Locator System flight tested in threat environments. Missile site location system integrated into an aircraft and tested [redacted] Broadband [redacted] antenna was demonstrated. The [redacted] development was completed. [redacted] demonstrated. [redacted] hardware is completed and is undergoing laboratory tests. Two successful live firings [redacted] Two [redacted] were breadboarded and tested. [redacted] bench integration was successfully demonstrated.

2. (U) FY 1982 Program: Complete joint Navy/Air Force follow-on flight testing of the Missile Site Location System to assess performance, [redacted] Using the results of the Missile Site Loction System tests, identify the [redacted] system requirements and design parameters for the Fighter Attack Emitter Strike System. Field test advanced receiver system [redacted] Build and launch three [redacted] missles. Initiate [redacted] system Advanced Development Model Hardware effort. Continue bench integration of a [redacted] for use in both air-to-air and air-to-ground roles. Captive flight test [redacted] in the air-to-air role. Complete [redacted] and conduct static site tests. Select the best of two alternative [redacted] for continued development.

3. (U) FY 1983 Planned Program: Using results of Fighter Attack Emitter Strike System [redacted] system design competition, identify critical design areas [redacted] required [redacted] Develop critical experiments to validate the design concepts without resorting to expensive all-up system flight tests. Design and fabricate hardware for these experiments. Design and initiate fabrication of an opertionally effective [redacted] based on requirements identified in [redacted] demonstration firings. Integrate components [redacted] and conduct captive flight tests. Prepare for live demonstrations. Initiate packaging of the [redacted] for Radar Warning Receiver application. Develop flight worthy antennas, receiver and transmitters for demonstration of the selected [redacted] Continue [redacted] testing.

4. (U) FY 1984 Planned Program: Modify [redacted] hardware and perform captive tests to assess the performance of the full-up Fighter Attack Emitter Strike System

under actual flight conditions. Complete testing and initiate full scale development of the [ ] System. Complete the integration of the [ ] with the appropriate airframe and flight test. Complete the advanced receiver packaging and conduct flight test. Continue testing [

5. (U) Program to Completion: This is a continuing advanced technology program.

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63306N
DoD Mission Area: 553 - Engineering Technology

Title: Advanced Air Launched Air-to-Surface Missile Systems
Budget Activity: 2 - Advanced Technology Development

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

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	5,389	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 Fuze Technology	1,363	1,496	1,621	1,730	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element provides for development and demonstration of technical concepts which could improve the combat utility of air-to-surface missile systems. The Air-to-Surface Missile 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 guidance technology project will require airframes as flight test beds for guidance system testing. The objective of the Air-to-Surface Missile Warhead and Fuze Technology project is increased weapon terminal effectiveness. The principal emphasis is on demonstrating the feasibility of unitary ordnance systems for multi-target applications and to investigate cluster submunition technology for modular warhead application.

(U) BASIS FOR FY 1983 RDT&E REQUEST: To address critical risk areas identified in joint Service requirements, additional effort is needed in the areas of missile guidance and ordnance subsystems development. In particular, additional work is required to demonstrate terminal accuracy potential against representative ship and land point or area targets. Evaluate and analyze guidance options that will integrate with modular warhead concepts including fuzing, unitary warheads and wide area target sensitive submunitions. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: Decreases of 51 in FY 1981, 255 in FY 1982 and 451 in FY 1983 are the result of adjustments to inflation indices, refinement of costs estimates and Navy-wide reductions. Air-to-Surface Missile Propulsion Technology is not funded in FY 1982 and subsequent years pending a reassessment of all RAMJET development efforts. Advanced Propulsion Technology was carried as a continuing effort in this element in FY 1981 and prior years. The highly successful Advanced Low Volume RAMJET system which resulted from this effort was the progenitor of current and Navy and Air Force advanced RAMJET technology programs.

Program Element: 63306N
DoD Mission Area: 553 - Engineering Technology

Title: Advanced Air Launched Air-to-Surface Missile Systems
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,840	5,440	4,093	4,462	Continuing	Continuing
W0551	ASM Guidance Technology	2,799	4,061	2,577	2,809	Continuing	Continuing
W0996	ASM Warhead and Fuze Technology	1,041	1,379	1,516	1,653	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: 63306N
DoD Mission Area: 553 - Engineering Technology

Title: Advanced Air Launched Air-to-Surface Missile Systems
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The known and postulated capabilities of Soviet shipboard and land based anti-air defensive systems presents a formidable challenge to attacking aircraft. The multi-operational modes, extended range, redundancy and terminal lethality of surface-to-air missiles currently deployed and under development will impose unacceptable loss rates on strike aircraft. These defensive systems are effective against both aircraft attempting to deliver weapons, and most of the weapons themselves. The need to improve survivability and effectiveness during air-to-surface attack of heavily defended high value targets is the principal reason for the efforts currently being pursued by this program. The objectives of these projects are to demonstrate the suitability of technical concepts for supporting the development of an adverse weather, survivable, missile,] The Advanced Tactical Inertial Guidance System is based on the ring laser gyro concept which has demonstrated the potential for high accuracy navigation, exceptional reliability, small packaging and low power requirements at low cost. This project is also investigating whether [ ] guidance concepts can provide high precision all weather mid-course navigation fixes through correlation techniques and accurate terminal homing. Also under investigation is whether Synthetic Aperture Radar or other active radar guidance with an autonomous target identification capability can provide a high-precision active seeker option. The Warhead and Fuze Technology project is being used to evaluate concepts which provide the potential for high single-shot lethality against a range of high-value targets. Reactive case and kinetic energy warheads with programmable fuzing offer the potential for significantly increased lethality for ship attack. The feasibility of delivering cluster munitions such as the Air Force Wide Area Anti-Armor Munitions using standoff missiles will also be investigated.

(U) RELATED ACTIVITIES: A major portion of the guidance effort in this element is the Joint All Weather Guidance System Program under joint Navy/Air Force support. Air Force support is provided under PE 63601F. The [ ] guidance under this element are derived from earlier efforts under 62332N.

(U) WORK PERFORMED BY: In House: Lead Laboratory is Naval Weapons Center, China Lake, CA. Contractors: Vought Missile and Space Company, Dallas, TX; Chemical Systems Division, United Technologies, Inc., Sunnyvale, CA; Honeywell Defense Systems Division, Minneapolis, MN; Martin Marietta Aerospace, Orlando, FL; Goodyear Aerospace, Litchfield Pk., AZ;

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Past efforts to design, develop, fabricate and test an Air Launched Low Volume RAMJET propulsion/airframe system resulted in a successful free flight test program. Six systems were flown between November 1974 and April 1979 with more than 95% of all project objectives achieved. These flights demonstrated the full range of altitude, velocity and flight profile conditions including the split altitude anti-ship attack profile. The sixth flight demonstrated improved performance, low cost propulsion components and the ability of a passive microwave sensor to perform through an aerodynamic heated quartz polyamid radome. The Advanced Tactical Inertial Guidance System was developed and demonstrated. This effort transitioned early from PE 62332 in this Program Element. The Advanced Tactical Inertial Guidance System prototype was used to demonstrate the

potential of laser gyro systems for Aircraft navigation. Two scaled down missile navigation systems have been procured to support seeker captive flight tests. Mid-course position finding and terminal homing in captive flight was demonstrated utilizing Microwave Radiometer subsystems. The Advanced Tactical Inertial guidance System and the Microwave Radiometer breadboard subsystems were fully integrated and demonstrated in August 1979. A Memorandum of Agreement for the development of an adverse weather missile guidance system [ ] synthetic aperture radar technologies was negotiated with the Air Force and development activity was initiated.

2. (U) FY 1982 Program: Ordnance technology emphasis will be: (1) developing a programable fuze; (2) investigate the feasibility of expanding the target spectrum by the incorporation of alternate damage mechanisms into reactive case warhead designs; (3) shock tests will be conducted to verify performance of critical fuze components when exposed to the high shock environment associated with hardened targets; (4) system synthesis for modular warhead concepts including wide area Anti-Armor Munitions will be investigated. In the guidance technology project, the [ ] Microwave Radiometer seeker will be further flight tested as an all-weather terminal guidance system. Guidance concepts including [ ] synthetic aperture radar will be investigated to determine the most promising concept for demonstration through the joint Navy/Air Force guidance program.

3. (U) FY 1983 Planned Program: The technology program will continue initiatives established in FY 1982 which include evaluation and validation of guidance and control options and will conclude development of terminal and mid-course guidance units [ ] synthetic aperture radar). Empirical material penetration analysis will be conducted to determine the survivability of warhead designs during penetration of earth, concrete and steel. Programmable fuze design will be finalized and ready for missile integration. Proximity fuze effort will be initiated to support airburst requirements for a unitary warhead technology effort.

4. (U) FY 1984 Planned Program: Full scale and scaled baseline warhead design verification testing will be completed and penetration program prediction credibility established. The adaptive fuze design will be finalized and ten models will be fabricated for demonstration testing in FY 1984. A baseline proximity sensor design will be selected for development and demonstration. Promising missile guidance concepts will be selected on the basis of captive flight data generated in FY 1983 and efforts to validate these concepts in free flight testing will be initiated.

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

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63308N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Air-to-Air Missile Technology Demonstration
Budget Activity: 2 - Advanced Technology Development

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Demonstrate and refine air-to-air missile subsystems applicable to projected system needs. By exploitation of new technology, it is possible to obtain major improvements in capability without attendant increases in cost, size, complexity and development risks. The program is presently directed towards validating guidance airframe and propulsion technology that is needed to meet requirements for future missile systems. Exploratory development component subsystem techniques that have matured and require in-flight demonstration prior to system development commitment are conducted in terms of captive and free flight field tests. One specific guidance item is the charge coupled device seeker.

(U) BASIS FOR FY 1983 REQUEST: Perform final design, fabrication and integration of the charged coupled device seeker for free flight tests to validate in actual airborne tests the acquisition range and tracking in a cluttered look down environment. Evaluation of hardware to resolve performance and risk factors will help to establish a flight demonstrated technology base for an outer-air battle missile. Emphasis in FY 1983 will be more specifically directed toward a standoff air-intercept missile to provide for fleet defense in the outer air battle. This presages a shift to a system concept demonstration which stresses long range, high speed and increased firepower. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: -183 in FY 1981, -262 in FY 1982, and -397 in FY 1983, and are the result of refinement of cost estimates including inflation adjustments.

Program Element: 63308N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Air-to-Air Missile Technology Demonstration
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	3,054	4,524	3,320	Continuing	Continuing
W0453	Advanced Air Technology Demonstration	0	3,054	4,524	3,320	Continuing	Continuing

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

Program Element: 63308N
Title: Air-to-Air Missile Technology Demonstration
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The element is presently directed towards technologies that promise to enhance the capabilities of air-to-air missiles. The charged coupled device imaging array seeker shows promise of meeting the requirements for short range missile guidance. The charged coupled device seeker concept will be evaluated in captive and free flight demonstrations. The radar seeker technology of the Advanced Medium Range Air-to-Air Missile program in conjuction 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 a capability for long range air-to-air systems. Advances in airbreathing propulsion have demonstrated that a ramjet could be designed in a small diameter weapon. To exploit these technologies for potential applications to future missiles, performance and missile integration issues will be verified by ground tests, computer simulations and airborne field testing.

(U) RELATED ACTIVITIES: The guidance concepts of the Advanced Medium Range Air-to-Air Missile program do not meet the requirements of longer range missiles, however significant portions of the guidance technology are applicable. Work in passive radar seekers in the Electromagnetic Radiating Source Elimination program (PE 63303N) is supportive of the guidance demonstration for longer range anti-air missiles. Advanced Low Volume Ramjet, and Advanced Strategic Air Launched Missile are air-to-surface systems which may have applicable technology.

(U) WORK PERFORMED BY: In-House: Naval Weapons Center, China Lake, CA. Contractors: Raytheon Co., Bedford, MA.; Hughes Aircraft Co., Canoga Park, CA.; McDonnell Douglas Astronautics Co.; St. Louis, MO.; Boeing Co., Seattle, WA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Tri-Service Fast Acquisition Search and Track Seeker Program was completed. A flyable prototype charged coupled device seeker has been developed under integral laboratory funding and is in captive flight testing. Design studies for integrated radar guidance for long range missiles have been completed. Various propulsion/airframe configurations have been evaluated and candidates chosen for further investigation and verification.

2. (U) FY 1982 Program: The charged coupled device seeker investigations will be conducted by performing captive flight test, computer simulations, and contractual investigations, all leading to a guided flight test. Based on FY 1981 and FY 1982 efforts, modifications to equipment will be completed into a Sidewinder airframe for guided free flight test. Advanced concepts for long range air-to-air will be re-evaluated and further investigation and verification will continue in preparation for demonstration.

3. (U) FY 1983 Planned Program: An advanced seeker will be evaluated in captive flight test; 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. Procure, design and fabricate test hardware based on technical issues identified in advanced concept investigations to establish a flight demonstrated technology base for an outer air battle missile. Captive flight and safe separation testing will begin.

Program Element: 63308N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Air-to-Air Missile Technology Demonstration
Budget Activity: 2 - Advanced Technology Development

4. (U) FY 1984 Planned Program: Continue captive flight/laboratory tests and evaluation. Complete hardware fabrication. Begin air launched flight demonstrations.

5. (U) Program to Completion: This is a continuing technology program. 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 programs to upgrade present capabilities.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: S0379, Gas Turbine, Propulsion System: This program develops advanced propulsion systems and component improvements for Navy surface ships, (gas turbine engines and system components of 5,000 to 50,000 horsepower). A Rankine Cycle Energy Recovery System will be developed to convert gas turbine exhaust heat to useful power resulting in a potential energy saving of 25%. Devices and equipment necessary in the ship propulsion system - e.g., clutches, reversing gears and propellers, as well as fuel, air, and land control systems and equipment are developed. Aircraft engine designs will be modified and utilized in marine engine development. Gas turbine Component Improvement Program, provides technical support by the engine manufacturer in providing analyses of component problems identified as a result of fleet operating experience. As life-limiting component problems are identified, corrective modifications are developed to improve reliability. S1649, DDGX Propulsion: Develop pre-production prototype propulsion power transmission systems suitable for DDGX gas turbine powered surface combatants. Includes land based and at-sea operational evaluation. Propulsion machinery provides improved fuel economy for gas turbine ships by optimizing latest developments in fuel efficiency for DDGX requirements. S1683, Gas Turbine Efficiency Improvement: This project develops and validates LM2500 engine modifications that will result in a minimum 2.5% improvement in overall engine fuel consumption.

(U) BASIS FOR FY 1983 RDT&E REQUEST: S0379, Gas Turbine Propulsion System - Development of the Rankine Cycle Energy Recovery system to reduce future non-nuclear surface combatant main propulsion fuel consumption by 25% will continue. Continue at sea tests and evaluation of advanced high temperature corrosion resistant coatings and alloys. Continue development of shipboard controls incorporating microprocessor and digital distributed technology. Specific gas turbine component design improvement areas to be pursued in FY 1983 include high pressure turbine life extension, (e.g., continue the advanced shroud and blade coating improvement program, advanced vane life improvement; rematch 502K-17 first stage vane to improve work split and overall engine efficiency); low pressure turbine improvement, (e.g., continue program to strip and recoat airfoil and interlock coatings). Complete electronic fuel control investigation. Development of the 40,000 shaft horespower reverse gear will continue. Complete

development of advanced high temperature turbine materials. Specific component design improvement areas to be pursued in FY 1982 include high pressure turbine service life extension, (e.g., complete improved clearance control and single shank blade development, continue the advanced shroud and blade coating improvement program and initiate an advanced vane life improvement investigation); low pressure turbine improvement (e.g., initiate program to strip and recoat airfoil and interlock coatings); and controls and accessories (e.g., complete improved power level actuator study, complete improved compressor inlet temperature sensor response, continue electronic fuel control investigation and complete improved vibration sensing system). S1649, DDGX Propulsion: New start in FY 1983. Complete Phase I tradeoff studies and award contract for design, construction and factory test of land-based and at-sea test systems. Start test site design and long-lead test support equipment procurement for land-based test facility. S1683, Gas Turbine Efficency Improvement: Project was directed by Cogress in FY 1982. This project will be incorporated in S0379 in FY 1983 and out. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The change between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: S0379, Gas Turbine Propulsion System: The FY 1981 program reflects a total reduction of $2,670, of which $1,900 was reprogrammed to fund higher priority programs, and $770 was due to revised inflation estimates. The FY 1982 program was reduced by $1,632 and FY 1983 by $6,308 to fund higher priority programs. S1649, DDGX Propulsion: This is a new start in FY 1983. S1683, Gas Turbine Efficiency Improvement: The Congress directed efforts to improve gas turbine fuel efficiency and added $7,000 in FY 1982.

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	21,874	18,468	12,816	19,870	Continuing	Continuing
S0379	Gas Turbine Propulsion System	14,371	18,468	12,816	19,870	Continuing	Continuing
S0380	Superconductor Propulsion Machinery	7,503	0	0	0	0	45,491

(U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: S0379, Gas Turbine Propulsion System: This program develops advanced propulsion systems and component improvements for Navy surface ships. Required for development in this project are gas turbine engines of 5,000 to 50,000 horsepower and a Rankine Cycle Energy Recovery system. Also included are devices and equipment necessary in the propulsion system; e.g., clutches, reversing gears, controllable pitch propellers, high performance mechanical transmissions as well as fuel, combustion air, and control systems. Advanced aircraft engines and associated technology will be used and modified as appropriate for marine engine conversion and development. The machinery developed under the auspices of this program will provide significant improvements for Navy surface ship propulsion in the areas of manning, maintainability, ship availability, acoustic detection, ship performance, fuel consumption and automation. Also high performance ships such as hydrofoils and Surface Effects Ships will employ the advanced technology engines being developed. The LM2500 gas turbine developed under this program has been selected to propel the SPRUANCE Class (DD-963), PERRY Class (FFG-7) and PEGASUS Class (PHM-1). Development of additional engines, systems and components are required to allow a broad based Naval application of this technology. A Component Improvement Program improves the reliability, maintainability and durability of the LM2500 and 501-K17 gas turbines programmed for installation in the DD 963/DDG 993/FFG 7/CG 47/DDG 51 Class ships for main propulsion and ship service power and in the PHM-1 Class for foil-borne propulsion. This program supports the "on-condition" maintenance policy being applied to the ship gas turbines, i.e., equipment assemblies are normally repaired or replaced on an as required basis and are not subject to a fixed overhaul removal cycle. Through engineering analysis on initial inherent reliability, 3000 hour and 4000 hour Mean-Time-Between-Removal intervals for LM2500 were established for the two major engine subassemblies, i.e., the gas generator and power turbine, respectively. Naval Aviation experience with gas turbines has amply demonstrated the payback available through investment in engine component improvement to increase the time between removals thus reducing the requirement for spare parts, spare engines, number of reworks, and increased rework capacity. Inherent removal intervals of 9,000 and 10,000 hours were established as targets for the gas generator and power turbines to be achieved in the FYs 1983/85 time frame. The 501-K17 generator drive engine reliability goal of 5,000 hours Mean-Time-Between-Removal will be derived and maintained in approximately the same manner as the LM2500 efforts. The program includes technical support by the engine manufacturer in providing analyses of component problems identified as a result of fleet operating experience, lead the fleet service test of two engines in MSC WILLIAM M. CALLAGHAN and factory test of dedicated engines at the manufacturer's plant. As life-limiting component problems are identified, corrective modifications are developed to improve reliability. Once the target Mean-Time-Between-Removal is achieved, funding will drop to a level which will continue development of reliability enhancing modifications to maintain the Mean-Time-Between-Removal as the engine population ages. S1649, DDGX Propulsion: This project develops pre-production prototype machinery systems or alternative propulsion power transmission systems suitable for DDGX gas-turbine-powered combatant ships. Project includes operational evaluation of the propulsion power transmission components at a land-based test site and at-sea operational tests in an integrated ship propulsion system. Fuel efficiency savings of up to 35% in overall fuel consumption can be achieved through prototype system optimization for DDGX. S1683, Gas Turbine Efficiency Improvement: This program develops LM2500 engine modification that will result in a minimum 2.5% improvement in overall engine fuel consumption. Project includes factory testing of proposed engine improvements followed by at-sea endurance testing on the LM2500 CIP engine on MSC ADM CALLAGHN to validate integrated engine improvements prior to pre-production definition for fleet implementation.

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

(U) RELATED ACTIVITIES: Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 64701N, Navy Energy Program (Engineering); Program Element 61153N, Defense Research Sciences; Program Element 63573N, Electric Drive.

(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 (AiResearch), Phoenix, AZ and Torrance, CA; Mechanical Technology, Latham, NY; A.D. Little, Cambridge, MA; Philadelphia Gear Corporation, King of Prussia, PA; Pratt 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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: S0379, Gas Turbine Propulsion System: The 20,000 HP LM2500 engine pre-operational development is complete. The engine is in Fleet service. The 33,000 horsepower FT 9 engine development is complete including performance testing, a 5,000 hour durability test/Technical Evaluation, and Operational Test III-A. A reverse reduction gear development has been initiated. Advance materials to achieve 15,000 hour service life are under development. Designs for a Rankine Cycle Energy Recovery system capable of a potential 25 percent fuel saving have been completed. Evaluation of LM2500 and 501-K17 shipboard operating experience through FY 1979 has identified a number of engine life-limiting component problems which were subsequently analyzed and reliability improving modifications developed. The most significant was the first stage compressor blade wear out problem, encountered in 1977, which required gas generator removal in the 2000-3000 operating hour time period. Subsequently, an improved compressor blade and a method of replacing these blades in installed engines was developed and blade replacement is an ongoing program. Additionally, life-limiting components have been identified in the hot section, (e.g., high pressure turbine blades and vanes) and development of modifications is continuing. Improvements to date have increased LM2500 operating time before removal to 6,000 hours. S1649, DDGX Propulsion: Project starts in FY 1983. S1683, Gas Turbine Efficiency Imrovement: Project starts in FY 1982.

2. (U) FY 1982 Program: S0379, Gas Turbine Propulsion Systen: Continue development of Rankine Cycle Energy Recovery System. Continue high temperature materials development. Initiate control system microprocessor technology development. Continue analyses of previously identified inservice problem areas including development of engineering change proposals and modifications. Continue accumulation of operating hours on the MSC CALLAGHAN and commence analysis of any newly emerging problem areas. Complete at sea test and evaluation of fuel system pre-filter and self cleaning purifier programs. S1649, DDGX Propulsion: Project starts in FY 1983. S1683, Gas Turbine Efficiency Improvement: Initiate project optimization study and preliminary design and long lead hardware procurement.

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

3. (U) FY 1983 Planned Program: S0379, Gas Turbine Propulsion System: Continue at sea evaluation of advanced coatings and alloys. Continue Rankine Cycle Energy Recovery development. Continue program support for fleet problem and component investigations. Continue engine testing both at the contractor's plant and on board the MSC CALLAGHAN and conduct analysis of engine life-limiting problem areas identified through FY 1981. Specific component problem areas to be pursued in FY 1983 include high pressure turbine improvement, (e.g., continue the advanced shroud and blade coating improvement program and the advanced vane life improvement program); low pressure turbine improvement (e.g., continue program to strip and recoat airfoil and interlock coatings); and controls and accessories, (e.g., complete electronic fuel control investigation). Initiate 501-K17 engine rematch program. The FY 1983 funding estimates reflect decrease of $7,940 from the FY 1982 estimates. This was caused by a reduction for inflation in FY 1981 and reprograming to higher priority programs in FY 1981 through FY 1983. Complete gas turbine fuel efficiency studies and preliminary design and commence testing the program. S1649, DDGX Propulsion: Start 3-phase program consisting of preliminary design, construction and factory test, and operational evaluation. Complete Phase I studies and award contract for construction and factory test of test systems for both land-based and at-sea operational evaluation. Start test site design and long-lead procurement of test equipment for the land-based test facility.

4. (U) FY 1984 Planned Program: S0379, Gas Turbine Propulsion System: Attain 15,000 hour turbine material service life. Initiate reverse reduction gear system development. Erect common test facility for Rankine Cycle Energy Recovery system and reverse gear machinery test. Install Rankine Cycle Energy Recovery System in test facility. Investigate and correct newly emerging in-service engine component problems. Complete shipboard integrated control system hardware Development Test and Evaluation. Continue gas turbine fuel efficiency program with tests of a new integrated electronic control system. S1649, DDGX Propulsion: Continue fabrication of components for both land-based and test-ship operational evaluation systems. Conduct factory tests on critical elements. Continue construction and acquisition of test support equipments.

5. (U) Program to Completion: S0379, Gas Turbine Propulsion Systems: Continue gas turbine engine development. Complete reverse gear and Rankine Cycle Energy Recovery system development. This program is a continuing program to provide development of gas turbine propulsion systems and in-service reliability improvement. Complete gas turbine fuel efficiency land-based testing and at-sea testing on MSC CALLAGHAN. S1649, DDGX Propulsion: Complete construction and factory tests of all systems. Shock test one system on barge. Complete land-based test facilities and test-ship preparations. Complete development testing and operational evaluation in land-based test integrated with gas-turbine and Rankine Cycle Energy Recovery.

6. (U) Milestones:

Date	20,000HP LM2500	5,000HP GTPF 990	Propellers/Gears	33,000HP FT-9	RACER System	10,000HP Gas Turbine
FY 1977	Complete Development	Commence Development, Test and Evaluation		Commence Development, Test and Evaluation		

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

Date	20,000HP LM2500	5,000HP GTPF 990	Propellers/Gears	33,000HP FT-9	RACER System	10,000HP Gas Turbine
FY 1979				Commence Initial Operational Test and Evaluation (IOT&E), 3rd Qtr Complete Initial Operational Test and Evaluation 4th Qtr		
FY 1980		Complete Development 4th Qtr	Complete Controllable Pitch Propeller Development 4th Qtr Issue Design Guide 4th Qtr Commence Development Reversing Gear 4th Qtr	Obtain Provisional Approval for Service Use 3rd Qtr	Commence System Design 2nd Qtr	
FY 1983	Achieve final LM2500 Mean Time Between Failure Goal of 10,000 hours for the power turbine.		Commence Developmental Test and Evaluation and 2nd Qtr		Commence Development 1/	Commence Development 3rd Qtr
FY 1984						

Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

Date	20,000HP LM2500	5,000HP GTPF 990	Propellers/Gears	33,000HP FT-9	RACER System	10,000HP Gas Turbine
FY 1985	Achieve final LM2500 Mean Time Between Failure Goals of 9,000 hours for Gas Generator		Complete Developmental Test and Evaluation		Commence Developmental Test and Evaluation	
FY 1988					Complete Initial Operational Test and Evaluation	

1 Rankine Cycle Energy Recovery System Program replaced Reverse Gear as No 1 priority development.
2 FT 9 Provisional Approval for Service Use delayed due to requirement to provide integrated logistic support documentation.
3 10,000 HP program delayed due to a lack of resources compared to FY 1982 submittal.

Project: S0379
Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Gas Turbine Propulsion System
Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This program develops advanced propulsion systems and component improvements for Navy surface ships. Required for development in this project are gas turbine engines of 5,000 to 50,000 horsepower and a Rankine Cycle Energy Recovery system. Also included are devices and equipment necessary in the propulsion system; e.g., clutches, reversing gears, controllable pitch propellers, high performance mechanical transmissions as well as fuel, combustion air, and control systems. Advanced aircraft engines and associated technology will be used and modified as appropriate for marine engine conversion and development. The machinery developed under the auspices of this program will provide significant improvements for Navy surface ship propulsion in the areas of manning, maintainability, ship availability, acoustic detection, ship performance, fuel consumption and automation. Also high performance ships such as hydrofoils and Surface Effects Ships will employ the advanced technology engines being developed. The LM2500 gas turbine developed under this program has been selected to propel the SPRUANCE Class (DD-963), PERRY Class (FFG-7) and PEGASUS Class (PHM-1). Development of additional engines, systems and components are required to allow a broad based Naval application of this technology. A Component Improvement Program improves the reliability, maintainability and durability of the LM2500 and 501-K17 gas turbines programmed for installation in the DD 963/DDG 993/FFG 7/CG 47/DDG 51 Class ships for main propulsion and ship service power and in the PHM-1 Class for foil borne propulsion. This program supports the "on-condition" maintenance policy being applied to the ship gas turbines, i.e., equipment assemblies are normally repaired or replaced on an as required basis and are not subject to a fixed overhaul removal cycle. Through engineering analysis on initial inherent reliability, 3000 hour and 4000 hour Mean-Time-Between-Removal intervals for LM2500 were established for the two major engine subassemblies, i.e., the gas generator and power turbine, respectively. Naval Aviation experience with gas turbines has amply demonstrated the payback available through investment in engine component improvement to increase the time between removals thus reducing the requirement for spare parts, spare engines, number of reworks, and increased rework capacity. Inherent removal intervals of 9,000 and 10,000 hours were established as targets for the gas generator and power turbines to be achieved in the FYs 1983/85 time frame. The 501-K17 generator drive engine reliability goal of 5,000 hours Mean-Time-Between-Removal will be derived and maintained in approximately the same manner as the LM2500 efforts. The program includes technical support by the engine manufacturer in providing analyses of component problems identified as a result of fleet operating experience, lead the fleet service test of two engines in MSC WILLIAM M. CALLAGHAN and factory test of dedicated engines at the manufacturer's plant. As life-limiting component problems are identified, corrective modifications are developed to improve reliability. Once the target Mean-Time-Between-Removal is achieved, funding will drop to a level which will continue development of reliability enhancing modifications to maintain the Mean-Time-Between-Removal as the engine population ages.

(U) RELATED ACTIVITIES: Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 64701N, Navy Energy Program (Engineering); Program Element 61153N, Defense Research Sciences; Program Element 63573N, Electric Drive.

(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

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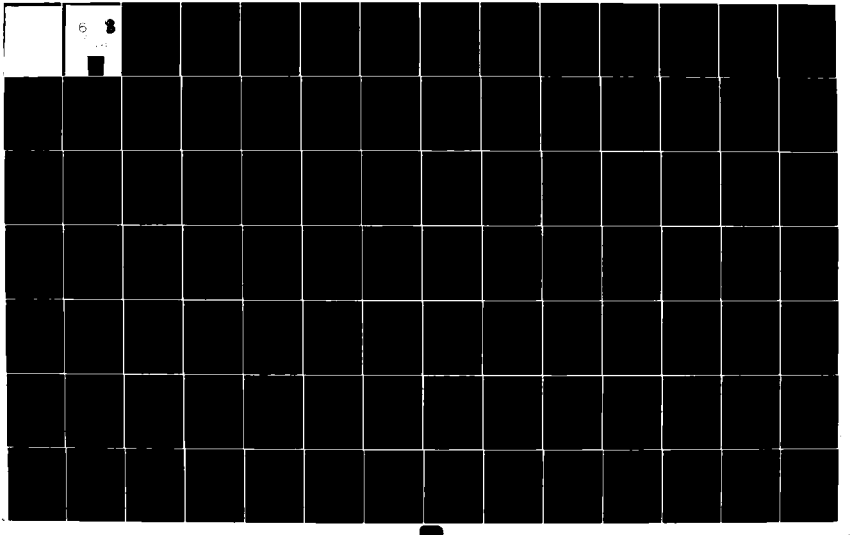

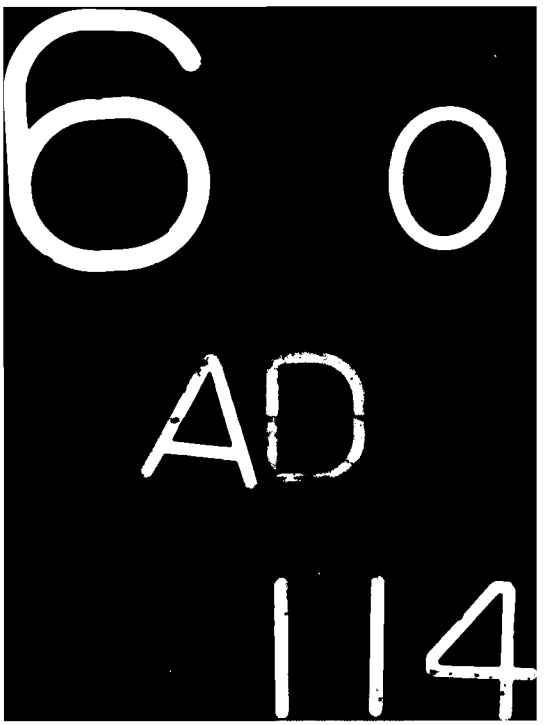
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Project: S0379 Title: Gas Turbine Propulsion System
Program Element: 63508N Title: Ship Propulsion System (Advanced)
DoD Mission Area: 553-Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

(AiResearch), Phoenix, AZ and Torrance, CA; Mechanical Technology, Latham, NY; A.D. Little, Cambridge, MA; Philadelphia Gear Corporation, King of Prussia, PA; Pratt 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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The 20,000 HP LM2500 engine pre-operational development is complete. The engine is in Fleet service. The 33,000 horsepower FT 9 engine development is complete including performance testing, a 5,000 hour durability test/Technical Evaluation, and Operational Test III-A. A reverse reduction gear development has been initiated. Advance materials to achieve 15,000 hour service life are under development. Designs for a Rankine Cycle Energy Recovery system capable of a potential 25 percent fuel saving have been completed. Evaluation of LM2500 and 501-K17 shipboard operating experience through FY 1979 has identified a number of engine life-limiting component problems which were subsequently analyzed and reliability improving modifications developed. The most significant was the first stage compressor blade wear out problem, encountered in 1977, which required gas generator removal in the 2000-3000 operating hour time period. Subsequently, an improved compressor blade and a method of replacing these blades in installed engines was developed and blade replacement is an ongoing program. Additionally, life-limiting components have been identified in the hot section, (e.g., high pressure turbine blades and vanes) and development of modifications is continuing. Improvements to date have increased LM2500 operating time before removal to 6,000 hours.

2. (U) FY 1982 Program: Continue development of Rankine Cycle Energy Recovery System. Continue high temperature materials development. Initiate control system microprocessor technology development. Continue analyses of previously identified inservice problem areas including development of engineering change proposals and modifications. Continue accumulation of operating hours on the MSC CALLAGHAN and commence analysis of any newly emerging problem areas. Complete at sea test and evaluation of fuel system pre-filter and self cleaning purifier programs.

3. (U) FY 1983 Planned Program: Continue at sea evaluation of advanced coatings and alloys. Continue Rankine Cycle Energy Recovery development. Continue program support for fleet problem and component investigations. Continue engine testing both at the contractor's plant and on board the MSC CALLAGHAN and conduct analysis of engine life-limiting problem areas identified through FY 1981. Specific component problem areas to be pursued in FY 1983 include high pressure turbine improvement, (e.g., continue the advanced shroud and blade coating improvement program and the advanced vane life improvement program); low pressure turbine improvement (e.g., continue program to strip and recoat airfoil and interlock coatings); and controls and accessories, (e.g., complete electronic fuel control investigation). Initiate 501-K17 engine rematch program. The FY 1983 funding estimates

Project: S0379
Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Gas Turbine Propulsion System
Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

reflect decrease of $7,940 from the FY 1982 estimates. This was caused by a reduction for inflation in FY 1982 and reprograming to higher priority programs.

4. (U) FY 1984 Planned Program: Attain 15,000 hour turbine material service life. Initiate reverse reduction gear system development. Erect common test facility for Rankine Cycle Energy Recovery system and reverse gear machinery test. Install Rankine Cycle Energy Recovery System in test facility. Investigate and correct newly emerging in-service engine component problems. Complete shipboard integrated control system hardware Development Test and Evaluation.

5. (U) Program to Completion: Continue gas turbine engine development. Complete reverse gear and Rankine Cycle Energy Recovery system development. This program is a continuing program to provide development of gas turbine propulsion systems and in-service reliability improvement.

6. (U) Milestones:

Date	20,000HP LM2500	5,000HP GTPF 990	Propellers/Gears	33,000HP FT-9	RACER System	10,000HP Gas Turbine
FY 1977	Complete Development	Commence Development, Test and Evaluation		Commence Development, Test and Evaluation		
FY 1979				Commence Initial Operational Test and Evaluation (IOT&E), 3rd Qtr		
				Complete Initial Operational Test and Evaluation 4th Qtr		

Project: S0379 — Title: Gas Turbine Propulsion System
Program Element: 63508N — Title: Ship Propulsion System (Advanced)
DoD Mission Area: 553-Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

FY 1980		Complete Development 4th Qtr	Complete Controllable Pitch Propeller Development 4th Qtr Issue Design Guide 4th Qtr Commence Development Reversing Gear 4th Qtr	Obtain Provisional Approval for Service Use 3rd Qtr.	Commence System Design 2nd Qtr
FY 1983	Achieve final LM2500 Mean Time Between Failure Goal of 10,000 hours for the power turbine.		Commence Developmental Test and Evaluation and 2nd Qtr		Commence Development 1/
FY 1984					
FY 1985	Achieve final LM2500 Mean Time Between Failure Goals of 9,000 hours for Gas Generator		Complete Developmental Test and Evaluation		Commence Developmental Test and Evaluation

Project: S0379
Program Element: 63508N
DoD Mission Area: 553-Engineering Technology (ATD)

Title: Gas Turbine Propulsion System
Title: Ship Propulsion System (Advanced)
Budget Activity: 2 - Advanced Technology Development

FY 1988

Complete Initial Operational Test and Evaluation

1 Rankine Cycle Energy Recovery Probram replaced Reverse Gear as No 1 priority development.
2 FT 9 Provisional Approval for Service Use delayed due to requirement to provide integrated logistic support documentation.
3 10,000 HP program delayed due to a lack of resources compared to FY 1982 submittal.

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S0379	Gas Turbine Propulsion System	15,798	11,184	13,562	19,550	Continuing	Continuing

Project: S1649 Title: DDGX Propulsion
Program Element: 63508N Title: Ship Propulsion System (Advanced)
DOD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This project develops pre-production prototype propulsion power transmission systems suitable for twin-screw gas-turbine-powered combatant ships. Project includes operational evaluation at a ship system land-based engineering facility and at-sea operational tests. Optimizing current developments to enhance suitability for DDGX will result in as much as 35% total fuel savings for the DDGX. Systems to be optimized include reverse reduction gear, Rankine Cycle Energy Recovery System and ship service generator power source. Test support equipment acquired under this project will also support testing of ship propulsion machinery developed under Electric Drive, Program Element 63573N.

(U) RELATED ACTIVITIES: Program Element 63573N, Electric Drive; Program Element 63589N, Major Surface Combatant Development; Program Element 63513N, Shipboard System Component Development; Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 61153N, Defense Research Sciences.

(U) WORK PERFORMED BY: In-House: Naval Ship Systems Engineering Station, Philadelphia, PA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. Contractors: To be determined.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This is a new start for FY 1983. Conceptual designs for DDGX in FY 1981 identified requirements necessary to meet ship Top Level Requirements involving Ranking Cycle Energy Recovery System, reverse reduction gear and improved ship service generator power.

2. (U) FY 1982 Program: This a new start for FY 1983. Feasibility level studies and trade off analyses will continue in order to identify the design requirements for optimization of candidate propulsion machinery for twin-screw gas-turbine-powered surface combatants.

3. (U) FY 1983 Planned Program: Initiate 3-phase program consisting of Phase I - Preliminary design; Phase II - Construction and factory tests; and Phase III - land-based and at-sea tests. Complete Phase I studies and award single contract for detailed design, construction and factory tests. Start test site design and long-lead procurement of test equipment for the land-based test facility.

4. (U) FY 1984 Planned Program: Continue fabrication of components for both landbased and at sea operational evaluation systems. Conduct factory tests on initial design of some critical elements. Continue construction of land-based test site and acquisition of test support equipment.

Project: S1649 Title: DDGX Propulsion
Program Element: 63508N Title: Ship Propulsion System (Advanced)
DOD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

5. (U) Program to Completion: Complete construction and factory tests of all systems. Shock test one system on a shock test barge. Complete construction of land-based test facilities and test ship preparations. Complete development testing and operational evaluation in a land-based facility integrated with a gas-turbine powered propulsion at-sea tests leading to service use approval.

6. (U) Milestones: Not Applicable.

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S1649	DDGX Propulsion	0	0	6,895	14,921	Continuing	Continuing

FY 1982 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63526N
Title: Advanced Computer Technology
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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
Z0872	Advanced Software/Computer Technology	3,662	3,600	3,272	4,085	Continuing	Continuing
X0911	Automatic Data Processing Security	1,852	934	0	0	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the basic resources required to improve capabilities and reduce development and life cycle maintenance cost of computer resources in automated Navy tactical systems. During the 1980's the Navy will need to provide replacements for existing tactical embedded computers, develop a Navy standard software engineering environment based on Ada (DOD standard programming language) to increase the efficiency of the limited number of skilled programmers, implement Ada as the Navy tactical programming language, and reduce the life cycle costs of tactical systems computer hardware and software. Z0872 Advanced Software/Computer Technology: provides more efficient support software and software development, test, and life cycle maintenance tools to increase programmer efficiency and improve software reliability; and provides software-compatible, new technology, military standard computer hardware for use in tactical communications, command and control, intelligence and weapon systems throughout the Fleet. Directly supports AN/UYK-43 and AN/UYK-44 Navy Tactical Embedded Computer (PE 64574N) program. X0911 Automatic Data Processing Security: provides the capability to reduce the vulnerability of Navy systems (including automated weapon and command and control and communition systems) to unauthorized disclosure or modification of data, including denial of system services. Specifically, develops and validates techniques and hardware/software prototypes which will increase the effectiveness of Automatic Data Processing security and provide secure multi-level data processing. This project has been transferred in FY 1983 to PE 64574N Tactical Embedded Computer Programs.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Z0872C Advanced Software/Computer Technology: continue upgrading existing Navy standard Computer Programming Environment as necessary to meet urgent near-term tactical applications software development needs; continue development of new Navy Standard Ada Programming Support Environment. The decrease of 1,262 between the FY 1982 and FY 1983 funding is because of the transfer of X0911, Automatic Data Processing Security to PE 64574 Tactical Embedded Computer Programs, and because of routine budget adjustments. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

Program Element: 63526N
Title: Advanced Computer Technology
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: Z0872 Advanced Software/Computer Technology: Decreases of 141 (FY 1982) and 988 (FY 1983) resulted from routine budget adjustments. X09il Automatic Data Processing: Decreases of 148 (1981) and 17 (1982) resulted from routine budget adjustment actions. The decrease of 2,170 (1983) was because this project was transferred to PE 64574N, Tactical Embedded Computer Programs in FY 1983.

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,494	5,662	4,692	6,430	Continuing	Continuing
Z0872	Advanced Software/Computer Technology	2,494	3,662	3,741	4,260	Continuing	Continuing
X0911	Automatic Data Processing Security	0	2,000	951	2,170	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: None.

Program Element: 63526N
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: Advanced Computer Technology
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Z0872 Advanced Software/Computer Technology: The ability of Naval forces to accomplish assigned tactical missions is directly related to the performance of computer based communication, command and control, intelligence and weapon systems. It is necessary to develop standard management methodologies, tools, and techniques which will reduce life cycle software costs and improve quality and mission responsiveness of tactical systems. Specific tasks include computer architecture standardization, to allow capture of existing support software; improvement and augmentation of Navy standard programming environments, to provide DOD-approved programming language support for new AN/UYK-43 and AN/UYK-44 computers and to reduce life-cycle support costs by minimizing the number of environments required; development, test and implementation of tactical software design and verification and validation tools to increase programmer productivity; development of a Navy standard Ada Programming Support Environment to significantly reduce the cost of tactical software acquisition and life-cycle support; and development of state-of-the-art computers, microcomputers and microprocessors which allow cost-effective upgrades of systems without loss of the existing investment in software and which are less costly and more reliable, maintainable and supportable than existing standard Navy computers. X0911 Automatic Data Processing Security. Recent incidents involving the misuse of Automatic Data Processing systems, including theft of sensitive information and resources and the disruption and denial of user services, have emphasized security deficiencies. Traditional physical and personal security measures are no longer adequate to protect computer resident data and to support multi-level data processing. This project will ensure that a proper mechanism exists for implementing Automatic Data Processing security technology into Navy systems. Specific tasks include: developing specifications and prototyping a secure operating system, a semi-automatic sanitization program, and a data base management system, designing secure access control features, and implementing effective risk modeling techniques.

(U) RELATED ACTIVITIES: Automated Design for Command Control Communications Systems (PE 62721N); Computer Technology for Tactical Weapons Systems (PE 63717N, 63520N); Multiprocessing in a Distributed Environment (PE 26570N); Shipboard Tactical Intelligence Processing (PE 25670N); Militarized Peripherals (PE 24163N); AN/AYK-14 (PE 64203N); Army Automatic Data Processing Equipment Development (PE 63703A); Air Force Advanced Computing Technology (PE 63728F); Navy Tactical Embedded Computer Program (PE 64574N); World-Wide Military Command and Control System (PE 33151N, PE 33113N); Intelligence Data Handling System (PE 31025N); Ocean Surveillance Information System (PE 24600N); and Advanced Command Control Architectural Testbed (PE 62701N).

(U) WORK PERFORMED BY: In House: Naval Electronic Systems Command, Washington, D.C.; Naval Sea Systems Command, Washington, D.C.; Naval Air Systems Command, Washington, D.C.; Naval Ocean Systems Center, San Diego, CA; Navy Underwater Systems Center, Newport, RI; Naval Surface Weapons Center, Dahlgren, VA; Naval Weapons Center, China Lake, CA; Naval Research Laboratory, Washington, D.C.; Naval Air Development Center, Warminster, PA; and David Taylor Naval Ship Research and Development Center, Bethesda, MD.

Program Element: 63526N
Title: Advanced Computer Technology
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments: Z0872 Advanced Software/Computer Technology. This program element was established in FY 1978. However, FY 1978 funding was denied by Congress pending delivery of a more adequate work description. A Master Plan for Tactical Embedded Computer Resources was subsequently prepared and approved by the Chief of Naval Operations. This coordinated plan defines the tasks to be accomplished, aligns this program with the Defense System Software Research and Development Plan, and consolidates all development efforts of the Advanced Computer Technology project and the Navy Tactical Embedded Computer Program (PE 64574N, Z1353) under the management of a single Principal Development Activity (Headquarters, Naval Material Command). Four tasks were initiated. (1) CMS-2 and SPL/I Language Control and Compiler Improvement studies: Study revealed that elimination of CMS-2 dialects and development of a common CMS-2/SPL/I compiler would yield significant life cycle cost benefits. Investigated feasibility of merging the numerous CMS-2 dialects that are in current use. Continuation of this task will be in coordination with the Navy implementation of the new DOD standard programming language, Ada. (2) Develop Navy Standard Computer Programming Environments: For each new computer development, it is essential that a stable programming environment be in place prior to the time the computer is available for use. Therefore, initiated development of the software tools required to support the new AN/UYK-44 Militarized Reconfigurable Processor (MRP) and Computer (MRC), to be accomplished by modifying the Navy Machine Transportable Support Software/Miniature system which currently supports the Navy standard 16-bit computers (AN/UYK-20 and AN/AYK-14). Initiated development of the software tools required to support the new AN/UYK-43 Navy Embedded Computer System, to be accomplished by modifying the CMS-2Y support system which currently supports the Navy standard 32-bit computer, AN/UYK-7. (3) Ada High Order Language and Programming Support Environment: Contributed to the development of a long term standard programming language for use by all Services in future tactical system developments in the 1980s. Participated in the Ada language Test and Evaluation effort and in the final Ada language design effort. Initiated CMS-2-to-Ada transition studies addressing both host environment and target environment requirements. (4) Computer Architecture Standardization. Developed specifications and issued the Request for Proposals for the AN/UYK-44 Military Reconfigurable Processor and Computer and issued Request for Proposal for the AN/UYK-43 Computer. Developed test criteria and methodology to certify compliance of proposed hardware to the architecture specifications and the ease of its insertion into Fleet use. These efforts have transitioned to engineering development (PE 64574N Navy Tactical Embedded Computer Program). X0911 Automatic Data Processing Security: A new start for Navy in FY 1980. This project is based upon documented requirements and is coordinated with other DoD agencies to avoid duplication of effort. Three tasks are underway: (1) Assumed development of a kernelized secure operating system, (2) initiated development of a semi-automatic sanitization program, and (3) Commenced evaluation of commercially available data base management systems to determine which security features have already been adopted.

2. (U) FY 1982 Program: Z0872 Advanced Software/Computer Technology. Complete essential support software development for the AN/UYK-44. Continue essential support software development for the AN/UYK-43. Complete detailed high level requirements for Ada High Order Language and support environment implementation, based on CMS-2 to Ada transition studies and coordinate with the tri-service Ada Joint Program Office prior to acquisition. X0911 Automatic Data Processing Security. Continue development,

prototyping, and testing of the kernelized secure operating system, the secure semi-automatic sanitization program, and the secure data base management system. Evaluate feasibility of integrating these three areas into an operational, multi level secure, general purpose computer system.

3. (U) FY 1983 Planned Program: Z0872 Advanced Software/Computer Technology. Continue support 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. X0911 Automatic Data Processing Security. Transferred to PE 64574N, Tactical Embedded Computers.

4. (U) FY 1984 Planned Program: Z0872 Advanced Software/Computer Technology. Complete 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.

5. (U) Program to Completion: Z0872 Advanced Software/Computer Technology. 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 maximixe efficiency and effectiveness of operational systems employing embedded computer resources. The decrease between the FY 1982 and FY 1983 funding is because X0911 Automatic Data Processing Security was transferred to another program element (-939), and because of Navy budget reductions (-328).

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63573N
Title: Electric Drive
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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
S1693	Electric Drive (Advanced)	0	0	2,500	5,100	Continuing	Continuing

(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 WWII because of excessive size and weight of available electrical machinery. The advantages of electric drives include ship machinery arrangement flexibility, ease of maneuvering control, low noise, and fuel economy derived from the ease of electrical cross-connect between propeller shafts and variable prime mover/propeller speed reduction ratio. 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, for example, 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. S1314, Electric Propulsion Systems: This project develops and operationally evaluates electric propulsion systems for navy ships with propulsion power requirements in the range of 20,000 to 50,000 horsepower per shaft. Initial developments are directed toward electric propulsion systems for near-term operational evaluation (FY 1987) in a Navy test ship and Approval for Service Use supportive of FY 1989-FY 1990 acquistions of LM-2500-gas-turbine-powered surface combantants such as DD/DDG-type ships. Development preference is for those electric propulsion machinery designs which are considered low development risks for near-term at-sea evaluaton and which are amenable to future upgrade with higher-performance, more-advanced-design componentss. S1693, Electric Drive (Advanced): This project develops advanced-design electric drives for Navy ships up to 75,000 horsepower per shaft. Emphasis is given to development of higher performance electric drives including advanced-design combined propulsion and ship service power generation. 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. Project includes land-based and at-sea operational evaluation of advanced-design full-scale hardware.

Program Element: 63573N
Title: Electric Drive
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) BASIS FOR FY 1983 RDT&E REQUEST: S1314, Electric Propulsion Systems: Complete preliminary design competition and award single contract to proceed with detailed design, long-lead material procurement, and construction of nominal 40,000 horsepower per shaft system for land-based and test-ship operational evaluation. Continue critical component development. S1693, Electric Drive (Advanced): Continue laboratory and test craft evaluation of reduced-scale (e.g. 3000 horsepower) feasibility-model advanced electric drive systems. Start design, construction and laboratory evaluation of full-scale experimental prototype hardware and test rigs for advanced-design components including shaft seals, current collectors, switchgear, controls, transmission lines, superconductive magnets and associated cryogenic equipment. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: In FY 1982 Project S1314, Electric Propulsion System was funded under Program Element 63589N. In FY 1983, Project S1314 Electric Propulsion System was increased by $480K to accelerate near-term at-sea evaluation of electric propulsion systems and a new Project S1693, Electric Drive (Advanced) was started to provide higher-performance electric drive systems.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	557	6,787	Continuing	Continuing
S1314	Electric Drive	0	0	557	6,787	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 63573N Title: Electric Drive
DOD Mission Area: 553 - Engineering Technology (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: S1314, Electric Propulsion Systems - This project develops electric propulsion systems for near-term application in Navy ships. The advantages of electric drive include ship machinery arrangement flexibility, ease of maneuvering control, low noise, and fuel 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. 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 near-term, full-scale electric drive systems and components. Operational evaluations are currently planned in nominal 40,000 horsepower per shaft systems at a land-based test site and follow-on at sea test ship operations. Initial efforts will be directed to development of electric propulsion systems which are considered low development risks for near-term (FY 1987) test ship installation and Approval for Service Use supportive of LM-2500 gas-turbine-powered ship acquisition (e.g. DD/DDG) in the FY 1989-1990 time frame. Electrical machinery design selection preference is being given to those designs which are amenable to future upgrade with higher performance machinery and capable of integration with propulsion-prime-mover-derived ship service power systems. S1693, Electric Drive (Advanced): This project develops advanced-design electric drives for Navy ships up to 75,000 horsepower per shaft. Principal technical thrust is toward high-performance electric drives incorporating advanced-concept systems for combined propulsion and ship service power generation. Advanced-design electric drive developments will support upgrade of previously-constructed near electric propulsion systems and advanced ship acquisition beyond FY 1990. Advanced-design component developments include generators, motors, shaft seals, current collectors, switchgear, controls, transmission lines, superconductive magnets, cryogenic refrigeration and/or critical arcillary systems.

(U) RELATED ACTIVITIES: Program Element 63508N, Ship Propulsion Systems (Advanced); Program Element 63589N, DDGX; Program Element 63513N, Shipboard System Component Development; Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 61153N, Defense Research Sciences.

(U) WORK PERFORMED BY: In-House: Naval Ship Systems Engineering Station, Philadelphia, PA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. Contractor: To be determined.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. (U) FY 1981 and Prior Accomplishments: S1314, Electric Propulsion Systems: New program start in FY 1982 under Program Element 63589N. The following work has been accomplished under other programs such as Ship Propulsion Systems (Program Element 63508N) and Ships, Submarines and Boats Technology (Program Element 62543N) over the period FY 1973 to FY 1981. Various combinations of advanced-design features have been included in conceptual designs of full-scale shipboard electric propulsion systems up to 40,000 horsepower per shaft. These conceptual design studies encompassed future ship propulsion applications such as an early-desigh-version of DDGX, a 3000-ton small-water-plane-twin-hull ship and an ocean-transit hydrofoil ship design. These

design studies have consistently shown a potential for substantial improvements in ship performance and/or costs with electric propulsion as compared with alternative mechanical gear drives for these gas-turbine-powered ship designs. S1693, Electric Drive (Advanced): New program start in FY 1983. The following work has been accomplished in advanced electric drive machinery technology developments during the period FY 1973 to FY 1981 under other program elements. Detailed design, construction and factory tests have been completed on 3,000 horsepower scale models of some of full-scale systems and Navy laboratory evaluation has started. Construction and laboratory tests of an experimental model 400 horsepower superconductive propulsion system have been completed and initial shipboard tests have been successfully completed. Supporting technology developments are underway in the areas of high-performance current collector system (solid brushes and liquid metals), lightweight switchgear, cryogenic helium refrigeration equipment and superconductive magnets. Ship design impact studies with electric drive system designs incorporating technology being demonstrated in 3,000 horsepower scale model systems show a reduction of 14% in full load displacement, 29% less propulsion fuel requirement and 9% reduction in ship building contract cost for a general purpose destroyer design with conventional mechanical transmission and controllable/reversible propellers.

2. (U) FY 1982 Program. S1314, Electric Propulsion Systems: This work will be supported under the DDGX Line in FY 1982 as directed by Congress. Results of prior conceptual design and tradeoff studies together with results of 3,000 horsepower scale-model systems and supporting techno.ogy developments will be used to identify design concepts suitable for FY 1983 start on construction in full scale electric drive system. Develop contractor solicitation specifications for development of norminal 40,000 horsepower per shaft system for operational evaluation in land-based and at sea tests and award contracts for competitive preliminary designs with two or more manufacturers. Start development of critical components for full scale systems. S1693, Electric Drive (Advanced) - Program starts in FY 1983.

3. (U) FY 1983 Planned Program: S1314, Electric Propulsion Systems: Complete preliminary design competition and award contract for design, construction and factory test of full-scale systems. Start detailed design and long-lead material procurement. Continue development of critical components. S1693, Electric Drive (Advanced): Continue laboratory and test craft evaluation of reduced-scale (3000 horsepower) models of advanced electric drive systems which were started under the Ships, Submarines and Boats Technology Program Element 62543N. Start development of full-scale, experimental-prototype hardware and test rigs for advanced-design components including shaft seals, current collectors, switchgear, controls, transmission lines, superconductive magnets including associated cryogenic refrigeration equipment.

4. (U) FY 1984 Planned Program: S1314, Electric Propulsion Systems: Continue critical component development and construction of full-scale nominal 40,000 horsepower per shaft systems for a near-term (FY 1987) at sea test installation. Start designs and long lead-time test support equipment procurement for the land-based test site for full-sclae electric propulsion systems. S1693, Electric Drive (Advanced): Continue development of full-scale experimental prototype components. Start design and construction of advanced-design machinery to support assembly of an advanced electric drive system at a land based test site in FY 1987.

Program Element: 63573N
Title: Electric Drive
DOD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

5. (U) Program to Completion: S1314, Electric Propulsion Systems: Complete construction and factory tests on initial full scale machinery and conduct shock tests on a test barge. Install system at land based test site, conduct operational evaluation and obtain provisional approval for service use of the first machinery in 1987. Install on test ship and conduct at-sea operational evaluation. Obtain Approval for Service Use to support applications in FY 1990 ship acquisitions. S1693, Electric Drive (Advanced): Continue development of advanced-design components for electric drives including combined propulsion and ship service power generation. Complete construction of advanced-design machinery for installation at a land-based test site beginning in FY 1987. Following land-based evaluation, install in a test ship as an upgrade to previously-tested near-term system and obtain Approval for Service Use. This program is a continuing effort to provide development of advanced electric drive 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-power high-performance ships requiring very lightweight machinery.

6. (U) Milestones: Not Applicable.

Project S1314 — Title: Electric Propulsion Systems
Program Element: 63573N — Title: Electric Drive
DOD Mission Area: 553 Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This project develops electric propulsion systems for Navy ship propulsion. Electric propulsion for combatant ships was abandoned by the Navy after WWII because of excessive size and weight of available electrical machinery. The advantages of electric propulsion include ship machinery arrangement flexibility, ease of maneuvering control, low noise, and fuel 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) and superconductive field windings 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 40,000 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 at-sea test ship installation (FY 1987).

(U) RELATED ACTIVITIES: Program Element 63508N, Ship Propulsion Systems (Advanced); Program Element 63513N, Shipboard Systems Component Development; Program Element 62543N, Ships, Submarines and Boats Technology; Program Element 61153N, Defense Research Sciences. Program Element 63589N, DDGX.

(U) WORK PERFORMED BY: In-House: Naval Ship Systems Engineering Station, Philadelphia, PA; David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. Contractors: To be determined.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The following work has been accomplished under advanced electric drive machinery technology programs conducted under program elements Ship Propulsion Systems (Program Element 63508N) and Ships, Submarines and Boats Technology (Program Element 62543N) over the period FY 1973-FY 1981. Various combinations of advanced-design features have been included in conceptual designs of full-scale shipboard electric drive systems up to 40,000 horsepower per shaft. Detailed design, construction and factory tests have been completed on 3,000 horsepower scale models of some of these full scale systems and Navy laboratory evaluation has started. Construction and laboratory tests of an experimental model 400 horsepower superconductive propulsion system have been completed and shipboard evaluation has been completed on a specially prepared 65-foot testcraft operating in the Chesapeake Bay area. Supporting technology developments are underway in the areas of high-performance current collector system (solid brushes and liquid metals), lightweight switchgear, cryogenic helium refrigeration equipment and

Project S1314 — Title: Electric Propulsion Systems
Program Element: 63573N — Title: Electric Drive
DOD Mission Area: 553 Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

superconductive magnets. Ship design impact studies with electric drive system designs incorporating technology being demonstrated in 3,000 horsepower scale model systems show a reduction of 14% in full load displacement, 29% less propulsion fuel requirement and 9% reduction in ship building contract cost for a general purpose destroyer design with conventional mechanical transmission and controllable/reversible pitch propellers.

2. (U) FY 1982 Program: This work will be 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 supporting technology developments will be used to select candidate design concepts which are suitable for development in full-scale electric drive systems with detailed design to start in FY 1983. Develop procurement plans and specifications and award contracts with two or more manufacturers of large electrical machinery for the competitive preliminary design of nominal 40,000 horsepower per shaft systems for operational evaluation. Start development of critical components for full-scale systems including shaft seals, switchgear, transmission cables, control elements and other ancillary components.

3. (U) FY 1983 Planned Program: Complete preliminary design competition phase with two or more contractors and award contract to proceed with detailed design, long-lead material procurement, and start construction of nominal 40,000 horsepower per shaft systems. Continue development of critical componts for full scale systems .

4. (U) FY 1984 Planned Program: Continue critical component development and construction of full-scale electric propulsion systems. Start design and long-lead preparation of land-based test site for operational evaluation of full-scale systems.

5. (U) Program to Completion: Complete construction and factory tests on initial full scale machinery and conduct shock tests on a test barge. Install system at land based test site, conduct operational evaluation and obtain provisional approval for service use of the first machinery in 1987. Conduct at-sea evaluation in selected test ship and obtain Approval for Service Use in FY 1990 ship acquisition. Continue component improvements identified in operational evaluation and service application of electric drive systems and opportunities for more effective electric drives demonstrated in technology programs. This program is a continuing effort to provide development of advanced electric drive 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-power high-performance ships requiring very lightweight machinery.

6. (U) Milestones: Not Applicable.

Project S1314 — Title: Electric Propulsion Systems
Program Element: 63573N — Title: Electric Drive
DOD Mission Area: 553 Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S1314	Electric Propulsion Systems	0	0	7,267	15,654	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63609N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Surface Launched Munitions
Budget Activity: 2 - Advanced Technology Development

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

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

(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 producibility.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Investigate the most suitable process for producing new explosives and for filling warheads (pilot plant investigations). Conduct explosives characterization and large-scale safety/performance evaluation of new explosives for surface launched munitions. Coordinate related on-going explosives developments and compile information on explosives properties (data base). This work is a coordinated part of a joint service program managed by Program Planning Directorate under the Joint Logistics Commander. These funds are required to provide for a level of effort compatible with the number of explosives that require advanced development and with the cost of large-scale testing as development of explosives moves into this phase. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary for Project S0363 are: an increase of 971 in FY 1981 due to a Navy reprogramming that identified additional funds to forestall delays in development of aluminized plastic bonded explosives. Decreases of 568 in FY 1982 and 777 in FY 1983 result from adjustments during budget development. Project S1044 is no longer reflected in the current submission due to cessation of funding after FY 1980.

Program Element: 63609N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Surface Launched Munitions
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY.

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7,582	2,956	4,788	5,108	Continuing	Continuing
S0363	Advanced Explosives Technology	3,799	2,956	4,788	5,108	Continuing	Continuing
S1044	5" Infrared Guided Projectile	3,783	0	0	0	46,900	66,195

(U) OTHER APPROPRIATIONS FUNDS: Not Applicable.

Program Element: 63609N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Surface Launched Munitions
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Desirable insensitive explosives, primarily plastic bonded explosives (PBXs) are available from the explosives exploratory development program. Although preliminary testing shows that these explosives exhibit marked improvement over conventional explosives, generally, they cannot 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 improve 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) RELATED ACTIVITIES: Undersea Warfare Weaponry Technology, PE 62633N; Shipboard Damage Control, PE 63514N; Advanced ASW Torpedo, 63610N; Mine Development (Engineering), 64601N. Promising new, high-performance, insensitive explosives from the Undersea Warfare Weaponry Technology program, PE 62633N, are transferred into the Advanced Development Project. Information on new explosives producibility and characteristics, including large-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, the Advanced ASW Torpedo program, PE 63610N, and the Mine Development (Engineering) program, PE 64601N. Cooperative programs between the Explosives Advanced Development project and these weapon project offices are in progress, where the Explosives Advanced Development program provides information on the new explosives producibility and characteristics while the weapon offices conduct tests to determine warhead effectiveness and behavior of in-service munitions.

(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; and Army/ Single Manager.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: S1044 - 5-Inch Infrared Guided Projectile: 5-inch Infrared Guided Projectile Advanced Development has been completed. Bodies for infrared projectiles (including control section, warhead, rocket motor and finned afterbody) have successfully completed prequalification testing under the companion 5-inch Semi-active Laser Guided Projectile program. The Infrared seeker has been successfully demonstrated in overwater test firings against heaters/flares and ballistic aerial targets. Six Infrared seekers were completed for late FY 1979/early FY 1980 delivery to the Anti-ship Missile Defense project for compatibility tests on the 5-inch Rolling Airframe Missile. Twenty additional 5-inch Infrared Guided Projectile rounds fabricated at Naval Ship Weapons Center Dahlgren Laboratory for FY 1981 flight, land-based and developmental and operational testing. S0363 - Advanced Explosives Technology: Work on this project was started in Sept 1978. A coordinated,

multi-laboratory, tri-service program has been organized. Pilot plant scale-up has been completed on four insensitive, plastic bonded explosives (PBX's: PBXW-106, PBXW-109, PBXC-117, and AFX-708), resulting in AFX-708 being dropped from further testing and evaluation in the Navy's Explosives Advanced Development program. Cooperative efforts (shared costs) are currently underway with the QUICKSTRIKE (PE 64601N), Advanced Light Weight Torpedo (PE 64610N), and Ship Damage Prevention and Control (PE 63514N) offices.

2. (U) FY 1982 Program: Continue large-scale testing of an insensitive nonaluminized PBX for projectiles and missile warheads and of insensitive aluminized PBX's for Advanced Light Weight Torpedo (ALWT). Continue work on an explosive characteristics data base. Initiate pilot plant scale-up of a deformable explosive for missile warheads.

3. (U) FY 1983 Planned Program: Complete large-scale testing of an insensitive, non-aluminized PBX for projectiles and missile warheads, and of aluminized PBX's for use in Advanced Light Weight Torpedo. Conduct safety tests for new primary explosives. Perform pilot plant scale-up of an energetic aluminized PBX and o. a deformable explosive for missile warheads. Complete documentation and publish first edition of an explosives data base document. Perform producibility assessment on candidate PBX's.

4. (U) FY 1984 Planned Program: A high performance explosive for use in Advanced Light Weight Torpedo and insensitive PBX for projectiles and missile warheads and a less hazardous primary explosive (lead oxide replacement) will be recommended. Complete performance testing of underwater explosive and of a cook-off resistant booster explosive. Complete safety testing on deformable explosives for SAW-Missile warheads.

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

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63654N
Title: Joint Service Explosive Ordnance Disposal Development (Advanced)

DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2-Advanced Technology Development

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

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	3,063	3,330	4,957	5,114	Continuing	Continuing
S0377	Explosive Ordnance Disposal Procedures	3,063	3,330	4,957	5,114	Continuing	Continuing

(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 by Department of Defense Directive 5160.62 of 24 November 1971, for management of the Joint Service Explosive Ordnance Disposal Research and Development Program.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Twelve development projects are planned to continue advanced development during FY 1983 - two of these projects are high priority: Area Point Search System, and an Ordnance Rapid Area Clearance System. The Area Point Search System is designed to detect, locate/relocate ordnance items within three meters in water depths to 300 feet. Four projects are scheduled for completion and seven new projects are scheduled to be initiated. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: Decreases in FY 1981 of 37 and 98 in FY 1982 result from the application of lower inflation indices. The increase in FY 1983 of 1,271 is due to combining PE 63574N, Joint Ordnance Development with this Program Element.

Program Element: 63654N

Title: Joint Service Explosive Ordnance Disposal Development (Advanced)

DoD Mission Area: 553 - Engineering Technology (ATD)

Budget Activity: 2-Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,129	3,100	3,428	3,686	Continuing	Continuing
S0377	Explosive Ordnance Disposal Equipment	3,129	3,100	3,428	3,686	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
OPN	1,256	2,035	1,585	4,161	Continuing	Continuing

Program Element: 63654N

Title: Joint Service Explosive Ordnance Disposal Development (Advanced)

DoD Mission Area: 553 - Engineering Technology (ATD)

Budget Activity: 2-Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: 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) RELATED ACTIVITIES: All weapon related development, both domestic and foreign; Program Element 64654N, Joint Service Explosive Ordnance Disposal Development (Engineering).

(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 Inst., San Antonio, TX.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Joint explosive ordnance disposal development effort began in 1976. The Navy Decision Coordinating Paper for explosive ordnance disposal equipment was updated in January 1981 and advanced development projects were prioritized by the Department of Defense Explosive Ordnance Disposal Program Board. Eleven items have completed operational test and evaluation; seven from the previous Navy Decision Coordinating Paper and four from the 1981 revision. Projects resulting in approval for service use are: MK 30 XRAY; MK 9 Cryogenic Application System; MK 31 Tool Set; MK 3 Mod 0 Cutting Torch; MK 10 Mod 0 Explosive Analyzer; MK 23 and MK 24 Powder Actuate Cutters; MK 634 Explosive Container; MK 1 Fiberscope; MK 62 Steam Generator; Underwater Shaped Charges; and MK 22 Ordnance Locator.

2. (U) FY 1982 Program: Advanced development will continue on ten items. Operational evaluation is scheduled for four items: MK 35 Tool Set; Mechanical Remote Fuze Disassembly Kit; Fuze Neutralization System; and MK 33 Delay Firing Device.

3. (U) FY 1983 Planned Program: Advanced development will continue on twelve items. The four items completing operational evaluation in FY 1982 will be submitted for approval for service use. Operational evaluation is scheduled for five items: Jet Perforator; Disposable Dearmer; Shaft Liner Kit; and Area Point Search System (Phase B). Seven additional development projects will be initiated.

Program Element: 63654N

Title: Joint Service Explosive Ordnance Disposal Development (Advanced)

DoD Mission Area: 553 - Engineering Technology (ATD)

Budget Activity: 2-Advanced Technology Development

4. (U) FY 1984 Planned Program: Advanced development will continue on the remaining items. The Area Point Search System (Phase B) will undergo operational test and evaluation. Advanced development will be initiated on four items.

5. (U) Program to Completion: This is a continuing program under which development of new explosive ordnance disposal equipment will be initiated.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63701N Title: Human Factors Engineering Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

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

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	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 & Evaluation	542	0	0	0	0	1,048
1190	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

(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 major needs identified are: (1) improved crew and work station design and evaluation methods, (2) target acquisition and weapon system combat and display interface criteria, (3) human performance assessment and prediction techniques for air combat maneuvering, (4) human factors baseline support for emerging systems, and (5) near term improvements of crew/ship interface capability.

(U) BASIS FOR FY 1983 RDT&E REQUEST: To accomplish the approved Navy program, the following milestones will be met: Apply workload measurement technology to reduce manual control problems. Complete development of capability to designate and retrieve air combat measuring data. Complete development of energy maneaverability measures of in-flight performance. Test and evaluate carrier launch and recovery system. Apply human factors engineering technology to development of improved surface navigation procedures, and to SEAFIRE console design and simulation requirements. Complete and validate mockup evaluation procedures. Adapt mission operability assessment technique for multicrew platforms. As this is a continuing program, the above funding profile

Program Element: 63701N
Title: Human Factors Engineering Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

Includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only, except for Projects W1188, W1189, W1191, W1192, W1195, and W1197, for which the above funding includes all work or development phases now planned or anticipated.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are a decrease in FY 1981 of a total of 345 as a result of reprogramming. The total reduction of 1,151 in FY 1982 is a result of reduced program scope. The total reduction of 1,390 in FY 1983 is a result of project completions and policy on technology effort funding.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,084	3,220	4,201	3,994	Continuing	Continuing
W1188	Voice Interactive Systems Technology	600	540	739	0	0	1,879
W1189	Computer Assisted Methods of Human Factors Engineering Design & Evaluation	506	629	0	0	0	1,135
W1190	Technology Integration and Application	349	320	643	1,258	Continuing	Continuing
W1191	Air-to-Air Visual Target Acquisition	315	311	170	0	0	796
W1192	Improving Air Combat Performance	175	221	389	583	2,401	3,768
W1195	Models of System Cost Effectiveness	305	315	743	0	0	1,363
W1196	Human Factors Engineering Technology for Ships	324	437	776	1,201	Continuing	Continuing
W1197	Human Factors Engineering Technology for Test and Evaluation	510	447	741	952	3,188	5,838

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63701N Title: Human Factors Engineering Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This program responds to the need for effective integration of the human operator/maintainer into Navy weapons systems; it is intended to (1) improve current Human Factors Engineering capabilities for predicting, assessing, and maximizing human performance, (2) specify quantitatively operator/maintainer performance requirements and standards, and (3) detect, measure and predict personnel proficiency and proficiency loss over time with minimal impact on system availability. The projects are: W1188, VOICE INTERACTIVE SYSTEMS TECHNOLOGY, to reduce operator overload by use of voice interaction with equipments; W1189, COMPUTER ASSISTED METHODS FOR HUMAN FACTORS ENGINEERING DESIGN AND EVALUATION, to evaluate numerous possible function allocations and crewstation configurations; W1190, TECHNOLOGY INTEGRATION AND APPLICATIONS, to employ Human Factors Engineering within predefined time windows in the RDT&E cycle; W1191, AIR-TO-AIR VISUAL TARGET ACQUISITION, to improve visual acquisition for tactical advantage and to reduce midair collisions; W1192, IMPROVING AIR COMBAT PERFORMANCE, to provide methods for air combat maneuvering training, and evaluate individual squadron and air wing readiness, W1195, MODELS OF SYSTEM COST EFFECTIVENESS, to measure effectiveness of systems that include people; W1196, HUMAN FACTORS ENGINEERING TECHNOLOGY FOR SHIPS, apply and validate effectiveness of Human Factors Engineering as applied to ships. W1197, HUMAN FACTORS ENGINEERING TECHNOLOGY FOR TEST AND EVALUATION, to evaluate man-machine compatibility as affecting mission success.

(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).

(U) WORK PERFORMED BY: In House: Naval Aerospace Medical Research Laboratory, Pensacola, FL; Naval Air Development Center, Warminster, PA (lead laboratory): Naval Air Test Center, Patuxent, MD; Naval Ocean Systems Center, San Diego, CA: Naval Sea Systems Command, Washington, D.C.; Naval Training Equipment Center, Orlando, FL; Pacific Missile Test Center, Pt. Mugu, CA. (U) Contractors: Analytics, Inc., Willow Grove, PA: Barten, Inc., San Diego, CA, Boeing Aerospace Company, Seattle, WA; Canyon Research Group, Westlake Village, CA; Decisions and Designs, Inc., McLean, VA; Dunlap and Associates, Inc., La Jolla, CA. McDonnell-Douglas Corporation, St. Louis, MO, Systems Technology, Inc., Hawthorne, CA; Eagle Technology, Arlington, VA; Threshold Technology, Delran, NJ; plus three other contractors.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A set of computer support models for determining and evaluating operator functions for developing systems were completed in FY 1981 and have been applied seventeen times with a savings of 1.5 million dollars for the Light Airborne Multi-Purpose System (LAMPS) and F-18 alone. A $200 thousand investment in a technique to allocate panel space resulted in a 45% reduction in time to use the controls on the panel, and 99% reduction in probability of error. New control and display techniques use human voice capabilities to decrease workload by 35%, simplify work space design and increase the value of automation. Crew station assessment of reach model as applied to F-18 design increased the per cent of aviators accommodated from 20% to 80% of the available male population which reduced projected manpower costs by at least 5,000,000 dollars per year. This model can also assess percent of accommodation of female population in any work station. Development of training feedback methods

resulted in a 30% increase in kill ratio on the Air Combat Maneuvering Range. The spin-offs of emerging Human Factors Engineering technology are applied in design of complex ship systems. Aircraft arrestment systems, air traffic control areas, and shipboard internal communications systems have been selected for demonstration and application. Validation of Computer Aided Methods was accomplished by application of submodels to Maritime Patrol Aircraft, Vertical/Short Takeoff and Landing, Conversion in Lieu of Procurement, and the tactical support center aboard aircraft carriers. Additional methods developed with Exploratory Development funds for panel space allocation, labeling and control/display grouping were incorporated into the Computer Assisted Methods. Initiated efforts for the development of anthropometric measuring and prediction techniques for equipment handling to meet male/female physical capabilities, required by Occupational Safety and Health Administration standards. A methodology for deriving initial training requirements for new systems was initiated to insure that training requirements are compatible with operational requirements. Components of Computer Assisted Methods were provided to NASA Johnson Space Center. Voice Interactive Systems was incorporated into the Advanced Integrated Display System simulator to derive cost and human effectiveness data. Human factors engineering efforts for ships were focused on the Carrier Aircraft Traffic Control Center and on evaluations and improvements of the Beartrap Recovery System. The Suitability of the Voice Interactive System in operator/system interactions was demonstrated aboard a flight simulator and safety margin factors in manual control of Vertical and Short Take-off and Landing (VSTOL) aircraft were determined. Computer Aided Function Allocation and Evaluation modules are available for application during system design. Human Factors Engineering technology was applied to determine training and test and evaluation requirements for systems development. Critical prior events for predicting successful air combat maneuvers were identified and a data management system for the Tactical Aircrew Combat Training System was developed. Human effectiveness data and models were integrated with models of hardware effectiveness. Solutions to the problems with existing propulsion systems were demonstrated and criteria were developed for design of ship crew stations. Decision analysis was performed on the F-18 *operational* assessment. Prepared specifications for voice interactive hardware/software in airborne systems and trainers. Developed long lead time training requirements for Vertical/Short Takeoff and Landing (VSTOL) class platforms. Completed inflight validation of Vision Test Battery, accommodation training, and Visual Detection Simulator. Defined events predictive of successful air combat maneuvers. Demonstrated applications of system cost effectiveness techniques on selected systems. Developed mock-up for crew station evaluations of catapult systems. Validated decision analysis capabilities during F-18 Board of Inspection and Survey Trials.

2. (U) FY 1982 Program: W1188, VOICE INTERACTIVE SYSTEMS TECHNOLOGY: Complete evaluation of limited continuous speech recognition for airborne application. W1190, TECHNOLOGY INTEGRATION AND APPLICATIONS: Application of workload assessment technology to Long Range Airborne Anti-Submarine and Vertical/Short Takeoff and Landing Systems to reduce workload. W1191, AIR-TO-AIR VISUAL TARGET ACQUISITION: Complete inflight validation of vision test battery, accomodation training and scan/time sharing training. Complete project and submit final report. W1192, IMPROVING AIR COMBAT PERFORMANCE: Validate derived measures of air combat maneuvering performance. W1195, MODELS OF SYSTEM COST EFFECTIVENESS: Complete model for evaluation of alternatives for ASW sensor, signal processing and software systems. W1196, HUMAN FACTORS ENGINEERING TECHNOLOGY FOR SHIPS: Develop simulation techniques for assessing combat systems operations and apply Human Factors Engineering technology to new automatic propulsion

systems. W1197 HUMAN FACTORS ENGINEERING TECHNOLOGY FOR TEST AND EVALUATION: Complete development of hardware/software for mission operability assessment of airborne systems.

3. (U) FY 1983 Planned Program: W1190, TECHNOLOGY INTEGRATION AND APPLICATIONS: Apply decision aiding technology to VSTOL flight controls and displays. W1192, IMPROVING AIR COMBAT PERFORMANCE: Evaluate the effects of innovative displays on air combat training and assessment of inflight performance. W1196 HUMAN FACTORS ENGINEERING TECHNOLOGY FOR SHIPS: Complete evaluation of Mark 14 Arresting Gear mockup with Human Factors Engineering technology design applications. Complete Human Factors Engineering technology applications to Mark 13 Catapult System. Issue preliminary report on the application of Human Factors Engineering technology concepts for maintainability design of ship systems. W1197, HUMAN FACTORS ENGINEERING TECHNOLOGY FOR TEST AND EVALUATION: Complete development of an inflight monitoring technique for evaluation of pilot/operator workload and system operability assessment. Apply the mission operability assessment technique to multicrew platforms.

4. (U) FY 1984 Planned Program: W1190, TECHNOLOGY INTEGRAION AND APPLICATION: Implement cost effectiveness methodology into systems planning. W1192, IMPROVING AIR COMBAT PERFORMANCE: Evaluate effects of energy maneuverability display on training, and assess capability of emerging technologies for improving air combat performance. W1196, HUMAN FACTORS ENGINEERING FOR SHIPS: Apply human factors engineering technology to design of electro-optical sensor control stations. W1197, HUMAN FACTORS ENGINEERING TECHNOLOGY FOR TEST AND EVALUATION: Complete and validate mockup evaluation procedures, and adapt the mission operability assessment technique for application to multiple crew aircraft.

5. (U) Program to Completion: Continuing program.

6. (U) Milestones: Not Applicable

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63704N Title: Oceanographic Instrumentation Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops highly specialized, ultra high resolution oceanographic instrumentation and measurement techniques in response to the needs of the Navy's survey and fleet communities. R0118, Oceanographic Instrumentation Systems: develops instrumentation required for: (1) direct support of the Fleet; (2) conduct of surveys in response to fleet requirements; and (3) use by the Navy's research community. R1299, Oceanographic Techniques: (1) develops, experimental and analytical techniques to reliably and efficiently describe micro-scale physical processes in the upper ocean for the Navy's survey and fleet communities; and (2) describe the variability and natural sources of such variability in the upper ocean. These two projects are complementary and support high priority Navy oceanographic requirements such as Fleet Ballistic Missile Defense and Non-Acoustic Anti-Submarine Warfare. R1593, Mapping, Charting and Geodesy Instrumentation: Will develop specialized instru mentation for unique Navy Mapping, Charting and Geodesy survey requirements in accordance with written agreement with the Defense Mapping Agency. R1596, Satellite Oceanography Tactical Applications: Will develop, operationally demonstrate, and implement techniques for the automated identification of tactically significant ocean features derived from remote sensors.

(U) BASIS FOR FY 1983 RDT&E REQUEST: R0118, Oceanographic Instrumentation Systems: Efforts will continue to provide portable, expendable, and unattended instrumentation for Navy communities with emphasis on designing complete instrument systems rather than just sensors. The principal focus for FY 1983 is on physical oceanography sensors with a minor investment in bioluminescence detectors. R1299, Oceanographic Techniques: Efforts will continue in the areas of data analysis of upper ocean background features for strategic areas, in field experiments to develop deployment, data processing, and data analysis techniques for background measurement systems, and in the area of modeling to provide operational prediction capability for upper ocean background features such as shear, internal waves, and temperature-salinity structure, and to transition these developed systems to the operational survey fleet. R1593, Mapping, Charting and Geodesy Instrumentation: This is a new start, which will address the special mapping, charting and geodesy requirements of the Naval Oceanographic Office. R1596, Satellite Oceanography Tactical

Program Element: 63704N Title: Oceanographic Instrumentation Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

Applications: This project is a new start, implemented by the requirement for real time oceanographic data applicable to fleet tactical applications. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: The decrease of 19 in FY 1981 results from Navy Budget Adjustments. The decrease of 256 in FY 1982 results from refinement of cost estimates including inflation (-41) and reductions which occurred during budget development (-215). The increase of 123 in FY 1983 results from reduced inflation rates (-80), pay increases (+24), adjustments during budget development (-499), and addition of 678 to start project R1596.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,130	2,475	3,158	2,876	Continuing	Continuing
R0118	Oceanographic Instrumentation Systems	2,130	989	1,542	1,574	Continuing	Continuing
R1299	Oceanographic Techniques	0	1,486	1,616	1,302	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 63704N
Title: Oceanographic Instrumentation Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: In 1970, 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 oceanographic instrumentation and measurement techniques are still valid and are illustrated by the stringent oceanographic data requirements of the present Fleet Ballistic Missile Defense Program. The Program has two objectives: (1) to insure the availability of instrumentation required for direct support of the Fleet, for conduct of surveys in response to fleet requirements, and for use by the Navy's research community; and (2) 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 has been designed to support high priority Navy areas such as Fleet Ballistic Missile Defense and nonacoustic Anti-Submarine Warfare. Two new projects have been added for FY 1983: (1) A new advanced development project for mapping, charting and geodesy, and (2) a remote sensing effort in support of fleet tactical needs. The mapping, charting and geodesy project was established as 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. The remote sensing effort (Satellite Oceanography Tactical Applications) is in response to fleet requirements for real time sensing of ocean features.

(U) RELATED ACTIVITES: Certain tasks in Program Element 61153N, Defense Research Sciences (Oceanography) are directed toward basic research in oceanographic sensor and measurement equipment. Likewise tasks in Program Elements 62759N, Ocean and Atmospheric Support Technology and 62711N, Undersea Target Surveillance are directed toward exploratory development studies of specific oceanographic problem areas related to Navy operational needs, remote sensing and mapping, charting and geodesy efforts. Some tasks in Program Element 11224N, SSBN Security Technology Program are directly concerned with measurement capabilities of oceanographic parameters necessary for Fleet Ballistic Missile Defense. The Defense Mapping Agency has two specific program elements, 63701B and 64701B, which support general Navy mapping, charting and geodesy efforts.

(U) WORK PERFORMED BY: In-House: Naval Ocean Research and Development Activity, Bay St. Louis, MS; Naval Research Laboratory, Washington, DC; Naval Ocean Systems Center, San Diego, CA; Naval Oceanographic Office, Bay St. Louis, MS; Naval Postgraduate School, Monterey, CA. Contractors: Sippican Corporation, Marion, MA; Grundy Environmental Systems, San Diego, CA; Applied Physics Laboratory, University of Washington, Seattle, WA; Oregon State University, Corvallis, OR; University of British Columbia, Vancover, BC, Canada; Science Applications, Inc., McLean, VA; Johns Hopkins University, Baltimore, MD; Scripps Institute of Oceanography, San Diego, CA; Marine Environments, Inc., Washington, DC; Computer Science Corporation, Bay St. Louis, MS.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: R0118, Oceanographic Instrumentation Systems: Designed, constructed, tested and deployed the following instrumentation: Acoustic sensor array for Navy laboratory use; Remote Sensing Environmental Data Package for shallow water; first Expendable Shear Current Profiler and the digital data collection, storage and processing unit; air-expendable bathythermograph for deeper, more accurate temperature measurement; first multi-station, multi-probe digital data

collection, storage and processing unit for all existing expendables except shear probe; first three-axis Richardson Number Profiler; first air-deployable sound velocity probe. Designed, constructed, tested and demonstrated feasibility of: optical fiber data link for expendables; two-axis and three-axis thermal film current sensors; moored automatic vertical profiler; expendable shipboard sound velocity-temperature probe. Designed and constructed: expendable dissipation profiler; automatic microstructure shipboard profiler; acoustic remote sensing shear profiler. Completed feasibility study of dense pack tow chain. R1299, Oceanographic Techniques: Transitioned Expendable Current Profiler System, including data acquisition system, data processing system, and data logging system to survey fleet. Completed analysis of experimental data of high frequency interval waves in the upper ocean from acoustically tracked mooring. Developed empirical model of upper ocean shear based on mean structure. Completed evaluation of spatial and temporal variability of shear in the upper ocean with emphasis on the North Atlantic. Completed study of experimental data on the role of shear on internal waves. Completed preliminary model of upper ocean shear based on atmospheric forcing. Developed two-dimensional non-linear model of internal waves. Conducted shear measurements and demonstrated shear system to survey fleet.

2. (U) FY 1982 Program: R0118, Oceanographic Instrumentation Systems: Complete expendable shear probe remote deployment technique. Develop algorithms and software for automatic microstructure profiler, design digital deck data collection unit and test system. Begin development of horizontal towed current meter. Test competing new acoustic current profiling systems. Provide improved means of depth indication for expendable profilers. Design and test a towed turbulence sensor. Design and construct new bathyphotometer system. Investigate means of adaptive data collection and compaction. Provide initial research and development support to Naval Oceanographic Office. R1299, Oceanographic Techniques: Data Analysis: Provide environmental data analysis for strategic areas in the North Atlantic and Pacific Oceans. Develop and transition algorithms and methods for analyzing Expendable Current Profiler (shear) results. Complete a comparison of observed shear data with dynamical and statistical model results developed previously. Assess the role of turbulence in the upper ocean background. Complete the development of relationships between vertical temperature and salinity structure in the North Atlantic and Pacific Oceans. Develop techniques to describe fine structure based on measurements of mesoscale features. Field: Conduct and demonstrate microstructure measurements in the Gulf of Alaska in support of the Naval Oceanographic Office. Develop measurement and data processing techniques for vector and scalar microstructure measurements in the North Atlantic and Pacific Oceans. Continue planning for FY 1983 and FY 1984 field experiments. Modeling: Complete a model of regional upper ocean background shear based on atmospheric forcing. Complete an evaluation of a statistical model for estimating background levels of mean shear as a function of upper ocean structure. Complete a sensititivy study of non-linear two-dimensional model for internal waves to such effects as topography and atmospheric forcing. Complete the development of an empirical model to infer density from observed temperature profile.

3. (U) FY 1983 Planned Program: R0118, Oceanographic Instrumentation Systems: Complete development of acoustic current profiling techniques. Complete automatic yo-yo microstructure profiler and provide training to Naval Oceanographic Office personnel in its use. Demonstrate feasibility of air-launched shear profilers. Construct and test horizontal profiling current meter. Demonstrate feasibility of adaptive data collection and compaction techniques. Incorporate new depth indication techniques into

expendable sensors. If towed turbulence sensor proves itself, build system for naval use. Design and construct new profiling system for boluminescent data collection. Provide the Naval Oceanographic Office with initial research and development support. R1299, Oceanographic Techniques: Develop data management plans for shear, internal waves, and upper ocean structure (micro and fine structure). Transition shear modeling capability. Initiate study of turbulence effects on upper ocean background features. Continue analysis of relevant environmental data for strategic areas. Continue analysis of data from FY 1982 and FY 1983 field exercises and development of deployment, data processing and analysis techniques. R1593, Mapping, Charting and Geodesy: Develop and test a marine optical pumping magnetometer system which will achieve continuous sampling of the magnetic field with 0.02 gamma sensitivity in mapping, charting and geodesy survey operations. The primary task is to develop a self-orienting sensor within a hydrodynamically stable housing. A new Kevlar coaxial tow cable may be developed for use with this magnetometer. R1596, Satellite Oceanography Tactical Applications: Initiate development of tactical applications of geophysical satellite and Defense Meteorological Satellite Program microwave imager data to the analysis of tactically significant ocean features.

4. (U) FY 1984 Planned Program: R0118, Oceanographic Instrumentation Systems: Provide air deployable version of expendable conductivity probe developed under 6.1 funding. Support development of remote sensors. Continue bioluminescent sensor system development. Complete horizontal turbulence measurement system. Complete horizontal current profiler. Develop moored motion sensor package. Initiate evaluation of optical and chemical sensors. R1299, Oceanographic Techniques: Develop strategic area assessments of relevant background parameters. Continue analysis of turbulence related to upper ocean structure and velocity. Participate in North Pacific shear, internal wave, and upper ocean structure experiments. Complete analysis of FY 1983 data and begin analysis of FY 1984 data. Begin effort in bioluminescent modeling and air-sea interaction. Continue technology transfer to the Naval Oceanographic Office. R1593, Mapping, Charting and Geodesy: Continue development of the marine optical pumping magnetometer system. R1596, Satellite Oceanography Tactical Applications: Continue development of applications techniques and install at Fleet Numerical Oceanographic Center, Naval Ocean Systems Center and aboard ships.

5. (U) Program to Completion: This is a continuing program for development of oceanographic instruments and ocean satellite interpretation techniques which are responsive to changing and future program support requirements, in upper ocean measurements, mapping, charting and geodesy and tactical applications of remote sensing.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced development of medical and dental health care maintenance and delivery systems, systems to enhance unit/individual performance effectiveness, and mission aborting disease and injury prevention techniques in support of continuing Medical Department efforts to ensure optimum health, performance and combat readiness of Navy and Marine Corps personnel as they adapt to new weapons systems and changing operational environments.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Funds are required to support the following major thrusts in Advanced Medical Development: improved techniques for testing balance-sense functions of aviation personnel; disposition criteria for personality disorders, physical fitness enhancement and computer-managed weight reduction programs for use in Navy and Marine Corps occupational settings; design criteria for the development of sonar headphones; selection standards for Explosive Ordnance Disposal personnel; determination of human dynamic performance and neurophysiological responses to impact acceleration; human vibration tolerance criteria for use in equipment design; improved field/shipboard medical equipment; operational evaluation of freeze-preserved blood components; improved methods for prevention and treatment of hemorraghic and septic shock; clinical procedures for treating acute oral diseases; and chemical warfare-conventional casualty prediction model applicable to Navy and Marine Corps combat operations. As this is a continuing program, the above funding includes outyear escalation and emcompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: Total program obligations for FY 1981 were 220 less than the estimate shown in the FY 1982 Descriptive Summary. This decrease was due to internal reprogramming to Exploratory Development (136) and a Navy-imposed reduction (84) and results in a reduced level of effort. The FY 1982 total program estimate is 516 more than that shown in the FY 1982 Descriptive Summary, a change attributable to a more precise computation of dollar requirements and

internal realignment of effort increasing the Fleet Health Standards project. The FY 1983 total program estimate shows a significant reduction (-4,768) from that shown in the FY 1982 Descriptive Summary. This decrease is due to transfer of funds to the Army, associated with its designation as lead service for infectious disease and combat dental research.

(U) FUNDINC AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,994	9,648	11,718	13,626	Continuing	Continuing
M0095	Fleet Health Technology	4,410	6,287	7,927	9,262	Continuing	Continuing
M0096	Fleet Health Standards	1,038	1,219	873	1,046	Continuing	Continuing
M0097	Air Crew Impact Injury Prevention	1,546	2,142	2,918	3,318	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This element consists of three projects: M0095 Fleet Health Technology: This project is a composite of tasks encompassing (1) improvement of medical and dental treatment and management procedures for injuries suffered during fleet operations; e.g. treatment of shock, development of frozen blood component system, tissue repair, preservation and transplantation techniques; (2) development of methods to enhance fleet health care delivery systems; and (3) development of improved field and shipboard medical and dental equipment and facilities. M0096 Fleet Health Standards: This project is directed toward the development and validation of (1) medical screening guidelines for establishing service entry, assignment and retention standards; (2) medical guidelines for physical conditioning and weight control and the minimization of the biomedical effects of occupational stressors such as fatigue, workload and vibration; and (3) medical guidelines for equipment design, work procedures, industrial hygiene and occupational medical surveillance and treatment in Navy and Marine Corps working environments. M0097 Air Crew Impact Injury Prevention: The purpose of this project is to determine human physical, performance, and neurophysiological responses to impact acceleration. Data will be used for the development of (1) design criteria for the construction of anthropomorphic test manikins; and (2) mathematical and engineering models for the prediction of injurious effects of impact and for the design and evaluation of aircraft and military vehicular safety features and protective devices.

(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, vaccines, and tissue transplantation techniques. The Army is the lead agency for infectious disease and combat dental research. The Navy participates in these areas with funding and technical direction from the Army. While both the Army and Air Force support programs to develop physical fitness standards, the resulting standards are specific to the tasks performed in each military service. The program is coordinated through various reviews sponsored by the Undersecretary of Defense for Research and Engineering and Management Committees to ensure that work is complementary to, rather than duplicative of, the programs of the other Military Departments and non-DoD research organizations.

(U) WORK PERFORMED BY: In-House: Naval Medical Research Institute, Bethesda, MD and seven other Naval Medical Research and Development Command laboratories; Naval Ocean Systems Center, San Diego, CA; Naval Weapons Center, China Lake, CA. 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; Johns Hopkins University, Baltimore, MD; Advanced Research Resources Organization, Washington, DC; Institute of Human Performance, Fairfax, VA.

Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: M0095 Fleet Health Technology: Demonstrated the feasibility of using frozen red blood cells and platelets in a theater fleet hospital during desert and cold weather exercises. Developed a "trauma score" for evaluating the severity of injuries during mass casualty situations. Developed a vaccine that protects experimental animals against epidemic and endemic typhus infections. Developed and evaluated laboratory methods for the rapid identification of Rift Valley fever, Sandfly fever, Pseudomonas, rickettsial and typhoid antigens. Demonstrated the efficacy of freeze-dried tissue allografts in the treatment of maxillofacial wounds with tissue loss. Demonstrated a reduction in maxillofacial infections with adjunctive use of high pressure oxygen therapy. M0096 Fleet Health Standards: Developed guidelines for design of visual displays for use in Swimmer Delivery Vehicles; identified and measured the physical dimensions and forces required by Navy personnel to perform critical damage control tasks and by Marine Corps personnel to perform combat tasks in cold weather and desert environments; completed development of the Brief Vestibular Test Device that is now being used to screen naval aviation candidates for balance-sense function. M0097 Air Crew Impact Injury Prevention: Developed techniques for measuring the biodynamic effects of parachute-opening shock; developed a standard coordinate and instrumental system for use in evaluating the biodynamic effects of ejection seat acceleration; defined pre-injury threshold limits of exposure to the front-to-back acceleration vector as being in the range of 70 to 80g's.

2. (U) FY 1982 Program: M0095 Fleet Health Technology: Commence development of methods to prepare intravenous solutions from dried preparations in the field and on ships. Continue development of procedures for the management of radiated combat casualties throughout the medical evacuation chain. Continue development of a laser device to repair severed blood vessels and nerves. Continue development of an animal model to assess treatment modalities for hypothermic trauma casualties. Continue development and evaluation of methods to reduce graft rejection in tissue transplant-treated patients. Determine feasibility of utilizing frozen red blood cells and platelets and frozen, biochemically-modified red blood cells to support a theater blood program and shipboard medical departments. Evaluate treatment drugs against bacterial and parasitic diarrheas. Develop simplified methodologies for the field identification of tropical infectious disease agents (insect borne viruses and gastrointestinal pathogens). Evaluate Marine Corps Expeditionary Dental Shelter system for delivery of dental care in the field. Develop and test chemical agents to block the effect of toxic products on vital dental nerve tissues to reduce incidence of dental emergencies. Continue evaluation of selected allogeneic graft materials and microsurgical graft techniques for oral and maxillofacial reconstruction. M0096 Fleet Health Standards: Complete development of: criteria for use in the design of sonar headphones; methods to identify those naval personnel at risk for alcohol abuse and for assessing the effectiveness of alcohol treatment programs; disposition standards for naval personnel diagnose as having personality disorders; measures to assess psychological stress in Marine Corps recruit training. Continue work on strength and endurance requirements for Navy and Marine Corps tasks and development of computer-managed weight reduction program. Begin development of selection standards for Explosive Ordnance

Disposal personnel and exposure criteria for short duration (under 1 hour) sine-wave and mixed frequency vibrations using performance measures. M0097 Air Crew Impact Injury Prevention: Continue development of a three dimensional model of head and neck responses to variable angle and direction impact accelerations and a family of anthropomorphic test manikins. Continue assessment of head and neck effects of vertical axis impact acceleration, as well as the neurophysiological and long-term medical effects of exposure to impact acceleration. Begin work on determining the three dimensional biodynamic effects of parachute-opening shock and the acute performance effects of linear acceleration.

3. (U) FY 1983 Planned Program: M0095 Fleet Health Technology: Continue development of an animal model in which to test procedures for managing cold weather trauma casualties. Determine the safety and clinical efficacy of freeze-preserved platelets and plasma clotting factors for the treatment of trauma casualties. Improve resuscitative and surgical procedures for the treatment of shock and trauma in combat casualties. Initiate program to develop clinical procedures for the transplantation of blood-forming cells to radiated casualties. Field test a "hardened" modular laboratory developed to assist in the clinical evaluation of trauma patients. Continue to develop a new wound covering which provides for the slow release of pharmaceutical topical treatment agents. Begin developing a field medical information system to expand the Navy Medical Department's ability to protect and care for personnel engaged in amphibious operations. Development of malaria, Pseudomonas and epidemic/endemic typhus vaccines and evaluation of drugs for treatment of acute diarrheal diseases encountered outside continental United States will continue under Army management and funding. Continue evaluation of microsurgical techniques for oral/maxillofacial reconstruction. Continue clinical trials of blocking agents in deep dental decay lesions. Continue evaluation of topical enzyme preparations and concurrent electrical stimulation for facilitating healing of oral/maxillofacial wounds will continue under Army management and funding. Initiate development of a chemically contaminated warfare-conventional casualty prediction model for medical manpower and logistical planning for Navy and Marine Corps combat operations in a chemically contaminated environment. M0096 Fleet Health Standards: Complete development of computer-managed weight reduction program. Continue development of physical conditioning methods and body fat standards for Navy and Marine Corps personnel; selection of standards for Explosive Ordnance Disposal personnel; methods to assess balance-sense function among naval aviators; and performance based, short duration exposure criteria for sine-wave and mixed frequency vibration exposures. Begin development of methods and equipment to enhance signal detection by sonar operators. Commence validation of personnel exposure limits to nitrate ester propellants. M0097 Air Crew Impact Injury Prevention: Complete development of three dimensional mathematical model for predicting head and neck injuries resulting from impact acceleration along frontal and lateral body axes. Complete assessment of head, neck and pelvic effects of vertical impact acceleration and biodynamic effects of parachute-opening shock. Continue determination of long-term medical effects of exposure to impact acceleration.

4. (U) FY 1984 Planned Program: M0095 Fleet Health Technology: Continue development and evaluation of new procedures for early diagnosis and treatment of shock and trauma. Continue to develop new and improved medical equipment and devices to enhance field and shipboard casualty support. Develop procedures to obtain therapeutic quantities of peripheral blood-forming cells and bone marrow. Evaluate the therapeutic effectiveness and safety of white blood cells, platelets and plasma fractions for the

treatment of patients in hemorraghic and septic shock. Evaluation of methods to enhance bone repair through facilitation of mononuclear cell response to injury. Complete evaluation of effectiveness of high pressure oxygen on wound infections. Continue development of predicting models for combined chemical warfare and conventional injuries in Navy and Marine Corps personnel. Develop human engineering criteria and work-rest rotation schedules for shipboard personnel garbed in chemical warfare protective ensebles and performing engineering, fire and damage control, sonar, combat information, and communication tasks in a chemically contaminated environment. M0096 Fleet Health Standards: Complete development of physical conditioning methods and body fat standards for Navy and Marine Corps personnel; selection standards for Explosive Ordnance Disposal personnel; and short duration human vibration exposure standards. Continue development of methods to enhance operator sonar signal detection and to assess balance sense function in naval aviators. Continue validation of personnel exposure limits to nitrate ester propellants. M0097 Air Crew Impact Injury Prevention: Complete development of impact injury prediction model for each g-force vector (X, Y, and Z) and for all vector combinations using neurophysiological criteria and three dimensional head and neck prototype manikin. Begin comparison of head, neck, and pelvic effects of linear acceleration in the back-to-front vector on human subjects with or without head restraints.

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

6. (U) Milestones: Not Applicable

Project: M0095 Title: Fleet Health Technology
Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Worldwide commitments make it mandatory for the Navy Medical Department to be prepared to prevent, treat, and manage medical and dental casualties in many operational and climatic environments, including those in which chemical warfare weapons may be employed. Treatment and management of combat casualties are also considered. The following development and evaluation efforts are proposed or currently underway to improve the effectiveness of medical/dental health care delivery systems on a global basis for Navy and Marine Corps personnel. They are directly related to the unique environmental aspects of Navy and Marine Corps operations and are closely coordinated with the efforts of the other Services to avoid duplication or overlap.

(U) New means to preserve blood components for use in operational situations

(U) Improved methods for estimating Navy and Marine Corps chemical warfare and conventional warfare casualties during amphibious operations

(U) New medical and dental equipment that will increase the ability to deliver prompt and effective casualty care in all operational settings and geographical areas

(U) Methods to make bone marrow transplantation militarily feasible

(U) Navy input to drug and vaccine R&D Program for which the Army is lead Service.

(U) Methods for preventing and controlling hemorrhagic and infectious shock following traumatic combat injury

(U) RELATED ACTIVITIES: Army and Air Force R&D efforts in medical support of military operations; Army and National Institutes of Health efforts in the development and evaluation of blood products, vaccines and tissue transplantation techniques where alternative technological approaches are pursued. The program is coordinated through the Under Secretary of Defense (Research and Engineering) and the Armed Services Biomedical Research Evaluation and Management Committee.

(U) WORK PERFORMED BY: In-House: Naval Medical Research Institute, Bethesda, MD and four other Naval Medical Research and Development Command laboratories; National Bureau of Standards, Washington, DC; Naval Ocean Systems Center, San Diego, CA. Contractors: University of North Carolina, Chapel Hill, NC; University of California, San Diego, CA; University of Miami, Miami, FL; Michael Reese Hospital and Medical Center, Chicago, IL; Boston University, Boston, MA; Georgetown University, Washington, DC; Massachusetts General/Harvard Medical School, Boston, MA.

Project: M0095 Title: Fleet Health Technology
Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments:

a. (U) Developed a "Trauma Score" which can be used to assist triage personnel in predicting the probability of a combat casualty surviving his wounds.

b. (U) Determined feasibility of using frozen blood cells and platelets in a mobilization theater hospital in desert and cold high-altitude environments.

c. (U) Submitted an application to the Food and Drug Administration for the licensure of a safe cost effective means to freeze red blood cells in the original donor bag.

d. (U) Developed new laboratory tests for diagnosing Rift Valley fever, Sandfly fever, Pseudomonas infections, rickettsial infections, typhoid and paratyphoid fevers.

e. (U) Evaluated a miniaturized kit for rapid diagnosis of gastrointestinal enteric fevers, meningitis and cholera under remote field conditions.

f. (U) Developed a vaccine that protects experimental animals against epidemic and endemic typhus fevers. Fleet introduction of human vaccine estimated in FY 1985.

g. (U) Demonstrated the beneficial effect of adjunctive hyperbaric oxygen in the management of maxillofacial infections.

2. (U) FY 1982 Program:

a. (U) Determine clinical feasibility of using frozen platelets, red blood cells and biochemically-modified red blood cells to support a theater blood program and shipboard medical departments.

b. (U) Evaluate feasibility of using rejuvenated red blood cells on casualty receiving and transport ships.

c. (U) Commence development of a system to prepare intravenous solutions from dried preparations in the field and on ships.

d. (U) Development of an animal model in which to assess management procedures for cold weather casualties with traumatic injuries.

e. (U) Evaluate the efficacy of hyperimmune serums in the prevention and treatment of Gram-negative blood infection.

f. (U) Continue development of procedures for the management of combat casualties exposed to ionizing radiation throughout the medical evacuation chain.

g. (U) Continue development of a laser device to repair severed blood vessels and nerves.

h. (U) Continue input to DoD-coordinated drug and vaccine R&D program.

i. (U) Develop and evaluate improved methodologies for diagnosing, managing, and treating tropical infectious diseases of military importance, e.g. paratyphoid fever, streptococcal and mycoplasmal pneumonias, anaerobic microorganisms and skin-penetraing worms.

j. (U) Evaluate Marine Corps Expeditionary Dental Shelter for delivery of dental care in the field.

k. (U) Develop microsurgical graft techniques for repairing maxillofacial wounds.

l. (U) Continue evaluation of vascular and cortical bone graft materials and banked freeze-dried bone preparations for maxillofacial reconstruction.

m. (U) Initiate evaluation of the effects of electrical stimulation on bone growth and repair in oral and maxillofacial injuries.

3. (U) FY 1983 Planned Program:

a. (U) Commence development of a field medical information system for amphibious operations.

b. (U) Develop improved techniques to manage combat trauma casualties in cold weather environments.

c. (U) Continue development of new wound covering which provides for the slow release of antibiotics and other biologically active agents.

d. (U) Initiate development of clinical procedures for transplanting blood-forming cells to radiation casualties.

e. (U) Continue test and evaluation of a device to monitor the efficacy of resuscitation fluids.

f. (U) Continue development of a laser device to join severed vessels and nerves.

g. (U) Complete two-year pre-clinical trial of pharmaceuticals to block the effect of toxic products on vital dental nerve tissues.

h. (U) Initiate development of a chemical warfare-conventional casualty prediction model applicable to fleet operations.

4. (U) FY 1984 Planned Program:

a. (U) Continue development of new improved medical equipment and devices.

b. (U) Evaluate treatment modalities for trauma casualties in cold weather environments.

c. (U) Accelerate program to develop clinical procedures for treating lethally radiated combat casualties.

d. (U) Evaluate the clinical effectiveness and safety of platelets, blood-forming source cells and plasma derivatives.

e. (U) Evaluate methods to enhance bone repair through facilitation of mononuclear cell response to injury.

f. (U) Continue development of chemical warfare-conventional casualty workload models.

g. (U) Initiate development of human engineering criteria and work-rest schedules for shipboard personnel wearing chemical warfare protective clothing.

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

6. (U) Milestones: Not applicable.

Project: M0095 Title: Fleet Health Technology
Program Element: 63706N Title: Medical Development (Advanced)
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
M0095	Fleet Health Technology	6,022	7,811	4,532	5,099	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63707N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Title: Manpower Control Systems Development
Budget Activity: 2 - Advanced Technology Development

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

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
Z1167	Procedures for Officer and Enlisted Acquisition	204	0	0	0	0	523
Z1169	Productivity Improvement Systems	248	211	212	0	0	1,021
Z1170 *	Human Processing of Large Automated Data Base	361	0	0	0	0	1,010
Z1178	Attrition Analysis and Management	213	0	0	0	0	577
Z1182	Military Personnel Cost Projections	372	0	329	349	893	2,318
Z1186	Fleet Support Manpower	845	1,011	796	506	2,999	6,897
Z1187	Computer Based Manpower Planning and Programming	602	653	498	395	897	3,625
Z1211	Recruiting System Management	0	0	398	386	1,455	2,239
Z1326	Integrated Crews	60	0	0	0	0	142
Z1342	Family Support Program	65	0	299	276	1,710	2,477
Z1383	Civilian Personnel Issues	65	0	301	297	996	1,859
Z1385 **	Computer Adaptive Test	0	898	0	0	0	898
Z1392 *	Performance Enhancement	94	0	0	0	0	185
Z1582	Second Generation Human Resources Management (HRM)	0	0	289	287	855	1,431
Z1583	Geographic Stability	0	0	389	297	296	982

*Transferred to PE 63710N in FY 1982 budget. Project subsequently cancelled by FY 1982 Budget Admendment.
**Transferred to PE 64709N after FY 1982.

(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.

Program Element: 63707N
Title: Manpower Control Systems Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) BASIS FOR FY 1983 RDT&E REQUEST: In FY 1983 efforts addressing Productivity Improvement, Fleet Support Manpower, and Manpower Planning and Programming will continue. Work is being started in Recruiting System Management, Human Resources Management (HRM), and Geographical Stability and is being reinitiated in Personnel Cost, Family Support and Civilian Personnel management. Work in Computerized Adaptive Test is being deleted from the program after FY 1982 and transferred to PE 64709N. As this is a continuing program, with projects having specific beginning and ending dates, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated for each individual project.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: The FY 1981 program is 1,056 less in this Descriptive Summary as a result of a recall of funds from projects which were scheduled for completion at the end of FY 1981 and other Navy Budget reductions. These projects include Z1167, Procedures for Officer and Enlisted Acquisition (-24); Z1178, Attrition Analysis and Management (-149); Z1182, Military Personnel Cost Projection (-28); Z1383 Civilian Personnel Issues (-135); Z1170, Human Processing of Large Automated Data Bases (-416); Z1326, Integrated Crews (-7); Z1342, Family Support Program (-156); and Z1392, Performance Enhancement (-336). (Plans are currently underway to reinstate the last four of these projects in FY 1982 with funds reprogrammed from lower priority work). Projects incremented in FY 1981 include Z1169, Projectivity Improvement Systems (+59); Z1186, Fleet Support Manpower (+85); and Z1187, Computer-Based Manpower Planning and Programming (+51). The FY 1982 program total was 250 less than in the *FY 1982 Descriptive Summary as a result of Navy Budget* reductions. Decremented projects include Z1169, Productivity Improvment Systems (-50); Z1186, Fleet Support Manpower (-200). The FY 1983 funding To Be Determined in the FY 1982 Descriptive Summary is now estimated to be funded at the 3,511 level.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY (Amended):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,700	4,185	3,023	TBD	TBD	TBD
Z1167	Procedures for Officer and Enlisted Acquisition	319	228	0	TBD	TBD	TBD
Z1169	Productivity Improvement Systems	350	189	261	TBD	TBD	TBD
Z1170 *	Human Processing of Large Automated Data Bases	649	777	0	TBD	TBD	TBD
Z1178	Attrition Analysis and Management	364	362	0	TBD	TBD	TBD

Program Element: 63707N
Title: Manpower Control Systems Development
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
Z1182	Military Personnel Cost Projection	375	400	0	TBD	TBD	TBD
Z1186	Fleet Support Manpower	740	760	1,211	TBD	TBD	TBD
Z1187	Computer-Based Manpower Planning and Programming	580	551	653	TBD	TBD	TBD
Z1326	Integrated Crews	82	67	0	TBD	TBD	TBD
Z1342	Family Support Program	150	221	0	TBD	TBD	TBD
Z1383	Civilian Personnel Issues	0	200	0	TBD	TBD	TBD
Z1385	Computerized Adaptive Test	0	0	898	TBD	TBD	TBD
Z1392 *	Performance Enhancement	91	430	0	TBD	TBD	TBD

* Transferred to PE 63710 in FY 1982 budget.

(U) OTHER APPROPRIATION FUNDS: None

Program Element: 63707N Title: Manpower Control Systems Development
DoD Mission Area: 552 - Environmental and Life Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The overall objective of this program is to develop techniques for the management of Navy manpower and personnel systems. This work is driven by escalating costs and difficulties in recruiting, training, fully utilizing, and retaining qualified Navy personnel. Specific problem areas being addressed include people/assignment mismatches, poor productivity, manpower shortages in critical ratings, high service attrition, inadequate compensation planning policies, inaccurate predictions of support manpower requirements, poor morale related to family instability and reassignment to other geographical areas, inadequate civilian management policies in the face of budget and workforce reductions, and lack of Navy wide plans and policies for the effective management of Naval personnel. Z1167: PROCEDURES FOR OFFICER AND ENLISTED ACQUISITION. Develop procedures for officer and enlisted selection and placement leading to greater job satisfaction, reduced attrition, and increased retention. Z1169: PRODUCTIVITY IMPROVEMENT SYSTEMS. Develop an integrated and programmatic approach to improving productivity in Navy industrial organizations. Z1170: HUMAN PROCESSING OF LARGE AUTOMATED DATA BASES. Integrate and apply existing knowledge about human information processing, automated information systems, and engineering design processes to develop tools for effectively using command and control, cost, and personnel data bases. Z1178: ATTRITION ANALYSIS AND MANAGEMENT. By tracking a group of enlistees through their first and second enlistment terms, develop techniques to identify and retain desirable individuals and to formulate policies related to acquisition and retention. Z1182: MILITARY PERSONNEL COST PROJECTION. Identify the factors, both internal and external to the Navy, that affect the requirements and on-board inventories of personnel, and project costs of alternative methods for reducing imbalances in supply and demand. Z1186: FLEET SUPPORT MANPOWER. Establish better procedures for forecasting Navy support manpower requirements based on different mixes of fleet and weapon systems. Z1187: COMPUTER-BASED MANPOWER PLANNING AND PROGRAMMING. Develop an executive-level decision system that can accommodate manpower planning and programming under severe time constraints and can provide gross estimates of civilian and military personnel required for alternative policies. Z1211: RECRUITING SYSTEM MANAGEMENT. Develop a computer-based technique for the optimal accession and utilization of available enlisted, officer, civilian, and contractor personnel. Z1326: INTEGRATED CREWS. Monitor the assignment of mixed crews of men and women to ships and evaluate the impact on operational readiness. Z1342: FAMILY SUPPORT PROGRAM. Provide an information base for the development and implementation of effective Navy family programs and policies. Z1383: CIVILIAN PERSONNEL ISSUES. Identify contemporary and long term issues dealing with the management of civilian personnel, and carry out research projects in these areas which will enhance personnel management effectiveness and productivity. Z1392: PERFORMANCE ENHANCEMENT. Improve the effectiveness of detection and tracking operators in Naval anti-air warfare systems. Z1582: SECOND GENERATION HUMAN RESOURCES MANAGEMENT. Develop a computer-based system that can forecast human resources management needs and determine the effects of proposed management policies. Z1583: GEOGRAPHIC STABILITY. Determine the feasibility, cost savings, and effect on personnel retention of implementing a program whereby an individual will be guaranteed a specific geographic location at which all of his sea/shore duty will take place.

(U) RELATED ACTIVITIES: Related Program Elements are PE 62703F, Air Force Personnel Utilization Technology; PE 62722A, Army Manpower, Personnel and Training; PE 62763N, Navy Personnel Support Technology; PE 64709N, Navy Prototype Manpower/Personnel Systems.

Program Element: 63707N Title: Manpower Control Systems Development
DoD Mission Area: 552 - Environmental and Life Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

(U) WORK PERFORMED BY: In-House: Navy Personnel Research and Development Center, San Diego, CA. Contractors: B-K Dynamics, Rockville, MD; Biotechnology, Inc., Falls Church, VA; Human Resources Research Corp., Alexandria, VA; Institute for Organizational Behavior Research, Houston, TX; Kinton, Inc., Alexandria, VA; Mathtech, Inc., Princeton, NJ; Rand Corporation, Santa Monica, CA; REHAB Group, Inc., Falls Church, VA; SDC Integrated Services, Norfolk, VA; Systems Exploration, Inc., San Diego, CA; and University of Minnesota, Minneapolis, MN.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Z1167: PROCEDURES FOR OFFICER AND ENLISTED ACQUISITION. Developed and began testing a computer-based system to better assign recruits to jobs taking both Navy needs and the recruits' preferences into account. Developed Naval Academy and NROTC procedures to improve selection and reduce attrition. Z1169: PRODUCTIVITY IMPROVEMENT SYSTEMS. Developed and tested a productivity improvement program based on the use of worker feedback and goal setting procedures. Z1170: HUMAN PROCESSING OF LARGE AUTOMATED DATA BASES. Developed software to improve operator performance on a prototype Navy Tactical Data System (NTDS) console. Developed tools which will enable hardware developers to determine the implications of their designs upon the Navy's manpower supply. Z1178: ATTRITION ANALYSIS AND MANAGEMENT. Collected information on the causes of attrition among first term enlistees and began to develop recommendations to reduce this attrition. Z1182: MILITARY PERSONNEL COST PROJECTION. Completed the development and evaluation of alternative wage indexes for adjusting military pay. Developed a model for estimating the total Navy manpower budget. Z1186: FLEET SUPPORT MANPOWER. Developed a model to forecast Pacific Fleet supply support requirements and began development of aggregate manpower forecasting models for Base Operations Support (BOS) activities. Z1187: COMPUTER-BASED MANPOWER PLANNING AND PROGRAMING. Developed an initial officer retention forecasting model as well as a model to test potential EEO policy changes. Z1326: INTEGRATED CREWS. Determined the dynamics of change as women were assigned to Navy ships for the first time and identified specific management problems likely to occur as other ships' crews are sexually integrated. Z1342: FAMILY SUPPORT PROGRAM. Data were collected on family issues critical to retention. Z1383: CIVILIAN PERSONNEL ISSUES. Major areas of civilian personnel management needing improvement were identified. Z1392: PERFORMANCE ENHANCEMENT. In order to improve the performance of Detection and Tracking Operators in NTDS anti-air warfare systems, an assessment of operator task variables which influence performance was completed.

2. (U) FY 1982 Program. Z1167: PROCEDURES FOR OFFICER AND ENLISTED ACQUISITION. Develop tests for the optimal selection of women recruits and test and evaluate proposed selection procedures for the Naval Academy and the NROTC College Program. (Jan-Sep) Z1169: PRODUCTIVITY IMPROVEMENT SYSTEMS. The impact of the worker feedback and goal setting program will be evaluated against measures of productivity. (Jan-Sep) Z1178: ATTRITION ANALYSIS AND MANAGEMENT. Complete development and evaluation of recommendations to improve retention, particularly among more productive individuals. (Jan-Sep) Z1182: MILITARY PERSONNEL COST PROJECTION. Continue the evaluation of cost and retention implications of proposed pay structures. (Jan-Sep) Z1186: FLEET SUPPORT MANPOWER. Complete development of manpower forecasting models for Base Operations Support (BOS) activities and expand model for forecasting Pacific Fleet support requirements to maintenance activities. (Jan-Sep) Z1187: COMPUTER-BASED MANPOWER

PLANNING AND PROGRAMMING. Develop unrestricted line officer planning system that merges accession and promotion planning with loss forecasting and supply constraints. (Jan-Sep) Z1383: CIVILIAN PERSONNEL ISSUES. Begin the determination of managerial duties and responsibilities of the Navy's GS 13-15 population. (Jan-Sep) Z1583: GEOGRAPHIC STABILITY. Develop geographic stability strategies, data bases, and models to evaluate the utility of such a program. (Jan-Sep)

3. (U) FY 1983 Planned Program: Z1169: PRODUCTIVITY IMPROVEMENT SYSTEMS. A monetary incentive program will be implemented for testing. Z1178: ATTRITION ANALYSIS AND MANAGEMENT. Personal, organizational, familial, and civilian occupational factors will be assessed as they relate to retention and career decision-making beyond the first enlistment. Z1182: MILITARY PERSONNEL COST PROJECTION. Develop a model to predict first term retention based upon demographic, rather than economic, variables. Z1186: FLEET SUPPORT MANPOWER. Develop initial methods and data bases for improving personnel utilization through alternative maintenance/assignment strategies. Z1187: COMPUTER-BASED MANPOWER PLANNING AND PROGRAMMING. Complete development of the officer planning model and develop models to determine enlisted accession requirements, forecast losses and other personnel flows, and generate enlisted cohort strength data. Z1211: RECRUITING SYSTEM MANAGEMENT. Develop techniques to forecast officer and enlisted personnel supply and develop data bases descriptive of qualified military eligibles within geographic recruiting areas. Z1342: FAMILY SUPPORT PROGRAM. Determine the role which family-related factors play in retention and types of family-related policy changes which might encourage retention. Z1383: CIVILIAN PERSONNEL ISSUES. Complete the determination of the duties and responsibilities of Navy GS 13-15 managers and identify characteristics of exemplary managers and supervisors. Z1582: SECOND GENERATION HUMAN RESOURCES MANAGEMENT. Conduct a needs assessment involving sponsors, managers and system users addressing current and future requirements for human resource management services. Z1583: GEOGRAPHIC STABILITY. Determine the cost of implementing a geographic stability program.

4. (U) FY 1984 Planned Program: Z1169: PRODUCTIVITY IMPROVEMENT SYSTEMS. The impact of monetary incentives will be evaluated in terms of worker performance, productivity and motivation. Z1178: ATTRITION ANALYSIS AND MANAGEMENT. Recommendations for improving retention among high-quality enlisted personnel will be developed and evaluated. Z1182: MILITARY PERSONNEL COST PROJECTION. Evaluate travel and transportation entitlements and develop a model to assess the implications of pay increases. Z1186: FLEET SUPPORT MANPOWER. Complete development and evaluation of the Navy-wide aggregate-level fleet support models and develop a systematic procedure for assigning type duty designations (e.g., sea, shore duty) to Navy activities to allow for equity in personnel rotation. Z1187: COMPUTER-BASED MANPOWER PLANNING AND PROGRAMMING. Test and evaluate an all-Navy accession planning system. Z1211: RECRUITING SYSTEM MANAGEMENT. Begin comprehensive investigation of recruiting demographics and investigation of supply trade-offs among enlisted, officer, civilian, and contractor personnel. Z1342: FAMILY SUPPORT PROGRAM. Begin evaluation of family-centered policies to determine their impact on family quality of life, retention, and readiness. Z1383: CIVILIAN PERSONNEL ISSUES. Begin investigation of ways to improve the effectiveness and productivity of first-line supervisors. Z1582: SECOND GENERATION HUMAN RESOURCES MANAGEMENT. Develop and pilot-test interventions for

improving retention, advancement rate, discipline and combat readiness and identify means to measure change in these areas. Z1583: GEOGRAPHIC STABILITY. Develop an information, monitoring, and tracking system to aid in managing and evaluating the geographic stability program.

5. Program to Completion: This is a continuing program composed of individual projects each having a definite completion date.

6. Milestones: Not applicable.

FY 1983 RDT&E DECRIPTIVE SUMMARY

Program Element: 63709N
DoD Mission Area: 552 - Environmental & Life Sciences (ATD)

Title: Advanced Marine Biological Systems
Budget Activity: 2 - Advanced Technology Development

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

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
80214	Advanced Marine Biological Systems	3,415	3,789	3,980	5,339	Continuing	Continuing

(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, [ ] are approved for service use [ ].

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue development of marine mammal systems for [ ] system in deep water. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases through FY 1984 only.

(U) COMPARISON WITH 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are: A reduction of 32 for FY 1981 is due to an adjustment in inflation indices. A decrease of 355 in FY 1982 is due to a reduction by Congress coupled with adjustments for inflation. The reduction of 743 in FY 1983 is due to a refined estimate of program cost.

Program Element: 63709N
DoD Mission Area: 552 - Environmental & Life Sciences (ATD)

Title: Advanced Marine Biological Systems
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN FY 1981 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,141	3,447	4,144	4,723	Continuing	Continuing
S0214	Advanced Marine Biological Systems	3,141	3,447	4,144	4,723	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: N/A

Program Element: 63709N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Advanced Marine Biological Systems
Budget Activity: 2-Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Hearing, echo-location, swimming, and diving capabilities of marine mammals often exceed those of man even when man is aided by sophisticated equipment. Navy research and exploratory development efforts have demonstrated reliable open-water control over marine mammals and application of these unique capabilities to military problems. Advanced Development Objective No. 38-12X was issued on 14 April 1967 to address development of marine mammal systems for a variety of military tasks.

(U) Development under this program element is directed toward testing the feasibility of, determining acquisition, training operation and maintenance costs and establishing optimum characteristics of engineering development and Fleet introduction of potential marine mammal mission systems. Initial effort demonstrated the feasibility [, which was approved for service use [The next system developed was the QUICK FIND object recovery system which is approved for service use and is currently in operational status. [

(U) RELATED ACTIVITIES: Efforts are underway in basic study of marine mammals by the Office of Naval Research under PE 62759N, Ocean and Atmospheric Support Technology; Project F95-558 , Marine Mammals.

(U) WORK PERFORMED BY: In-House: Naval Ocean Systems Center, San Diego, CA; Contractors: Integrated Science Corporation, Santa Monica, CA., Systems Engineering Analysis Company, Kailua, HI.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In March 1968 the Advanced Marine Biological Systems program undertook the development of a marine mammal system utilizing behavior conditioned dolphins. In June 1969, [was demonstrated and evaluated. Subsequently, this system [ ] was granted approval for service use in March 1976.

(U) An object recovery system, Project QUICK FIND, using the California Sea Lion, was transferred to the Fleet in May 1972 and is presently in operational status. QUICK FIND was granted approval for service use in April 1975. To date, the QUICK FIND Sea Lions have recovered over 40 ASROC Fired MK-17 practice depth charges.

(U) In FY 1973, a mine hunting and neutralization project was initiated. The project, LINEAR SWEEP, utilized the acoustic detection/classification capabilities of the porpoise to hunt for and mark or neutralize bottom mines.

Program Element: 63709N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Advanced Marine Biological Systems
Budget Activity: 2-Advanced Technology Development

(U) In FY 1974, the feasibility of mine hunting and neutralization was established and the project LINEAR SWEEP moved into Phase II of advanced development. A new project, LINEAR LOG, directed toward a diver support system utilizing dolphins, was initiated.

(U) In FY 1975, a countermeasures program, LINEAR CHEK, was initiated. Advanced development of the LINEAR SWEEP Mine Detection and Neutralization system continued. Development of the LINEAR LOG diver support system concepts continued.

(U) In FY 1976, advanced development of the LINEAR SWEEP minehunting system continued. LINEAR LOG, the diver support system continued and LINEAR SWEEP completed operational evaluation in October 1975.

(U) In FY 1977, LINEAR LOG, the diver support system was demonstrated. The MK 18 Mine Detection and Neutralization System began limited quantity production.

(U) In FY 1978, the MK 18 Mine Detection and Neutralization System continued limited quantity production. Two LINEAR CHEK countermeasures concepts (one animal and one hardware) were demonstrated.

initiated.

(U) In FY 1979, the countermeasures effort continued with the demonstration of countermeasures concepts based on disruption of the animals echo-location capability.

(U) In FY 1980, production of the MK 18 Mine Neutralization Detector System was completed. The system was used in conjunction with conventional minehunting and minesweeping during three Fleet exercises.

Project MITR (Minimum Training Requirements) was initiated in mid-FY 80 to collect the data required to establish criteria for the level of training

Program Element: 63709N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Advanced Marine Biological Systems
Budget Activity: 2-Advanced Technology Development

(U) In FY 1981, [redacted] The cold/deep water object recovery system was deployed to Nanoose Range, B.C., Canada, for testing.

2. (U) FY 1982 Program: The LINEAR CHEK countermeasures project will continue. [redacted]

3. (U) FY 1983 Planned Program: The LINEAR CHEK countermeasures project will continue. [redacted] Development of the cold/deep water recovery system will be completed.

4. (U) FY 1984 Planned Program: The LINEAR CHEK countermeasures project will continue. Development of a greater depth capability for the QUICKFIND Sea Lion object recovery system will be initiated. Development of the [redacted] system will be completed.

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

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63710N Title: Man-Machine Technology
DoD Mission Area: 552 - Environmental & Life Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

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

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	1,365	1,413	Continuing	Continuing
S1611	Skill Reduction Through System Design	0	0	100	130	2,397	2,627
S1613	Human Factors Engineering For Ship Design	0	0	100	169	2,095	2,364
W1609	Maintenance Simplification	0	0	100	261	1,860	2,221
Z1612	Assessing Shipboard Workload	0	0	134	174	1,500	1,808
W1584	Improved Personnel Records Systems	0	0	526	415	1,792	2,733
Z1610	Improved Personnel and Administrative Support System (PASS) Office	0	0	405	264	0	669

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element will develop techniques in software and hardware to improve the performance of people as operators or maintainers of current weapon, sensor, or other systems. Emphasis will be on near term improvements rather than those that can only be used in new system development.

(U) BASIS FOR FY 1983 RDT&E REQUEST: W1609, MAINTENANCE SIMPLIFICATION: Begin to validate maintainability design criteria and guidelines produced in Exploratory Development by applying them to the design of selected systems. Improve procedures for matching design to maintenance skills. W1584, IMPROVED PERSONNEL RECORDS SYSTEMS: Assess technology in micrographics to determine requirements for equipment. Z1610, IMPROVED PERSONNEL AND ADMINISTRATIVE SUPPORT SYSTEM OFFICES: Develop procedures to improve PASS office operations. S1611, SKILL REDUCTION THROUGH SYSTEM DESIGN: Quantify procedures for system design with constrained skill levels and training costs. S1613, HUMAN FACTORS ENGINEERING FOR SHIP DESIGN: Optimize application of high payoff HFE in ship design. Z1612, ASSESSING SHIPBOARD WORKLOAD: Improve capability to predict ship crew workload and optimize workload mix. As this is a continuing program, with projects having specific beginning and ending dates, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated for each individual project.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The differences between the funding shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary of -3,060 in FY 1982, and -1,348 in FY 1983 are as follows: Z1392 Performance Enhancement (-823 in FY 1982 and -949 in FY 1983), R0126 Operational Decision Aids (-942 in FY 1982 and -1,070 in FY 1983), and Z1170 Human Processing of Large Data Bases (-393 in both FY 1982 and 83) were cancelled. W1609 Maintenance Simplification (Titled W1230 Design for the Maintainer in FY 1982) decreased by 300 in FY 1982 and 201 in FY 1983 and

in FY 82) decreased by 602 in FY 1982 and increased by 526 in FY 1983 to accommodate delays in funding. S1611 Skill Reduction Through System Design(+100), S1613 Human Factors Engineering For Ship Design(+100), Z1612 Assessing Shipboard Workload(+134) and Z1610 Improved Personnel and Administrative Support System Office(+405) are all new additions to this Program Element.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	3,060	2,713	Continuing	Continuing
R0126	Operational Decision Aids	0	0	942	1,070	3,885	11,333
Z1170	Human Processing of Large Data Bases	0	0	393	393	0	2,429
W1230	Design for the Maintainer	0	0	300	301	1,206	2,366
Z1392	Performance Enhancement	0	0	823	949	5,473	7,612
W1393	Microfilm Technology for Personnel Records	0	0	602	0	0	TBD

(U) OTHER APPROPRIATION FUNDS: None.

Program Element: 63710N Title: Man-Machine Technology
DoD Mission Area: 552 - Environmental & Life Sciences Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The Navy faces a continuing problem in making better use of the individuals it is able to recruit. The purpose of this program element is to support technological developments and demonstrations which relate to automation and use of labor-saving techniques in areas which are currently labor intensive, better design of equipment so that personnel can be more productive while on the job, and improvement of the effectiveness of personnel in the system. W1609 MAINTENANCE SIMPLIFICATION: Maintenance requirements account for almost 40% of typical system life cycle costs. Project goals are to improve system readiness, decrease maintenance costs and reduce maintenance staffing through development and application of criteria for system design which are compatible with the characteristics and abilities of the maintenance population. S1611 SKILL REDUCTION THROUGH SYSTEM DESIGN: Project goals are to develop common methods and data sources for system designers to use in forecasting needed skill levels of military personnel. This project will develop techniques for determining the roles of man vs. automation in systems operation; and determine relationships between roles of man and skills required. Z1610 IMPROVED PERSONNEL AND ADMINISTRATION SUPPORT (PASS) OFFICE: Personnel Administrative Support System (PASS) offices will acquire automated support equipment. New system will be highly user-oriented. This effort seeks to make optimal use of on-line orientation and training, man-machine dialogues which adapt to the skill level of the system operator, and automated aiding of identification and interpretation of pertinent official personnel policy and regulations. S1613 INTEGRATED HUMAN FACTORS ENGINEERING FOR SHIP DESIGN: In order to solve operational problems involving man-machine interface, this project will develop and implement a Human Factors Engineering Audit to identify, validate, and evaluate crew performance problems in new ship designs. S1612 ASSESSING SHIPBOARD WORKLOAD: Develop workload requirements as a function of system design concepts, including operator workload, system crew workload, and total ship workload (manning levels). Develop methods for redistributing tasks, duties, responsibilities and jobs among operators and between man and machine. Project goals are to identify and propose solutions to reduce task overload problems in the fleet and thereby increase levels of performance. W1584 IMPROVED PERSONNEL RECORDS SYSTEMS: Manual control in updating and maintaining microform personnel records creates unacceptably high error rates and incurs unnecessarily high personnel costs. To reduce these impacts, intelligent microform hardware must be developed which virtually eliminates human decision making in selected update and retrieval processes.

(U) RELATED ACTIVITIES: Program Element 63701N, Human Factors Engineering Development, which focuses upon aviation systems; Program Element 62757N, Human Factors and Simulation Technology; 63727N, Navy Technical Information Presentation Program; 61153N(42), Defense Research Sciences (Behavioral and Social Sciences). 61102A(B74F), Defense Research Sciences, 62716A, Human Factors in Military Systems; 62717A, Human Performance Effectiveness Simulation; 63739A, Human Factors in Training and Operational Effectiveness. 61102F(2313), Defense Research Sciences (Training and Personnel); 62202F, Training and Simulation Technology; 63751F, Innovation in Education and Training.

(U) WORK PERFORMED BY: In-House: Navy Personnel Research and Development Center, San Diego, CA; Naval Ship Research and Development Center, Bethesda, MD. Naval Air Development Center, Warminister, PA. Contractors: Photomatrix, Santa Monica, CA, Biotechnology, Falls Church, VA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: 63710N
Title: Man-Machine Technology
DoD Mission Area: 552 - Environmental & Life Sciences
Budget Activity: 2 - Advanced Technology Development

1. (U) FY 1981 and Prior Accomplishments: R0126, OPERATIONAL DECISION AIDS: Developed three decision aids based on tactical engagement models that allow the commander to insert his own estimates and approximations; evaluated air strike and emission control aids. Combined several procedures into an integrated air strike planning aid. Continued transfer of initial set of aiding techniques to Advanced Command & Control Architechtural Testbed for demonstration with fleet personnel. Z1170, HUMAN PROCESSING OF LARGE DATA BASES: Examined responsibilities of Navy Tactical Data System operators, especially air-intercept controllers, to identify human factors engineering issues; operated a testbed improving accuracy of inputs to automated personnel information system; developed an Engineer's Guide to enable hardware developers to assess the implications of designs upon manpower resources; developed billet cost models for regular and reserve officer and enlisted billets; investigated decision-maker performance during submarine operations. Z1392, PERFORMANCE ENHANCEMENT: Conducted analysis of problems on surface platforms and with surface systems.

2. (U) FY 1982 Program: Not applicable.

3. (U) FY 1983 Planned Program: Z1610, IMPROVED PERSONNEL AND ADMINISTRATIVE SUPPORT SYSTEM (PASS) OFFICE: Design, develop and evaluate prototype human -computers interface, evaluate prototype on-line instructional system. S1611, SKILL REDUCTION THROUGH SYSTEM DESIGN: Identify workload requirements by crew stations, develop techniques of establishing workload impact on crewman performance and identify overload conditions and performance degradation. Z1612, ASSESSING SHIPBOARD WORKLOAD: Develop techniques for determining roles of man vs. automation in propulsion systems, identify the required role of persons in automated operations and determine skill requirements by level of automation for propulsion systems. S1613, INTEGRATED HUMAN FACTORS ENGINEERING FOR SHIP DESIGN: Develop procedures, criteria and data collection materials for the Human Factors Engineering Audit. W1609, MAINTENANCE SIMPLIFICATION: Transition from exploratory development, initiate validation of maintainability design criteria and guidelines produced under exploratory development by application to design of selected systems. W1584, IMPROVED PERSONNEL RECORDS SYSTEMS: Conduct advanced technology assessment; preliminary design; establishment of critical path for achieving full system operation.

4. (U) FY 1984 Planned Program: W1609, MAINTENANCE SIMPLIFICATION: Complete validation of maintenance design criteria. Commence development of computer-aided techniques and models for system designers to implement maintainability design procedures. W1584, IMPROVED PERSONNEL RECORDS SYSTEMS: Field records analysis, technology assessment of concept for new systems. Z1610-PN, IMPROVED PERSONNEL AND ADMINISTRATIVE SUPPORT SYSTEM (PASS) OFFICE: Investigate feasibility of appropriate cost effective user-computer relations. Investigate operator enhancements. S1613, INTEGRATED HUMAN FACTORS ENGINEERING FOR SHIP DESIGN: Validate and refine Human Factors Engineering Audit; conduct Human Factors Engineering Audits on selected ships systems; develop human factors engineering design solutions to identified problems. S1611-PN, SKILL REDUCTION THROUGH SYSTEM DESIGN: Develop methods for allocation of tasks among operators and crews, and between man and machine; develop techniques for estimating workload requirements. Z1612, ASSESSING SHIPBOARD WORKLOAD: Develop design concepts and criteria for propulsion systems as a function of level of automation.

Program Element: 63710N
DoD Mission Area: 552 - Environmental & Life Sciences

Title: Man-Machine Technology
Budget Activity: 2 - Advanced Technology Development

5. (U) Program to Completion: This is a continuing program. Projects are completed in a three-to-five year time frame and new projects are initiated as requirements dictate.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63713N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Ocean Engineering Technology Development
Budget Activity: 2 - Advanced Technology Development

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops system technology and components for deep ocean search, salvage/recovery, and submarine rescue operations. Program focus is on deep ocean operational components, diving biomedical technology, saturation diving, and manned/unmanned submersible systems development.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue development of titanium, syntactic foam, and other materials for use in deep ocean. Complete testing of sea water motor. Complete development of all components for modification of Deep Submergence Vehicle SEA CLIFF for 20,000 feet (6,000 meter) depth. Publish engineering handbooks on geotechnology and electro-mechanical cables design. Continue development of saturation diver's tool package. Complete at-sea testing of Advanced Unmanned Search System prototype. Complete development of MK-14 saturation diving system. Continue structural testing of one-man, one-atmosphere diving system. Complete prototype of Advanced Tethered Vehicle and initiate at-sea testing. Expand biomedical investigations of decompression principles to support shallow depth air and mixed-gas diving. Complete investigations of nitrogen-oxygen saturation diving. Continue physiological investigations to improve diver thermal protection. Continue physiological studies to provide engineering specifications for underwater breathing apparatus. Continue development of new indicators of acute and chronic oxygen poisoning. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: The decreases of 128 in FY 1981 and 403 in FY 1982 result from Navy Budget reductions. The decrease of 4,705 in FY 1983 results from decisions made during budget development to reduce level of effort and from decreased escalation rates.

Program Element: 63713N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Ocean Engineering Technology Development
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENTS	12,623	14,947	12,027	17,899	Continuing	Continuing
M0099	Deep Submergence Biomedical Development	4,526	6,342	3,811	5,260	Continuing	Continuing
S0396	Man-in-the-Sea Continental Shelf	806	3,036	1,610	2,690	Continuing	Continuing
S0397	Deep Ocean Technology	7,291	5,569	6,606	9,949	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63713N
DoD Mission Area: 553 - Engineering Technology

Title: Ocean Engineering Technology Development
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: 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) Man-in-the-Sea, Continental Shelf develops diver life support equipment and tools to permit: (a) construction, maintenance, and repair of underwater facilities; (b) conducting salvage; (c) searching for lost objects; (d) recovering objects of military importance; and (e) 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.

(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.

(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.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: (a) Deep Submergence Biomedical Development - Developed new computerized air decompression method that is safer and more efficient than existing procedures. Developed new drug treatments which improve the care of divers with severe decompression sickness and air embolism. Developed computer model which allows integration of new data on physiological response to cold water in order to predict exposure limits and improve protective equipment design. Validated heat stress limits applicable to portable recompression chambers. Completed evaluation of behavioral effects and safety of commonly used legal drugs when used during diving. (b) Man-in-the-Sea - MK-14 Recirculating Life Support System (saturation diving) was initiated for application to the MK-2 Deep Dive System Personnel Transfer Capsules. A prototype MK-14 has been tested by Naval Experimental Diving Unit to 1,100 foot depth. Completed development of two psychological monitoring systems which were tested, and turned over to the Experimental Diving Unit for operational use. Initiated development of one man, one atmosphere diving system. (c) Deep Ocean Technology - Completed development and made operational a 7,000 foot depth, cable-controlled unmanned submersible. Completed conversion of 6,000 foot Deep Submergence Vehicle ALVIN to a 12,000 foot depth capability, operationally demonstrating new materials and component technology. Hardware for submerged arrays was developed and demonstrated. Completed

development and demonstration of underwater components for a 20,000 foot depth capability Remote Unmanned Work System. Completed mathematical model of undersea search. Fifteen Technology Handbooks published. Initiated development of Advanced Unmanned Search System.

2. (U) FY 1982 Program: (a) Deep Submergence Biomedical Development - Began development of new criteria for oxygen exposure limits. Continue computation of improved air decompression methods. Continued human trials of new drug treatments for severe decompression sickness and air embolism. Continued studies on effects of inert and metabolic gases and high pressures on breathing, nervous system function, and performance capabilities in diving. Continued studies of human response to cold water immersion for design of protective garments. (b) Man-in-the-Sea - Completed prototype installation of the MK-14 Recirculating Life Support, Saturation Diving System on Personnel Transfer Capsule. Completed all MK-14 development testing and preparation for at-sea evaluations (technical and operational). Completed design of saturation divers tool package. Completed procurement of one-man, one-atmosphere diving system for structural testing and initiate development tests. (c) Deep Ocean Technology - Continued component development for Deep Submergence Vehicle SEACLIFF 20,000 foot depth modification to include: titanium hull, sea water variable ballast system, 34 pound per cubic foot syntactic foam buoyancy material and electric systems. Completed design of Advanced Underwater Search System test bed platform, and conducted test to verify mathematical model. Completed design and initiated fabrication of Advanced Tethered Vehicle System to be used as baseline for systems improvement. Published geotechnology engineering handbooks.

3. (U) FY 1983 Planned Program: (a) Deep Submergence Biomedical Development - Recommend new treatment procedures for gas embolism and begin validation of new air decompression tables. Complete development of decompression tables for saturation exposures on air and recommend procedures for rescue of personnel from pressurized submarines. Publish new physiological standards for design of Underwater Breathing Apparatus. Complete studies to evaluate the risk of diving while pregnant. Begin development of new indicators of acute and chronic oxygen poisoning. Publish updated "Annotated Bibliography on Underwater Medicine". (b) Man-in-the-Sea - Complete fabrication of saturation diver tool package and initiate operational test. Complete approval for service use for MK-14. Continue structural testing of one-man, one-atmosphere deep dive systems capable of supporting diver to 2,000 foot depth. (c) Deep Ocean Technology - Complete development of all components for modification of Deep Submergence Vehicle SEA CLIFF for 20,000 foot (6000 meters) depth. Complete fabrication of Advanced Unmanned Search System test bed. Publish electro-mechanical cables handbook. Complete fabrication of Advanced Tethered Vehicle prototype and initiate tests.

4. (U) FY 1984 Planned Program: (a) Deep Submergence Biomedical Development - Continue examination of (1) advanced decompression principles; (2) cold water protection requirements; (3) human oxygen poisoning limits; (4) Physiological criteria for breathing apparatus. Resume development of decompression procedures for MK-15 and MK-16 Underwater Breathing Apparatus. Complete evaluation of long-term health effects in divers. (b) Man-in-the-Sea - Continue development of one-man, one-atmosphere deep dive system. Complete development of saturation diver tool package. Complete design study of low cost, simple saturation deep dive

system. Initiate development of untethered closed-circuit underwater breathing apparatus. (c) Deep Ocean Technology - Complete Deep Submergence Vehicle SEA CLIFF modification. Conduct at-sea testing of Advanced Unmanned Search System. Complete design of Advanced Search System for fleet operation. Complete prototype of Advanced Tethered Vehicle, commence development testing of Advanced Tethered Vehicle and initiate development of work and recovery systems to be used with Advanced Tethered Vehicle.

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

6. (U) Milestones: Not applicable.

Project: S0397
Program Element: 63713N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Deep Ocean Technology
Title: Ocean Engineering Technology Development
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Project provides technology base for deep ocean environment. Lack of technology base caused numerous technical safety and financial problems in early deep submergence systems construction and operations. Future Navy combatant and non-combatant deep submergence systems will depend upon technology base being developed. Potential improvements to weapon systems will accrue, such as more efficient hull materials, lighter weapon (torpedo, mine) shells and high resolution optical and acoustic sensors. The objective is to identify and advance critical technologies which prohibit Navy from functioning effectively in the deep ocean environment. Inherent within the objective is development of operational systems to validate advances in technology. Operational systems include three categories of focal projects: manned submersible vehicles, unmanned submersible vehicles, and on-bottom/in water column fixed installations. Systems developed primarily for testing and validating technological advancements will become Fleet hardware, as appropriate after test completion.

(U) RELATED ACTIVITIES: Program Elements: 62543N, Ships, Submarines and Boats Technology; and 63702N, Ocean Engineering Systems Development.

(U) WORK PERFORMED BY: In-House: David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Ocean Systems Center, San Diego, CA; Naval Underwater Systems Center, Newport, RI. Contractors: General Dynamics, Groton, CT; Southwest Research Institute, San Antonio, TX; E.G. and G. International, Waltham, MA; Penberthy Glass Co., Seattle, WA; AMTEC/STRAZA, San Diego, CA; Bendix, Los Angeles, CA; Battelle Research Facility, Long Beach, CA; ITT Cable Division, National City, CA; U.S. Polymeric Incorporated, Santa Ana, CA; Philadelphia Resin Co., Philadelphia, PA; Westinghouse, Annapolis, MD; Lockheed Research Laboratory, Palo Alto, CA; Techwest Enterprises, Vancouver, BC.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Completed operational evaluation of 7,000 foot depth cable controlled Remote Unmanned Vehicle and specifications for certified massive glass bouyancy spheres for manned submersibles. Fabricated and tested one-atmosphere concrete sphere on seafloor at 600 foot depth. Installed 7 foot diameter titanium personnel sphere and miscellaneous equipment (sea water variable ballast, electric propulsion, syntactic buoyancy, etc.) in Deep Submergence Vehicle .VIN, and certified ALVIN for 12,000 foot operations. Developed submerged array hardware non-torque cables, embedment anchors, wet-make electrical electronic connectors. Published 15 technology handbooks; over 40,000 technology handbooks have been sold to industry through Defense Documentation Center. Installed major array structure in deep ocean, and began motion, strumming, noise/strain measurements and long-term exposure assessment; at-sea tested Remote Unmanned Work System in pressure tank and at-sea to 16,000 foot depth equivalent; initiated mission analysis and design trade-off for development of Advanced Underwater Search System; developed acoustic imaging system and completed testing; conducted at-sea testing of Work System Package with divers and Cable-Controlled Underwater Recovery Vehicle III completed sensor test plans for Advanced Underwater Search System. Initiated develop-

Project: S0397
Program Element: 63713N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Deep Ocean Technology
Title: Ocean Engineering Technology Development
Budget Activity: 2 - Advanced Technology Development

ment of key components for modifying Deep Submergence Vehicle SEA CLIFF for 20,000 foot depth operation. Completed final report for Remote Unmanned Work System. Initiated development of Advanced Tethered Vehicle (unmanned) employing fiber optic tether.

2. (U) FY 1982 Program: Continue component development for Deep Submergence Vehicle SEA CLIFF modification to include: titanium hull, variable ballast, 36-pound per cubic foot syntactic buoyancy material, and electric systems. Complete design of Advanced Underwater Search System test bed platform and initiate construction. Complete integration of work package with Advanced Tethered Vehicle concept and initiate fabrication. Evaluate sea water hydraulic pump system. Complete sea-water motor and initiate operational testing. Publish geotechnology engineering handbook. Complete technical evaluation of a rapid, free falling device to measure engineering properties of the ocean floor (Doppler Penetrometer).

3. (U) FY 1983 Planned Program: Complete development of all components (electrical system, buoyancy, wet electrical, etc.) for Deep Submergence Vehicle SEA CLIFF modification. Publish electro-mechanical cable handbook. Initiate development of a stable, high speed, underwater search platform (Advanced Underwater Search System). Complete fabrication of prototype of Advanced Tethered Vehicle.

4. (U) FY 1984 Planned Program: Complete Deep Submergence Vehicle SEA CLIFF modification and obtain vehicle certification for 20,000 foot depth. Conduct developmental testing at-sea of Advanced Underwater Search System and design of Advanced Search System for fleet operation. Complete development testing of Advanced Tethered Vehicle and initiate development of work and recovery systems. Complete demonstration experiment on the deep-depth current measuring system. Initiate development of critical component technology for advanced manned submersible.

5. (U) Program to Completion: Provide demonstratable technological options to deep ocean systems designers while producing one-of-a-kind first-of-a-kind usable systems. This is a continuing program.

6. (U) Milestones: Not applicable.

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S0397	Deep Ocean Technology	5,825	6,318	6,558	11,316	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63720N Title: Education and Training
DoD Mission Area: 552 - Environmental and Life Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

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

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
R0126	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
20992	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: These projects are responsive to the needs of the Chief of Naval Operations, the Fleets, and the Chief of Naval Education and Training. They are directed toward improving the efficiency and effectiveness of training activities ashore and afloat, avoiding the high costs of operational technical training, and increasing proficiency of training graduates. Specific objectives include developing a personnel system supported by job performance aids, automating the preparation of training materials, improving technical training, developing stand-alone computer-based training procedures, developing tactical training and functional context training programs, and exploring the use of low-cost microcomputers in Navy training.

(U) BASIS FOR THE FY 1983 RDT&E REQUEST: In FY 1983 work will concentrate on the development of job performance aids, automated authoring requirements, computer-based propulsion engineering training, a prototype functional context training system, and a low-cost micro-computer training system. Evaluation of a job-oriented basic skills training course will continue. Work will begin on

developing a tactical decision training system. As this is a continuing program, with projects having specific beginning and ending dates, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated for each individual project.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: The FY 1981 program is 18 greater in this Descriptive Summary than in the FY 1982 Descriptive Summary. Changes to specific projects are as follows: Z0828, Enlisted Personnel Individualized Career System (+171); Z1168, Relating Training Output and Job Performance (-8); Z1175, Training System Design and Management (+320); Z1176, Individual Technical Training (-36); Z1177, Advanced Computer-Aided Instruction (+77); Z1180, Techniques for Shipboard Training (+82); Z1181, Design of Combat Team Training (-47); and Z1251, Training Approaches to Counter Attrition (+176). One project, R0126, Operational Decision Aids was transferred to PE 63710N (-717). The FY 1982 program is 200 less than in the FY 1982 Descriptive Summary as a result of Navy Budget reductions in Project Z0828, Enlisted Personnel Individualized Career System. The FY 1983 funding To Be Determined in the FY 1982 Descriptive Summary is now estimated to be funded at the 3,496 level.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY (AMENDED):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,644	4,724	3,891	TBD	TBD	TBD
Z0828	Enlisted Personnel Individualized Career System	939	862	1,190	TBD	TBD	TBD
Z1168	Relating Training Output and Job Performance	408	276	0	TBD	TBD	TBD
Z1175	Training System Design and Management	588	191	0	TBD	TBD	TBD
Z1176	Individual Technical Training	833	696	901	TBD	TBD	TBD
Z1177	Advanced Computer-Aided Instruction	1,092	1,087	814	TBD	TBD	TBD
Z1180	Techniques for Shipboard Training	617	501	687	TBD	TBD	TBD
Z1181	Design of Combat Team Training	25	107	0	TBD	TBD	TBD
Z1218	Tactical Decision Training	0	0	0	TBD	TBD	TBD
Z1251	Training Approaches to Counter Attrition	404	283	0	TBD	TBD	TBD
Z1382	Functional Context Training	0	0	101	TBD	TBD	TBD
Z1388	Low Cost Microcomputer System	0	0	198	TBD	TBD	TBD
R0126	Operational Decision Aids	738	721	0	TBD	TBD	TBD

(U) OTHER APPROPRIATION FUNDS: None

Program Element: 63720N
Title: Education and Training
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

DETAILED DESCRIPTION AND BACKGROUND: 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. Technology must be explored, advanced, and applied to enhance the performance of current personnel while decreasing the costs of achieving and maintaining those performance benefits. Z0828: ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM. Determine the impact of modern performance aids on training and personnel systems. Current projections indicate that job performance aids could reduce school training time during the first enlistment by 50 to 75 percent and also significantly improve performance. Z0992: AUTHORING INSTRUCTIONAL MATERIALS SYSTEM. The Navy has a continuing need to make the production of instructional materials more efficient and effective. This project will develop an automated system for the development, preparation, and production of such material. Z1168: RELATING TRAINING OUTPUT AND JOB PERFORMANCE. No systems exist for providing decision makers with information concerning either the degree to which fleet personnel are capable of performing the critical aspects of their jobs or the relationship between specific training courses and fleet readiness. Such information is needed to assess readiness and to support decisions regarding selection, training, and assignment. Z1175: TRAINING SYSTEM DESIGN AND MANAGEMENT. Develop aids for planning and designing training; and provide computer-based resource models for the management of training. Z1176: INDIVIDUAL TECHNICAL TRAINING. Develop methods of teaching low-aptitude enlisted personnel the skills needed to prepare them for technical training; and develop technologies to improve the effectiveness of the Navy's computer-managed instruction systems. Z1177: ADVANCED COMPUTER-AIDED INSTRUCTION. The fact that Navy personnel have insufficient opportunity to practice complex skills such as electronics troubleshooting, electronic warfare counter-countermeasure operations, and propulsion engineering is a serious hindrance to operational readiness. The objective of this effort is to produce inexpensive, stand-alone, computer-based training programs for schools and remote sites that provide tutorial assistance to learners as they progress through exercises in a simulated learning environment. Z1180: TECHNIQUES FOR SHIPBOARD TRAINING. Design and evaluate an approach for developing shipboard training that is both responsive to Fleet priorities and compatible with the constraints of a shipboard environment. Z1181: DESIGN OF COMBAT TEAM TRAINING. Requirements in the area of combat training include better methods for the identification of training objectives and performance standards, more objective performance evaluations, and new ways to allocate team-member training and refresher training. The goal is to develop new ways to deal with these specific combat-team training problems. Z1218: TACTICAL DECISION TRAINING. In training there is insufficient opportunity for Naval officers to practice tactical decision-making skills in order to increase their speed and accuracy. The objective is to develop an inexpensive tabletop device for the individual student in order to provide systematic decision making practice, instructive feedback and tutoring, and proficiency assessment. Z1251: TRAINING APPROACHES TO COUNTER ATTRITION. Focusing on the General Detail population during recruit and apprentice training and on all personnel with discipline problems, this project will develop management strategies to reduce the premature loss of first term enlisted personnel. Z1382: FUNCTIONAL CONTEXT TRAINING. Navy specialized training generally begins with material remote from the job, proceeds to teach general principles, and finally, specific job tasks. In functional context training, initial training is an orientation to the entire job, training is a set of actual job tasks, and equipment functioning is taught in a whole-to-part sequence. This project will plan, develop, implement and evaluate functional context training in Navy specialized training. Z1388: LOW COST MICROCOMPUTER SYSTEM.

Program Element: 63720N Title: Education and Training
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

Evaluate the capability of low cost microcomputer-based training systems for a wide variety of applications including basic skills, technical maintenance, tactical, and shipboard training. R0126: OPERATIONAL DECISION AIDS. Concentrating on the task force commander and his staff, this project emphasizes tactical decision-making aids designed to take advantage of the experienced judgments of senior officers in the operational situation, rather than relying on the predictions of systems designers. Decision makers will be able to interact with a computer to help them rapidly examine and evaluate alternative courses of action.

(U) RELATED ACTIVITIES: 61120, Training, Personnel and Human Engineering; 63743A, Education and Training; 61102F, Human Resources; 61153N(42), Behavioral and Social Sciences; 63751F, Innovations in Education and Training; 62763N, Personnel and Training Technology; and 62722A, Manpower, Personnel and Training; Each of the above programs contributes to overall DoD Research and Development in education and training. Close liaison among program element coordinators provides responsiveness to Navy requirements. In addition, 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 and visit exchanges, special briefings, etc. Cooperation and participation in joint-service development efforts are common, and help to reduce unnecessary duplications of effort.

(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: Applied Science Assoc., Inc., Valencia, PA; Biotechnology, Inc., Falls Church, VA; Bolt, Beranek & Newman, Inc., Cambridge, MA; Data Design Laboratories, Cucamonga, CA; Kinton, Inc., Alexandria, VA; MAR Consultants, San Diego, CA; Syracuse University, Syracuse, NY; Systems Exploratfon, Inc., San Diego, CA; University of Illinois, Urbana, IL; University of Southern California, Los Angeles, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments: Z0828: ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM. Completed development and testing of job performance aids for apprentice technicians and began development of instructional packages for system technicians at lowest skill levels. Z1168: RELATING TRAINING OUTPUT AND JOB PERFORMANCE. Completed work on the development of a Sonar Performance Test System and investigated relationship between sonar performance and Armed Services Vocational Aptitude Battery (ASVAB) scores. Completed survey of readiness information data bases. Project terminated. Z1175: TRAINING SYSTEM DESIGN AND MANAGEMENT. Developed aids for planning and designing training. Developed a manual for criterion-referenced testing and completed evaluation of a computer-aided instruction study management system. Project terminated. Z1176: INDIVIDUAL TECHNICAL TRAINING. Job oriented basic training curricula preparing low aptitude enlisted personnel for technical training were developed, implemented, and evaluated in various occupational areas. Curricula were modified in accordance with the evaluation. Z1177: ADVANCED COMPUTER-AIDED INSTRUCTION. Completed and evaluated an electronic counter-countermeasures jamming recognition/reaction program for fleet radar operations. Completed initial phase of computer-based propulsion engineering training system for use in non-school settings. Z1180: TECHNIQUES FOR SHIPBOARD TRAINING. Materials for shipboard propulsion operator training have been installed aboard USS CONSTELLATION. Z1181: DESIGN OF COMBAT TEAM TRAINING. Completed an analysis of Naval Gunfire Support Team training. Project terminated. Z1251: TRAINING APPROACHES TO COUNTER ATTRITION. Completed

development and test and evaluation of an integrated system of interventions designed to decrease attrition and personnel turbulence and increase fleet performance among general detail personnel. Completed evaluation of Navy correctional custody units. Project completed.

2. (U) FY 1982 Program. Z0828: ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM. Complete development of all instructional aids for higher skill levels. Z0992: AUTHORING INSTRUCTIONAL MATERIALS. Gather as many existing author aids as possible and program onto a computer system. Begin to define requirements for the preparation of instructional materials. Z1176: INDIVIDUAL TECHNICAL TRAINING. Continue evaluation and enhancement of job oriented basic training curricula and examine the cost benefits of the program. Z1177: ADVANCED COMPUTER-AIDED INSTRUCTION. Complete the testing and evaluation of a computer-based propulsion engineering training system and implement for additional on-site development. Z1180: TECHNIQUES FOR SHIPBOARD TRAINING. Complete evaluation of training system aboard USS CONSTELLATION and evaluate its use aboard other carriers and surface ships. Evaluate techniques for application to other shipboard task areas. Z1382: FUNCTIONAL CONTEXT TRAINING. Develop functional context training principles and select training course as the testbed. Z1388: LOW COST MICROCOMPUTER SYSTEM. Define the applications upon which the microcomputer system will be evaluated and begin preparation of the prototype microcomputer system for those applications.

3. (U) FY 1983 Planned Program: Z0828: ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM. Complete development of instructional aids for higher skill levels and collect data in the fleet on the value of the system. Z0992: AUTHORING INSTRUCTIONAL MATERIAL SYSTEM. Develop new aids for the preparation of instructional materials and define requirements for their preparation. Z1176: INDIVIDUAL TECHNICAL TRAINING. Continue evaluation of job oriented basic training curricula. Z1177: ADVANCED COMPUTER-AIDED INSTRUCTION. Complete the development of a limited automated tutoring system for computer-based propulsion engineering training. Z1218: TACTICAL DECISION TRAINING. Begin design of a low cost, computer-based instructional device to be used by Navy Tactical Officers in developing and practicing their decision-making skills. Z1382: FUNCTIONAL CONTEXT TRAINING. Develop a low cost, prototype functional context training program incorporating principles of personalized instruction. Z1388: LOW COST MICROCOMPUTER SYSTEM. Continue development of the prototype system and begin evaluation of its training potential.

4. (U) FY 1984 Planned Program: Z0828: ENLISTED PERSONNEL INDIVIDUALIZED CAREER SYSTEM. Complete installation of instructional and job performance aids and complete data collection for the evaluation phase of the project. Z0992: AUTHORING INSTRUCTIONAL MATERIALS SYSTEM. Develop hardware specifications and initiate development of software specifications for an automated system for the preparation of instructional materials. Z1176: INDIVIDUALIZED TECHNICAL TRAINING. Continue evaluation of job oriented basic training curricula. Z1177: ADVANCED COMPUTER-AIDED INSTRUCTION. Implement the advanced tutorial system for computer-based propulsion engineering training and complete a cost-effectiveness analysis of the remote-site electronic counter-countermeasures training system. Z1218: TACTICAL DECISION TRAINING. Put initial tactical material on the system and establish site for development. Z1382: FUNCTIONAL CONTEXT TRAINING. Develop functional context training materials and

initiate procurement of equipment for selected course. Z1388: LOW COST MICROCOMPUTER SYSTEM. Develop software and lessonware for test applications and continue development of microcomputer system for new applications.

5. (U) Program to Completion. This is a continuing program composed of individual projects each having a finite completion date.

6. (U) Milestones: Not Applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63721N
Title: Environmental Protection
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	2,913	6,693	8,151	12,614	Continuing	Continuing
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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The goal is to develop processes, prototype hardware, systems and operational procedures that will extend the ability of the U.S. Navy to operate in national and international waters, air spaces and land areas while complying with the spirit and letter of current national statutes and international agreements enacted for the protection of the environment. The projects are in direct support of the Navy requirement to meet the 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 meet present and future regulations in a cost effective manner without impairing military readiness of its operational units.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue efforts in environmental protection development with specific emphasis on: the development of an integrated shipboard waste management system capable of handling liquid and solid waste streams; the development of efficient shipboard and shore based solid waste resource recovery and oil pollution abatement systems; environmentally safe ordnance reclamation/disposal systems; the development of real-time determination of heavy metals in the marine environment; techniques to minimize impact of hazardous wastes; and techniques to measure characteristics of air emissions from jet engine test cells. The $1,458 thousand increase between FY 1982 and 1983 reflects the necessity to reestablish effective programs for oil pollution abatment, hazardous waste disposal, and ordnance reclamation after congressional cuts in FYs 1980 and 1981. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: A 25 decrease in FY 1981, and a 217 decrease in FY 1982 are attributable to Navy Budget reductions including inflation adjustments. An increase of 1,318 in FY 1983 is to

allow for the completion of a new effort started in FY 1982, which is the evaluation of vacuum, forward feed, centrifugal and in-tank bilge oil water separators and to complete evaluation of oil content monitors for fleet introduction.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,000	2,938	6,910	6,833	Continuing	Continuing
S0400	Ordnance Reclamation	0	0	1,943	2,086	Continuing	Continuing
S0401	Shipboard Waste Management	1,229	1,000	1,765	1,926	Continuing	Continuing
S0402	Oil Pollution Abatement	636	1,000	1,139	0	0	13,369
Y0817	Pollution Abatement Ashore	1,135	938	2,063	2,821	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: 63721N
DoD Mission Area: 552 - Environmental and Life-Sciences (ATD)

Title: Environmental Protection
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: S0400, Ordnance Reclamation - will provide 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. S0401, Shipboard Waste Management - 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 multifunctional system components such as incinerators to burn sewage sludge, wet garbage, solid refuse and waste oil and removal, disposal, and detoxification processes for organotin anti-fouling paint. Shorter range development items include a small ship compactor, a waste water treatment system, waste food disposers, low flow showers and a classified document destructer. S0402, Oil Pollution Abatement - aimed at reducing the generation of oily wastes and development of oil/water separator systems and effluent stream monitoring equipment to permit ships and small craft to meet national and international discharge standards. Y0817, Pollution Abatement Ashore - Develop 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. Navy is now facing a variety of state and federal regulations which this program is designed to meet.

(U) RELATED ACTIVITIES: 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.

(U) WORK PERFORMED BY: In-House: David W. Taylor Naval Ship Research and Development Center, Bethesda, MD; Naval Ship Engineering Center, Philadelphia, PA; Naval Shipyard, Mare Island, CA; Naval Weapons Support Center, Crane, IN; Naval Surface Weapons Center, Silver Spring, MD, and Dahlgren, VA; Civil Engineering Laboratory, Port Hueneme, CA; Naval Ocean Systems Center, San Diego, CA. Contractors: Stanford Research Inst., Menlo Park, CA; Scripps Inst., La Jolla, CA; General Electric Co., King of Prussia, PA; Baird, Bedford, MA; Jered Inc., Birmingham, MI; Vent-O-Matic Incinerator Corp., North Quincy, MA; Fluidyne-Engineering Corp., Minneapolis, MN.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: S0400, Ordnance Reclamation - Completed pilot plant work and final report on recovery of phosphoric acid from red phosphorous smoke devices and aluminum recovery from illuminating flares. Confirmed process safety for solvolytic degradation of first generation TRIDENT propellant and scaled process up to 5 lb level. Developed and applied prediction program for kill probability contours for fish over broad range of conditions. S0401, Shipboard Waste Management -

Program Element: 63721N
Title: Environmental Protection
DoD Mission Area: 552 - Environmental and Life-Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

Completed shipboard validation of modified JERED System for vacuum collection and treatment of sewage on two DD-963 Ships, a Solid Waste Compactor for large ships and a low flow shower system for shipboard use. Obtained Environmental Protection Agency concurrence that organotin contaminated abrasive is non-hazardous, completed bench soak for detoxification of organotin processor water. Completed evaluation of rotary skin incinerator for the detoxification of organotin contaminated abrasive, and completed feasibility demonstration of compactor for small ships. Received approval for service use for three different sized food waste disposers, including one disposer also approved for classified document destruction. Navy laboratory full scale evaluations of shipboard multifunctional waste incinerator was completed. Completed laboratory evaluation of commercially available solids separation and waste water disinfection system. Initiated evaluation two additional units. S0402, Oil Pollution Abatement - Received provisional approval for service use for two parallel plate 10 gallons/minute bilge oil/water separators and a 50 gallons/minute centrifugal oil/water separator. Initiated shipboard evaluation of an in-tank parallel plate oil water separator on board a DDG. Completed shipboard evaluation of one oil content monitoring system for use with oil water separators to ensure compliance with environmental regulations. Y0817, Pollution Abatement Ashore - Evaluated techniques for upgrading Navy landfills. Developed life cycle costs of Navy oily waste management options. Completed acoustical model test of jet engine ground run-up noise suppression design for test cells. Developed two full scale sedimentation control concepts for Naval Ship berths.

2. (U) FY 1982 Program: S0400, Ordnance Reclamation: The $3,780 thousand increase over FY 1981 reflects the necessity to establish effective programs for hazardous waste disposal and ordnance reclamation after funding reductions in FY 1980 and FY 1981. Design and install 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. Degrade several plastic-bonded explosives by solvolysis. Publish environmental guidelines for underwater explosion field tests. S0401, Shipboard Waste Management - Initiate shipboard installation of multifunctional incinerator. Complete laboratory evaluation of disinfection system, solids separation clarifier, and small ship compactor. Complete field evaluation to detoxify organotin contaminated water and screw feeder for rotary kiln. S0402, Oil Pollution Abatement - Initiate follow-on testing for one 10 and one 50 gallon per minute oil water separator. Initiate technical evaluation of an in-tank parallel plate oil water separator on-board a DDG. Initiate shipboard operational evaluation of one oil content monitoring system for use with oil water separators to ensure compliance with environmental regulations. Y0817, Pollution Abatement Ashore - Develop acceptable methods for measuring emissions from jet engine test cells. Initiate development of methods for safe destruction of hazardous materials in Navy incinerators. Initiate development of specifications for solid waste resource recovery equipment to process and burn refuse derived fuel in Navy heat recovery incinerators. Continue oily waste treatment equipment development.

3. (U) FY 1983 Planned Program: S0400, Ordnance Reclamation - Operate infrared flare pilot plant. Procure/install pilot plants for colored smoke disposal and for plastic-bonded explosives removal by hydraulic jet. Begin solvolysis of SUBROC, ASROC, NARM propellants. Reconstitute platic-bonded explosive with ingredients recovered by solvolytic process. Develop method to clear fish from area before underwater tests. S0401, Shipboard Water Management - Complete Ship Evaluation and initiate Operational Evaluation of multi-functional waste incinerator. Procure disinfection system and clarifier for shipboard installation. Initiate

ship evaluation of small ship compactor. Initiate design for total ship integrated waste management system. Complete laboratory evaluation of cavitating water jet to remove organotin paint and infra-red heater to detoxify organotin paint on ship's hull. S0402, Oil Pollution Abatement - Complete Approval for Service Use for one 50 gallon per minute oil water separator. Complete shipboard evaluations of one 10 gallon per minute oil water separator, one in-tank parallel plate oil water separator and one oil content monitor. Initiate Approval for Service Use for one 10 gallon per minute oil water separator and one oil content monitor. Initiate shipboard evaluation for a second oil control monitor. Initiate shipboard evalation of DD 963 fuel/ballast tank modifications for prevention of oil pollution during refueling. Y0817, Pollution Abatement Ashore - Initiate tests for real-time determination of heavy metals in Naval harbors for environmental assessment. Continue development of package oily waste treatment including treatment for heavy metal. Continue development of methods for destroying hazardous wastes in Navy incinerators.

4. (U) FY 1984 Planned Progrm: S0400, Ordnance Reclamation - Complete/document effort on infrared flare pilot plant. Operate pilot plants for colored smoke disposal and for plastic-bonded explosives removal of hydraulic jet. Begin solvolysis of TOMAHAWK propellant and complete work on ASROC, NARM and SUBROC propellants. Develop explosion shock damage model for sea mammals and non-swim bladder fish. S0401, Shipboard Waste Management - Complete Operational Evaluation of multifunctional waste incinerator and Ship Evaluation of small ship compactor. Initiate ship evaluation of disinfection system and shipboard clarifier. Initiate shipyard evaluation of cavitating water jet and infrared heater. Complete design of total ship integrated waste treatment system. S0402, Oil Pollution Abatement - Complete Approval for Service Use for one 10 gallon per minute oil water separator, one in-tank parallel plate oil water separator and one oil content monitor. Complete shipboard evaluation of a second oil content monitor. Initiate small craft oil water separator ship evaluation. Initiate ship evaluation of CG-47 fuel ballast tank modification and complete shipboard evaluation of DD 963 fuel/ballast tank modifications. Y0817, Pollution Abatement Ashore - Continue demonstration of the Environmental Protection Agency "bubble concept" for air pollution control at a Navy installation. Complete development of technology for converting solid waste combustibles to usable fuel. Complete development of modular/deployable oily waste treatment unit. Continue development of methods for destroying hazardous materials.

5. (U) Program to Completion: S0400, Ordnance Reclamation: Document colored smoke disposal and plastic-bonded explosives removal results. Design/install/operate pilot plants to recover colored flare and dye marker ingredients and for plastic-bonded explosives solvent breakdown/ingredient recovery; document results. Analyze economics for plastic-bonded explosives removal, ingredient recovery by solvents. Complete solvolysis of TOMAHAWK and other missile propellants; reconstitute propellant with recovered ingredients. Analyze economics of propellant and plastic-bonded explosive solvolysis. Provide impact assessment, technology, and other environmental support needed to permit required explosion tests. S0401, Shipboard Waste Management - Incorporate integrated waste system on one combatant and tender and evaluate system components permitting Navy to meet all federal, state and local regulations. Obtain Approval for Service Use for multifunctional waste incinerator, small ship compactor, and solids separation and disinfection system. S0402, Oil Pollution Abatement - Program to be completed in FY 84. Complete Approval for Service Use for one oil content monitor and DD 963 fuel/ballast tank modifications. Complete Approval for Service Use for ballast system oil content monitor, Approval for Service Use for compensated fuel ballast tank modifications for

FF-1040 and CG-47 class ships, Approval for Service Use for small craft oily waste processing systems, Approval for Service Use for coalescer oil water separator systems, Approval for Service Use of bilge oily waste transfer pumping system, and design testing of ship/shore interface oily waste interface. This is a continuing program. Y0817, Pollution Abatement Ashore - Continuing program.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63722N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Naval Special Warfare
Budget Activity: 2 - Advanced Technology Development

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

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
S0416	Swimmer Weapon System	1,035	1,712	3,116	4,264	Continuing	Continuing
S0417	Swimmer Support System	3,155	262	2,126	2,805	Continuing	Continuing
S1317	Explosive Ordnance Disposal Support System	779	1,063	795	220	Continuing	Continuing
S1684	Special Warfare Combatant Craft	-	2,000	TBD	TBD	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops weapon, reconnaissance, navigation, life support systems for Navy Special Warfare forces (Underwater Demolition Teams, Sea-Air-Land Teams and Special Boat Units) and Explosive Ordnance Disposal divers in support of their missions which include amphibious reconnaissance and beach clearance, ship attack, interdiction and explosive ordnance disposal. It provides for development of the Swimmer Weapon System, a family of specialized swimmer weapons [ ] the Swimmer Support System (swimmer delivery vehicles, [ ] swimmer communications, navigation and reconnaissance mission support equipment, exposure suits, underwater breathing apparatus and an underwater decompression computer); the Explosive Ordnance Disposal Support System, a family of diver mission support equipment that has low acoustic and magnetic signatures which will 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Project S0416, Swimmer Weapons System - complete evaluation of the [ ] and the Swimmer Distress Signal. Resume development of the [ ] Project S0417, Swimmer Support System - Complete fabrication of Swimmer Delivery Vehicle Dry Deck Shelter, install and evaluate on host [ ] complete evaluation of the Underwater Decompression Computer and Swimmer Delivery Vehicle [ ] and initiate development of an improved [ ]

Project S1317, Explosive Ordnance Disposal Underwater Support System - Develop and evaluate low-magnetic signature decompression comuter and commence design of diver sanctuary. Project S1684, Special Warfare Combatant Craft - Continue design analysis and

craft development and evaluation project which was initiated in FY 1982. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are Project S0416, Swimmer Weapon System - Funding decreases of 8 in FY 1981 and 38 in FY 1982 are due to adjustments in inflation indices and the decrease of 1,125 in FY 1983 is due to a decision to defer development tasks in this project in order to fund higher priority programs. Project S0417, Swimmer Support System - Funding increased by 1,485 in FY 1981 to replace 1,000 which had been reprogrammed from this project in FY 1980 and add 485 to fund cost growth in the Swimmer Delivery Vehicle Submarine Deck Shelter contract. Project S1317, Explosive Ordnance Disposal Support System - Funding decreased by 307 in FY 1981 to help fund a shortfall in Project S0417, Swimmer Support System. Decreases of 14 in FY 1982 and 23 in FY 1983 are due to adjustments in inflation indices. (4) Project S1684, Special Warfare Combatant Craft - Funding increased by 2,000 in FY 1982 as the result of congressional addition for Special Warfare Combatant Craft development.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5,930	3,799	3,092	7,250	Continuing	Continuing
S0416	Swimmer Weapon System	1,854	1,043	1,750	4,241	Continuing	Continuing
S0417	Swimmer Support System	4,076	1,670	265	2,191	Continuing	Continuing
S1317	Explosive Ordnance Disposal Support System	0	1,086	1,077	818	Continuing	Continuing

Program Element: 63722N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Naval Special Warfare
Budget Activity: 2 - Advanced Technology Development

(U) OTHER APPROPRIATIONS FUNDS:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S0416	Swimmer Weapon System						
	OPN	2,426	1,534	2,678	2,815	Continuing	Continuing
	O&MN	427	461	530	551	Continuing	Continuing
S0417	Swimmer Support System						
	OPN	3,955	6,923	8,642	8,642	Continuing	Continuing
	O&MN	835	1,347	929	929	Continuing	Continuing

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S1317	Explosive Ordnance Disposal Support System						
	OPN	2,911	3,116	2,050	2,050	Continuing	Continuing
	O&MN	0	0	0	0	-	-

Program Element: 63722N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Naval Special Warfare
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: This program element provides support to: (1) Naval Special Warfare with appropriate weapons, ordnance equipment and underwater delivery, life support and reconnaissance systems to conduct special warfare operations; (2) Explosive Ordnance Disposal divers with low influence signature diving equipment essential to safely operate against underwater mines and weapons systems. Project S0416 - Swimmer Weapon System: This project provides unique weapons and ordnance equipment required by Underwater Demolition and Sea-Air-Land teams to conduct hydrographic reconnaissance/beach clearance, underwater attack, and direct action commando missions. Thirty ordnance items were developed since 1967 in response to Specific Operational Requirement S38-01. A Navy Decision Coordinating Paper S0416-SW Rev I approved 28 October 1980 contains twenty-one new ordnance items. Swimmer weapons equipment functions underwater to a depth of and is transportable by swimmer delivery vehicle. Major hardware includes the

as well as improved versions of previously developed weapons and firing devices. Project S0417 - Swimmer Support System: This project provides Underwater Demolition Team and Sea-Air-Land Team combat swimmers with diving, diving support, reconnaissance and underwater delivery systems for use in the conduct of Naval Special Warfare operations. Major items include: (1) MK 8 and MK 9 Swimmer Delivery Vehicles - These vehicles are used to transport combat swimmers and their equipment and weapons. Swimmer delivery vehicle missions

. (2) Swimmer Delivery Vehicle Dry Deck Shelter -

(3) Mission Support Package - will provide advancements in navigation, communication and reconnaissance equipment that will substantially improve the capability of combat swimmers to perform their missions. Also included are improved exposure suits, a diver decompression computer and a pure oxygen breathing apparatus. Project S1317-Explosive Ordnance Disposal Underwater Support System: This project provides explosive ordnance disposal divers with specialized diving equipment required for them to operate safely underwater to depths of 300 feet while locating, rendering safe and/or disposing of explosive ordnance which could be activated by fluctuations in magnetic, acoustic or seismic signatures. Major components of this system include: (1) MK 16 (low influence signature) Underwater Breathing Apparatus - Provides life support for swimming divers to 300 feet of sea water. (2) Gas transfer and storage system - supplies mixed breathing gas to support MK 16 Underwater Breathing Apparatus. (3) Ancillary equipment package - consists of low influence signature underwater support equipment for the explosive ordnance disposal diver. (4) Low Influence Signature Diver Sanctuary - provides self-contained enclosure for safe transfer of explosive ordnance disposal diver to vicinity of ordnance site and return to surface at depths from 300 feet of sea water. (5) Remote Vehicle - provides explosive ordnance disposal reconnaissance and recovery capability to depths 300-2000 feet of sea water. (6) Explosive Ordnance Disposal Support Craft - provides platform and support for four man explosive ordnance disposal team to conduct diving operations.

Program Element: 63722N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Naval Special Warfare
Budget Activity: 2 - Advanced Technology Development

(U) RELATED ACTIVITIES: Exploratory development in swimmer weapons under Program Element 62734N Project SF34-373, Work Unit 625; Program Element 63654N, Joint Explosive Ordnance Disposal: advanced development fuzing systems developed under Program Element 63601N, Mine Development Project S0267, Mine Improvements, and mine countermeasures systems developed under Program Elements 63502N, Surface Mine Countermeasures and 63260, Airborne Mine Countermeasures are providing technology base necessary for development of swimmer weapons, support systems and Explosive Ordnance Disposal mission support equipment.

(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 Center, China Lake, CA; 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; Ameteck-Straza, San Diego, CA; EDO Western, Salt Lake City, UT.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Project S0416, Swimmer Weapons System: Thirty-two ordnance items developed including an[Achieved service approval for MK 5 Limpet Assembly and the MK 138 Firing Device Blasting Adapter. Completed Standoff Weapon Assembly engineering field testing with MK 9 Swimmer Delivery Vehicle. Began Petroleum Demolition Charge development. Project S0417, Swimmer Support System: Completed development, technical and operational evaluation of: MK 8 and MK 9 Swimmer Delivery Vehicles, MK 15 Underwater Breathing Apparatus, AN/PQS-2 Hand-Held Sonar, and a family of acoustic transponders, beacons and associated marker buoys. Commenced production and fleet deliveries of these items. Continued development of underwater communications, underwater decompression computer and exposure suits. Completed advanced development and testing of swimmer delivery vehicles, reconnaissance sonar and inertial platform. Awarded contract for full scale development of Swimmer Delivery Vehicle Dry Deck Shelter to General Dynamics in FY 1979. Completed detailed design of shelter and host submarine modification and began shelter fabrication. Commenced comparative testing of 3 foreign and 2 U.S. pure oxygen breathing apparatus equipment sets. Project S1317, Explosive Ordnance Disposal Underwater Support System: Conducted development of the MK 16 Low Influence Underwater Breathing Apparatus. Conducted technical and operational evaluation.

2. (U) FY 1982 Program: Project S0416, Swimmer Weapon System: [Project S0417, Swimmer Support System: Procure full face mask; Underwater Decompression Computer - Conduct technical and start operational evaluation; Dry Deck Shelter -[Pure Oxygen Breathing Apparatus - Complete operational evaluation. Receive approval for service use. Project S1317, Explosive

Program Element: 63722N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Naval Special Warfare
Budget Activity: 2 - Advanced Technology Development

Ordnance Disposal Underwater Support System: Commence development of non-magnetic Underwater Decompression Computer, gas storage and transfer system and continue decompression schedule development for MK 16 Underwater Breathing Apparatus. Project S1684, Special Warfare Combatant Craft: Conduct concept design for combatant craft which will be capable of a variety of special warfare missions including employment of short range missile systems. Start development of prototype craft.

3. (U) FY 1983 Planned Program: Project S0416, Swimmer Weapon System - resume technical evaluations and conduct operational evaluations. Resume petroleum demolition charge; Refurbish R&D model as required. Initiate production Underwater Decompression Computer, complete operational evaluation; exposure suit, complete operational evaluation; Swimmer Delivery Vehicle Mission Support Package, complete technical evaluation. Procure Pure Oxygen Breathing Apparatus. Project S1317, Explosive Ordnance Disposal Support System - Begin procurement and production of MK 16 Underwater Breathing Apparatus and gas transfer and storage system; develop and evaluate prototype non-magnetic Underwater Decompression Computer; commence design phase Low Influence Signature Diver Sanctuary. Continue decompression schedule development; commence concept development phase of Explosive Ordnance Disposal Remote Vehicle. Project S1684, Special Warfare Combatant Craft - Continue development of prototype craft which was started in FY 1983.

4. (U) FY 1984 Planned Program: Project S0416, Swimmer Weapon System - conduct operational evaluation, petroleum charge, conduct technical evaluation; Project S0417, Swimmer Support System - Deliver Dry Deck Shelter to fleet. Production of Underwater Decompression Computer, commence development of pure oxygen breathing apparatus. Project S1317-SW, Explosive Ordnance Disposal System - Commence design phase of Explosive Ordnance Disposal Remote Vehicle. Develop Low Influence Signature Diver Sanctuary, commence production of non-magnetic Underwater Decompression Computer. Project S1684, Special Warfare combatant Craft - To be determined.

5. (U) Program to Completion: Project S0416, Swimmer Weapon System - complete development and evaluation of Petroleum Charge, Project S0417, Swimmer Support System - contract for production of two Swimmer Delivery Vehicle Mission Support Package systems in FY 1983. Program completion of Mission Support Package is planned for FY 1985 with delivery of all production units to fleet. Initiate the contract for production Dry Deck Shelter in FY 1983 followed shelters in FY 1986. Follow-on shelter construction is projected to be completed 20 months from contract award. Project S1317, Explosive Ordnance Disposal Support System - complete procurement of MK 16 Underwater Breathing Apparatus and gas transfer and storage system requirements. Evaluate prototype Low Influence Signature Diver Sanctuary and proceed with

procurement/production. Develop, evaluate, and procure Explosive Ordnance Disposal Remote Vehicle. Deliver fleet requirements of non-magnetic Underwater Decompression Computer. Project S1684, Special Warfare Combatant Craft - To be determined.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63727N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Navy Technical Information Presentation System
Budget Activity: 2 - Advanced Technology Development

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

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	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Navy Technical Information Presentation System when developed and implemented, will be a Navy-wide system for the acquisition generation, distribution, and control of Technical Information for use in weapon system operation, maintenance, training, and logistics support. Advancing technology of weapon systems requires expensive technical information support for operation and maintenance. Control, maintenance, and dissemination of this large volume of information require advanced means to reduce the high level of current support costs. More useable forms of technical information have the potential for major reductions in parts replaced in maintenance, maintenance time, and training time.

(U) BASIS FOR FY 1983 RDT&E REQUEST: The requested funding will provide for the completion of a test of the Navy Technical Information Presentation System, which will be used to acquire and control Technical Information for one Naval Air Systems Command type hardware system and two Naval Seas Systems Command hardware systems. The test will be completed in FY 1983. The above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated.

(U) COMPARISON WITH FY 1982 PROGRAM ELEMENT DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: increase in W1032 of 986 in FY 1983 due to change in scope of tests and 3,663 in FY 1984 and beyond due to increase in the scope of the program in accordance with the approved Navy Decision Coordinating Paper. Minor changes in FY 1981 and 1982 result from adjustments during budget development.

Program Element: 63727N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Navy Technical Information Presentation System
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,548	1,825	1,333	467	1,375	6,977
W1032	Navy Technical Information Presentation System	1,348	1,425	1,333	467	1,375	6,777
W1393	Micro Technology for Personnel Records	0	400	0	0	0	0
W1462	Record Image Mounter Development	200	0	0	0	0	200

(U) Other Appropriation Funds: Not Applicable.

Program Element: 63727N
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)

Title: Navy Technical Information Presentation System
Budget Activity: 2-Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: The purpose of this effort is to design and test an improved system for acquiring, generating, 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); (2) Decreasing reading capability of Navy recruits; (3) Delays in providing initial documentation, and in updating to reflect configuration changes; (4) Duplication of technical documentation between training and logistic communities; (5) Escalating costs of developing, distributing, and storing technical documentation. The Navy Technical Information Presentation System (W1032) will exploit various technologies such as computerized authoring, computer graphics, advanced data base design, videodisc, holography, digital storage, satellite communications, and human factors engineering. Navy Technical Information Presentation System will develop ways of providing technical information for all users from the same data base. W1393, MICROFILM TECHNOLOGY FOR PERSONNEL RECORDS: Manual control in updating and maintaining microfilm personnel records creates unacceptably high error rates and incurs unnecessarily high personnel costs. To reduce these impacts, intelligent microfilm hardware must be developed which virtually eliminates human decision making in selected update and retrieval processes.

(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.

(U) WORK PERFORMED BY: In-House: The Navy Technical Information Presentation System Lead Laboratory is the David W. Taylor Naval Ship Research and Development Center, Bethesda, MD. A participating naval activity is the Training Analysis and Evaluation Group, Orlando, FL. Contractors: The prime contractor for the Navy Technical Information Presentation System design is Hughes Aircraft Company, Aerospace Division, Los Angeles, CA. Biotechnology, Inc., Falls Church, VA., is providing human factors support. Grumman Aircraft Company, Bethpage, NY, and Clifton Precision Products, Drexel Hill, PA will prepare Technical Information for the overall system tests.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) General: Phase I of Navy Technical Information Presentation System development, completed under Program Elements 62757N and 62763N, resulted in a Preliminary System Concept, which is a Navy-wide system consisting of an integrated set of procedures and advanced technologies for acquisition, publication, distribution, use, update and control of operating, maintenance, training and logistic technical information. Phase II of the program, completed in FY 1981, resulted in the detailed system design. Phase III, the system test, is scheduled for completion in FY 1983. Phase IV, the prototype operation, is scheduled for FY 1984 and FY 1985. Phase IV, the development of full system capability, is scheduled for completion in FY 1988.

2. (U) Fiscal Year 1981 and Prior Accomplishments: Completed Phase II, i.e. critical element testing and detailed system design. Identified, classified, and analyzed technical information problems. Established Navy Technical Information Presentation System

element design objectives. Identified Navy Technical Information Presentation System boundaries and interfaces. Completed design drawings for all Navy Technical Information Presentation System subsystems. Identified and prioritized Navy Technical Information Presentation System elements. Completed detailed design of system elements. Completed critical element testing. Completed plans for testing and implementation of the system. Prime contractor is Hughes Aircraft Company; cost type contract.

3. (U) Fiscal Year 1982 Program: Initiate Phase III test of Navy Technical Information Presentation System on one Naval Air Systems Command and two Naval Sea Systems Command hardware systems. Technical Information for each hardware system will be defined and generated using the entire data-stream process of Navy Technical Information Presentation System. Contracts planned with Grumann Aircraft Company and Clifton Precision Products; cost type contracts.

4. (U) Fiscal Year 1983 Planned Program: Complete user test with target user population. Evaluation of test results will be performed. Recommendations on the prototype operation of the System will be provided to the Chief of Naval Operations.

5. (U) Fiscal Year 1984 Planned Program: Initiate Phase IV, the prototype operation of the Navy Technical Information Presentation System.

6. (U) Program to Completion: 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, modular specifications for use by equipment buyers in making a detailed selection of the technical information needed to support their equipment; transition documentation to the Chief of Naval Material for all changes required; i.e., a detailed statement of proposed changes involved in implementation and at the same time permitting continuing effectiveness of the current system during the phase-out period; a proposed Navy organization for handling 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.

7. (U) Milestones: Not Applicable

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63728N
Title: Manufacturing Technology
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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
Z1050	Manufacturing Technology	4,754	3,657	3,339	12,085	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is conducted in conjunction with the procurement-funded Manufacturing Technology Program, PE 78011 and relevant Exploratory and Advanced Development activities. Together they comprise a concerted effort to reduce the acquisition and support costs of weapon systems by developing and applying advanced methods of manufacturing for current and future Navy Systems. The goal of Manufacturing Technology is reduced manufacturing costs and improved productivity. Specifically this element provides for the exploration of manufacturing alternatives and concepts prior to the establishment of firm fabrication procedures and techniques for fully operational production equipment. New developments are pursued when they are generically applicable to a variety of weapon systems and when they appear to be cost-effective. This effort includes feasibility demonstrations of innovative concepts of equipment alternatives, process variables, and operating characteristics. Particular attention is paid to the demonstration of cost effective manufacturing feasibility and to design data in order to assure the timely transfer of technology to the production line.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Funds requested in FY 1983 will be used to: establish technical feasibility of innovative shipbuilding techniques; feasibility of application of existing robotics technology to shipbuilding and manufacturing processes; develop usable manufacturing techniques and procedures for ship and aircraft applications utilizing advanced materials such as metal matrix and carbon-carbon; develop low cost manufacturing and control techniques for high volume weapons production. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: a decrease of 246 in FY 1981; a decrease of 232 in FY 1982; and a decrease of 550 in FY 1983, all of which were the result of adjustments made for escalation and economy.

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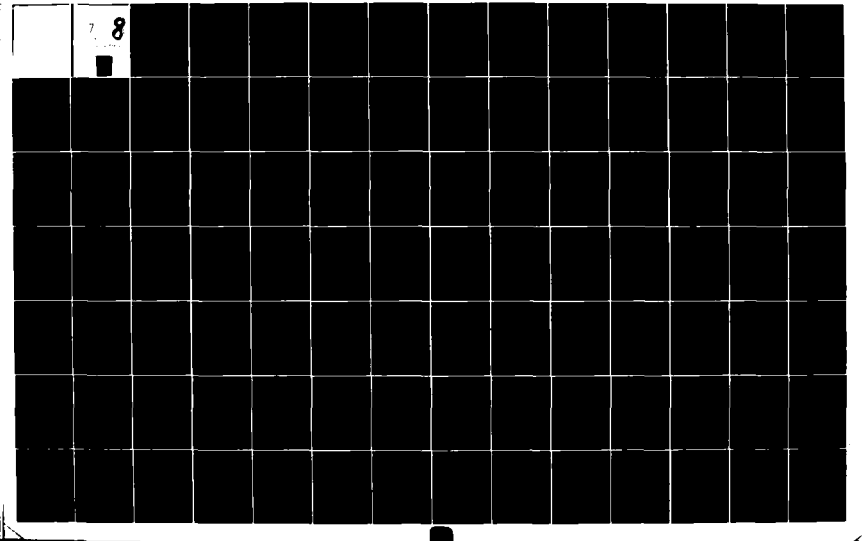

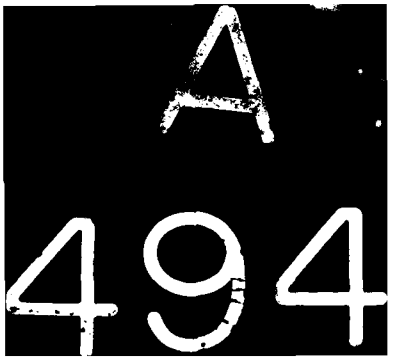
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Program Element: 63728N
Title: Manufacturing Technology
DoD Mission Area: 553 - Engineering Technology (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands)

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	5,000	3,889	3,889	Continuing	Continuing
Z1050	Manufacturing Technology	0	5,000	3,889	3,889	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	OPN	5,534	23,820	33,830	45,984	Continuing	Continuing
	O&MN	1,806	2,466	2,976	3,823	Continuing	Continuing

Program Element: 63728N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Manufacturing Technology
Budget Activity: 2- Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Manufacturing productivity is a national concern, and the need for improvement is clear from the fact that the rate of productivity growth in the U.S. ranks 11th among the 11 western industrialized nations and is among the lowest in the world. The Comptroller General has recommended that "The United States needs to make manufacturing productivity a national priority to remain internationally competitive and to maintain strong industries". Improving manufacturing productivity in the defense industrial base can be expected to reduce costs and lead times, and improve quality and industrial preparedness.

(U) The Manufacturing Technology Research and Development program is an outgrowth of the procurement-funded Manufacturing Technology program. This separation was made pursuant to the recommendation of the House and Senate Appropriations Committees during their review of the Navy's 1978 budget request. Prior to FY 1979 there were no separately requested funds for Manufacturing Research and Development. Program plans are formulated by assessment of status of on-going relevant Exploration and Advanced Developments, anticipated procurement requirements, and associated manufacturing requirements. Projects are selected on the basis of return-on-investment, breadth of application, time phasing, and application priority. Projects are structured as "seed money" to encourage the investment of private capital. No work is done in areas where sufficient economic incentive exists in the private sector.

(U) RELATED ACTIVITIES: The procurement-funded portion of the Manufacturing Technology program (Program Element 78011N) provides for the fabrication, installation and demonstration of fully operational, general purpose, production equipment, processes and tooling on a first-of-a-kind basis. Procurement-funded Manufacturing Technology projects are contingent upon demonstrated feasibility and completed Research and Development. In some instances, procurement-funded Manufacturing Technology projects will be a logical follow-on to Manufacturing Technology Research and Development projects and these in turn could be a logical follow-on to Exploratory and Advanced Development.

(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 Weapons Center, Silver Spring, MD; Naval Weapons Support Center, Crane, IN; and Naval Weapons Center, China Lake, CA. Contractors: Bath Iron Works, Bath, ME; Todd Pacific Shipyards, San Pedro, CA; SRI International, Palo Alto, CA; Hughes Research Labs, Malibu, CA; Westinghouse, Baltimore, MD; Varian Associates, Beverly, MA; Avco - Everett Metalworking Research Labs, Everett, MA., and others.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Benefits from the FY 1979 program include demonstration of economically feasible methods of manufacture and installation of military qualified fiber optic components, computer aided design and manufacture of shipboard piping systems, and robotic welding, blasting, grinding and cutting shipbuilding applications. RDT&E portion of FY 1980 was not funded. FY 1981 program addressed feasibility of processes related to ship construction and advanced materials not yet completed.

Program Element: 63728N
DoD Mission Area: 553 - Engineering Technology (ATD)

Title: Manufacturing Technology
Budget Activity: 2- Advanced Technology Development

2. (U) FY 1982 Program: The R&D funding in FY 82 will be used to support Manufacturing Technology projects for which manufacturing or processing feasibility has not been sufficiently demonstrated to warrant the expenditure of procurement funding. Areas of investment will include materials manufacturing and fabrication techniques, and application of computer aided design/computer aided manufacturing and robotics to shipbuilding.

3. (U) FY 1983 Planned Program: Selected projects begun in FY 1982 will be continued in FY 1983 to remove technical limitations and extend range of application of computer aided design/computer aided manufacturing and industrial robots to shipbuilding. In particular, vision for arc welding, mobility for large structural welding, and programming from a Computer Aided Design Data Base require development. Feasibility of process integration techniques will be demonstrated in ship construction. Material projects started in FY 1981 and FY 1982 will be continued to provide cost effective production demonstrations for ship and aerospace systems. Techniques identified for volume production of weapons will be implemented in a prototype mode. Identify existing robotics technology base for shipbuilding and manufacturing processes.

4. (U) FY 1984 Planned Program: Continue work on robotics applications. Implement computer aided design/computer aided manufacturing processes on pilot basis in shipyard. Demonstrate advanced materials production techniques and procedures for various aerospace, ship and missile development systems. Continue development of strategic material replacements. Develop specific advanced shipbuilding technology base projects identified in FY 1983.

5. (U) Program to Completion: Continuing Program.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63732M
Title: Marine Corps Advanced Manpower/Training System
DoD Mission Area: 552-Environmental and Life Sciences (ATD)
Budget Area: 2 - Advanced Technology Development

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

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	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

(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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Human Resources Management and Forecasting: Methodologies will be developed to improve manpower planning and control. Training Devices and Simulators: Advanced development of anti-tank weapons systems modules for the Universal Infantry Weapons Trainer will continue. Marine Corps Training Resources Development and Analysis: The development of methodologies to effectively implement the DOD directed instruction systems development process in Marine Corps instructional and unit training environments. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are as follows: The increase in Training Devices and Simulators is a result of necessary additional advanced development of 230 in FY 1981 required prior to the fabrication of an engineering prototype (+235) in FY 1983. The decreases in Marine Corps Training Resources Management and Analysis in FY 1982 of 2 and FY 1983 of 7 are the result of refinement of cost estimates including escalation adjustments. The decreases in Human Resources Management and Forecasting of 15 in FY 1982 and 63 in FY 1983 and the increase of 199 in FY 1981 are the result of program restructuring and refinement of cost estimates including escalation adjustments.

Program Element: 63732M
DoD Mission Area: 552-Environmental and Life Sciences (ATD)

Title: Marine Corps Advanced Manpower/Training System
Budget Area: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	433	863	1,507	1,344	Continuing	Continuing
C0073	Human Resources Management and Forecasting	273	688	1,196	1,189	Continuing	Continuing
C0074	Training Devices and Simulators	58	75	140	-	Continuing	Continuing
C0867	Marine Corps Training Resources Management and Analysis	102	100	171	155	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Total Additional to Completion	Total Estimated Cost
PMC						
Training Devices and Simulators:						
Manual Wargames	-	-	479	101	6,610	7,100
Quantity			*(299)*	*(40)*		

Program Element: 63732M
Title: Marine Corps Advanced Manpower/Training System
DoD Mission Area: 552-Environmental and Life Sciences (ATD)
Budget Area: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Human Resources Management and Forecasting: This is a continuing program to investigate methods and techniques necessary for manpower planning and control; Training Devices and Simulators: This is a continuing project for the development of training devices and simulators which were not or cannot be developed in conjunction with a major end item; Training Resources Management and Analysis: This is a continuing project to investigate and develop the methodologies and techniques to improve the efficiency of the training establishment and effectiveness of the training provided.

(U) RELATED ACTIVITIES: U. S. Army; Simulated Tank AntiTank 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, Versital Training Systems.

(U) WORK PERFORMED BY: In-House: Naval Training Equipment Center, Orlando, FL; Navy Personnel Research and Development Center, San Diego, CA. Contractors: Potomac General Research Group, McLean, VA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 AND Prior Accomplishments: Human Resources Management Development of the Officer Staffing Goal Model and Tour Optimization for Uniform Readiness II computer based models has been completed. Models will assist personnel mangers in optimizing the assignment functions. Development of computerized adaptive accesion testing and analysis of technological methods to facilitate the Precise Personnel Assignment System integration in the overall manpower management has been initiated. The development of the Automated Recruit Management System to automate the full spectrum of enlisted and officer personnel procurement has been initiated. Training Devices and Simulators: Testing of the advanced development model for the M16 Rifle of the Universal Infantry Weapons Trainer was completed. Advanced Anti-Tank Weapons System Module for the Universal Infantry Weapons Trainer continued. Training Resources Development and Analysis: The requirements analysis for a Marine Corps wide computer-based instructional system has been initiated.

Program Element: 63732M
DoD Mission Area: 552-Environmental and Life Sciences (ATD)

Title: Marine Corps Advanced Manpower/Training System
Budget Area: 2 - Advanced Technology Development

2. (U) FY 1982 Program: Human Resources Management and Forecasting: The development of the Precise Personnel Assignment System, Automated Recruit Mangement System, and Computerized Adaptive Testing will continue. Training Devices and Simulators: Prototype for company wargame will be fielded and advanced development of the battalion and Marine Amphibious Force wargame will continue. Advanced development of the Anti-Tank Weapons Modules for Universal Infantry Weapons Trainer will continue. Training Resources Development and Analysis: Development of economic feasibilities for alternative concepts and methods for the employment of automated training technology within the Marine Corps training systems.

3. (U) FY 1983 Planned Program: Human Resources Management and Forecasting: The development of the Automated Recruit Management System and the leadership program will be continued. Continue development of manpower methodologies in support of Precise Personnel Assignment System. Continue development of Computerized Adaptive Testing. Training Devices and Simulators: Engineering development model of the Universal Infantry Weapons Training System will be fielded for testing and advanced development of other Infantry Weapon System modules for the Universal Infantry Weapons Training System will continue. Marine Corps Training Resources Development Analysis: The development of methodologies to effectively implement the DOD directed Instructional Systems Development Process in Marine Corps institutional and unit training environments will continue.

4. (U) FY 1984 Planned Program: Human Resources Management and Forecasting: Development of the Automated Recruit Mangement System manpower methodologies in support of the Precise Personnel Assignment System and Computerized Adaptive Testing will continue. Training Devices and Simulators: Advanced development of Infantry Weapons System modules for the Universal Infantry Weapons Center will continue. Training Resources and Analysis: FY 1983 efforts will be continued.

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

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63733N
Title: Training Devices Technology
DoD Mission Area: 552 - Environmental and Life Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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	5,975	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	3,191	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Meets requirements of the Chief of Naval Operations for technology applicable to cost effective simulators for flight, weapon system operation, maintenance, and other required training. Demonstrates techniques to improve training effectiveness and reduce the life cycle cost of trainers.

(U) BASIS FOR THE FY 1983 RDT&E REQUEST:

W1200, Visual Technology Research Simulator Utilization: Continue development of Conventional Takeoff and Landing (CTOL) training device technologies appropriate for air to ground weapons delivery and low-level terrain following and initiate air-to-air tasks;

continue Vertical Takeoff and Landing (VTOL) efforts for at-sea operations and initiate terrain and field operations; initiate testing for lower cost head- and eye-directed helmet-mounted displays. W1202, Integrated Maintenance Training System: Develop an innovative information delivery system which will employ the benefits of modern microprocessor technology in order to provide easy-to-follow step-by-step procedures for maintenance technicians. An engineering model will be developed as an automated job performance aid called PEAM (Personal Electronic Aid for Maintenance) in response to the recommendations of the Defense Science Board.

W1204, Microcomputer Architecture for Trainer Systems: Continue development of a model for a standardized microcomputer system architecture for future simulators/trainers.

W1209, Dynamic Scene Visual Display: Commence efforts to develop improved dynamic scenes in visual simulation displays. The dynamic change of objects in scenes generated by Computer Image Generation (CIG) would be applicable to seascape simulation, cloud shapes and upper cloud layer scenes, special effects such as bomb, rocket, artillery shell bursts, and damage depiction in weapons effects simulation.

W1390, Multi-Spectral Image Simulation: Continue efforts to develop a model simulation system pertaining to Multi-Spectral Image Sensors. Procure components for the Feasibility Model.

W1391, Helmet Mounted Display: Continue development of an experimental Pilot Helmet Mounted Visual Display System. Review critical design features.

The Program was restructured to attempt to provide minimum acceptable solutions that meet the highest priorities in Fleet training needs. Accordingly, project W1207 was terminated in FY 1981; projects W1199 and W1206 were terminated in FY 1982. Initiation of projects W1208 and W1209 was delayed.

As this is a continuing program with projects having specific beginning and ending dates, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated for each individual project except Project W1200 which includes all work or development phases through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a decrease in FY 1981 of 275 as a result of project resconstructuring; decreases of 302 in FY 1982 as a result of Navy Budget reductions. Adjustments in funding for specific projects are as follows: FY 1981, W1199 -37, W1203 -195, W1205 +117 increase to complete projection in FY 1981, W1200 +5, W1207

Program Element: 63733N Title: Training Devices Technology
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

-165; FY 1982, W1200 -1, W1204 -300, W1391 -1. The FY 1983 Funding To Be Determined in the FY 1982 Descriptive Summary is now estimated to be funded at the 7,399 level. Efforts under Projects W1198 and W1199 will continue under Project W1200 by the close of FY 82. The overall thrust for Project W1202 has changed following completion of initial objectives. Project W1201 completed. Effort on Project W1205 in support of the Dynamic Naval Aviator Selection Test and Evaluation System Program was completed and will continue at the Naval Aerospace Medical Research Laboratory. Project W1207 was terminated in FY 1981. In addition, projects W1208 and W1209 have been rescheduled to start respectively in FY 1984 and FY 1983.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY: (Amended):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,748	6,250	8,252	TBD	TBD	TBD
W1198	Conventional Take-off and Landing Visual Technology Research Simulator	630	404	0	TBD	TBD	TBD
W1199	Vertical Take-off and Landing Visual Technology Research Simulator	1,991	2,724	618	TBD	T3D	TBD
W1200	Visual Technology Research Simulator Utilization	1,372	1,288	2,624	TBD	TBD	TBD
W1201	Intermediate Hands-On Maintenance Simulator	321	289	0	TBD	TBD	TBD
W1202	Integrated Maintenance Training System	195	333	510	TBD	TBD	TBD
W1203	Individual Adaptive Training System	239	336	561	TBD	TBD	TBD
W1204	Microcomputer Architecture for Trainer Systems	0	197	625	TBD	TBD	TBD
W1205	Simulation for Selecting Aviation Trainees	0	120	0	TBD	TBD	TBD
W1206	Automation of Part Task Trainers	0	322	1,084	TBD	TBD	TBD
W1207	Simulation/Training Requirements for Automatic Test Equipment	0	237	0	TBD	TBD	TBD
W1208	Computer Generated Imagery for Simulation	0	0	0	TBD	TBD	TBD
W1209	Dynamic Scene Visual Display	0	0	0	TBD	TBD	TBD
W1389	Vertical Take-off and Landing Visual Technology Research Simulator Laser Display	0	0	0	TBD	TBD	TBD
W1390	Multi-Spectral Image Simulation	0	0	124	TBD	TBD	TBD
W1391	Helmet Mounted Display	0	0	2,106	TBD	TBD	TBD

(U) OTHER APPROPRIATIONS FUNDS: N/A

Program Element: 63733N Title: Training Devices Technology
DoD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: There is an urgent need to provide advances in the engineering and training technology required for expansion of the use of simulators/training devices in all phases of Naval weapon system training. This need results from: (1) decreased availability of advanced systems for training, (2) high procurement and operational costs of weapon systems now used as trainers, (3) high development and maintenance costs for a large inventory of dedicated trainers, (4) reduced opportunity for training in the operational environment, and (5) the high training-related accident rate. This development advances the technology for improvements in design and capability of training systems. Through more precise definition of training requirements, training and engineering design methodologies are correlated to develop training devices and systems which are cost effective. Such training devices and systems will also provide for higher levels of trainee skill transfer to the operational environment.

(U) RELATED ACTIVITIES: 62757N: Subproject W57-526, Training Devices and Simulation; 62727A, Non-systems Training Devices Technology; 63227F, Advanced Simulation Technology and 62205F, Training and Simulation Technology; Marine Corps Elements 63732M and 64657M; 64703N, Training Devices Prototype Development; 64714N, Air Warfare Training Devices; 64715N, Surface Warfare Training Devices; 64716N, Submarine Warfare Training Devices. The successes achieved from advanced development experimental applications could lead to prototype implementation.

(U) WORK PERFORMED BY: In-House: Naval Training Equipment Center, Orlando, FL; Contractors: Singer, Link Division, Binghamton, NY; General Electric Corp., Syracuse, NY; Canyon Research Group, Inc., Westlake Village, CA; Digital Equipment Corp., Orlando, FL; University of Central Florida, Orlando, FL; Seville Research Corporation, Pensacola, FL; Vreuls Research Corporation, Thousand Oaks, CA; Computer Sciences Corporation, Orlando, FL; and Applimation Inc., Orlando, FL.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The basis for Program Element 63733N, Training Devices Technology, was Project W0543, TRAINING DEVICES TECHNOLOGY, which commenced in 1974 and addressed subprojects in visual simulation, maintenance training and instructional features. In FY 1980, the subprojects of Project W0543 were restructured into individual projects under P.E. 63733N. Projects were initiated to develop the Conventional and Vertical takeoff and landing visual research simulator components and to investigate hardware performance towards improving the technology in flight simulator visual systems. Maintenance training projects were initiated to develop and demonstrate experimental avionics maintenance training systems for intermediate level technicians and to develop and test a state of the art maintenance training program designed to support multi-rate and team training. A conceptual system for improved tactical team training was also initiated using recent developments in voice technology, performance measurement and adaptive training. Efforts in FY 81 under the restructured projects included: Project W1198, CONVENTIONAL TAKEOFF AND LANDING VISUAL TECHNOLOGY RESEARCH SIMULATOR; the Visual Technology Research Simulator (VTRS) computer image generator (CIG) system with full color and distortion correction capability is integrated with the Conventional Takeoff and Landing (CTOL) simulator. Weapons sound input is complete. Development of terrain tasks along with human factors and

engineering evaluations are complete. Project W1199, VERTICAL TAKEOFF AND LANDING VISUAL TECHNOLOGY RESEARCH SIMULATOR; specification for the display dome for large down angle-field-of-view has been completed, and work on the acquisition package is proceeding. Procurement package for Computer Image Generation (CIG) modifications to meet Vertical Takeoff and Landing (VTOL) requirements has been released. G-cuing system in-house investigation efforts are continuing. The VTOL demonstration mockup is useable for VTOL visual technology. The anti-submarine warfare VTOL/LAMPS MKIII Cockpit Subsystem was received and accepted from SINGER/LINK. Project W1200, VISUAL TECHNOLOGY RESEARCH SIMULATOR UTILIZATION; experiments to date have suggested that relatively inexpensive low complexity, but high quality night carrier landing simulator visual systems may be sufficiently effective to support all Navy carrier landing simulator training including Undergraduate Pilot Training (VTXTS). Naval Air Test Center (NATC) test pilots utilized the Visual Technology Research Simulator (VTRS) to conduct tests and practice flights on the simulated version of the Augmented Visual Carrier Aircraft Recovery System (AVCARS). Two studies and one carrier landing experiment in support of VTXTS have been initiated. The CTOL air-to-ground Weapons Delivery System (WDS) was completed as a baseline operational system. Project W1201, INTERMEDIATE HANDS-ON MAINTENANCE SIMULATORS; the experiment model simulator for the electronic subsystem, the A7E HUD Test Set, has been completed. The electro-mechanical subsystem, the MA3 Generator/CSD Test Stand, has been completed. Front-end analysis is underway for the mechanical subsystem, the CH-46 Automatic Flight Control System. Project W1202, INTEGRATED MAINTENANCE TRAINING SYSTEM, completed definitions of instructional features, incorporation of instructional innovations and development of a matrix of these instructional features for the Woodward Electric Governor simulator training system. Project W1203, INDIVIDUAL ADAPTIVE TRAINING SYSTEM, developed functional specifications for a generic team skills trainer. Project W1204, MICROCOMPUTER ARCHITECTURE FOR TRAINER SYSTEMS, was initiated to standardize trainer computer system components, languages and software modules in order to significantly reduce total life cycle costs in the Navy inventory. An initial operating system was written for the Programmable Aiding and Learning Machine (PALM). Feasibility of concept and techniques is being established via an ongoing Exploratory Development project. Project W1205, SIMULATOR FOR SELECTING AVIATION TRAINEES, provided performance measurement technology for the Dynamic Naval Aviation Selection Test and Evaluation System (DYNASTES) effort. Project W1206, AUTOMATION OF PART TASK TRAINING, was initiated to develop part task trainers to provide low cost, effective training. Front-end analysis to determine development areas has commenced. Project W1207, SIMULATOR/TRAINING REQUIREMENTS FOR AUTOMATIC TEST EQUIPMENT, has developed a conceptual training plan which could be applied to families of Automatic Test Equipment (ATE) in support of weapon systems for operator and maintainer training.

2. (U) FY 1982 Program: Project W1199, VERTICAL TAKEOFF AND LANDING VISUAL TECHNOLOGY RESEARCH SIMULATOR, Computer Image Generation (CIG) is in operation with an FFG-7 data base. The visual system radius dome is under contract for delivery July 1982. Agreement has been reached for an 18-month contract to upgrade the CIG scene content capability required for helicopter confined-area maneuvering. Project W1200, VISUAL TECHNOLOGY RESEARCH SIMULATOR UTILIZATION, continues research in progress which includes investigations of the effectiveness of several simulator variables for carrier landing training, CTOL air-to-ground weapons delivery, and, low-level terrain following. Project W1202, INTEGRATED MAINTENANCE TRAINING SYSTEM, will define the design criteria, identify and evaluate hardware and software alternatives for a Personal Electronic Aid for Maintenance (PEAM). Design techniques will include interactive technology, videographics and synthetic voice. Project W1204, MICROCOMPUTER ARCHITECTURE

FOR TRAINER SYSTEMS, will complete fabrication and feasibility testing of Programmable Aiding and Learning Machine hardware/software. Interface with the Navy Personnel Research and Development Center (NPRDC) on selection and evaluation of candidate application areas. Project W1206, AUTOMATION OF PART TASK TRAINING, will determine artificial intelligence requirements needed to extract diagnostic information for performance measurement applicable to a ground-controlled, air-intercept trainer. Project W1390, MULTI-SPECTRAL IMAGE SIMULATION, is initiated to study advanced multi-spectral target acquisition/weapon delivery suites such as Forward Looking Infra Red (FLIR), Radar, Laser and Visual sensors, in order to determine the training requirements and possible areas of simulation. Initial effort will center on the development of display characteristics such that proper correlation between sensors can be detected. A detailed design for a feasibility model is projected. Project W1391, HELMET MOUNTED DISPLAY RESEARCH TOOL, is initiated to develop a head/eye coupled display system which will concentrate on full fidelity in a very narrow field in the direction the trainee is looking. Contract award towards the design of the system is scheduled for February 1982.

3. (U) FY 1983 Planned Program: Project W1200, VISUAL TECHNOLOGY RESEARCH SIMULATOR UTILIZATION, will include CTOL air-to-air tasks as well as VTOL sea and terrain tasks and initiate testing for head and eye directed displays. Project W1202, INTEGRATED MAINTENANCE TRAINING SYSTEM, will develop the Personal Electronic Aid for Maintenance (PEAM) software, compiler, authoring system with the use of higher-order-languages, and data base, prior to packaging the Personal Electronic Aid for Maintenance (PEAM) as a portable device for field test and evaluation. Project W1204, MICROCOMPUTER ARCHITECTURE FOR TRAINER SYSTEMS, will integrate the demonstration system with an existing in-house research facility, Visual Technology Research Simulator (VTRS), using an operational flight trainer simulation math model. Individual modules will be programmed and debugged. Project W1390, MULTI-SPECTRAL IMAGE SIMULATION, will procure components for an Advanced Development Feasibility Model and initiate assembly of the model. The model will be used to develop technology alternatives investigated through an ongoing Exploratory Development Research Project. Project W1391, HELMET MOUNTED DISPLAY RESEARCH TOOL, will continue with a Critical Design Review of the pilot helmet-mounted display (PHMD) System. Integration of the display system with the Visual Technology Research Simulator (VTRS) will be initiated to evaluate the concept and the training potential. Project W1209, DYNAMIC SCENE VISUAL DISPLAY, initiates the development of a visual display system which will present a dynamic change of objects in scenes generated by Computer Imagery Generation (CIG). Present Exploratory Development technology in CIG will be applied to the study contract for the system development.

4. (U) FY 1984 Planned Program: Project W1200, VISUAL TECHNOLOGY RESEARCH SIMULATOR UTILIZATION, will continue with CTOL air-to-air tasks and VTOL sea and terrain tasks, and address problems inherent to helicopter training. Project W1204, MICROCOMPUTER ARCHITECTURE FOR TRAINER SYSTEMS, will continue with tests and evaluations of the demonstration system. Project W1390, MULTI-SPECTRAL IMAGE SIMULATION, will complete the construction of the Feasibility Model. Project W1391, HELMET MOUNTED DISPLAY RESEARCH TOOL, will install and integrate the display system with the Visual Technology Research Simulator. Project W1209, DYNAMIC SCENE VISUAL DISPLAY, will identify hardware and software requirements for mathematical models. Project W1208, COMPUTER-GENERATED IMAGERY FOR SIMULATION, will be initiated to extend the hardware capability of the existing Visual Technology

Research Simulator in order to provide more scene detail and texture in the picture. Project W1663, PART TASK TRAINING FOR MISSILE ENVELOPE RECOGNITION, will be initiated to develop an experimental part task trainer based on results of related exploratory development efforts.

5. (U) Program to Completion: Continuing program containing a changing group of projects, most of which have definite end dates.

6. (U) Milestones: N/A

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63786N
Title: Airborne Electromagnetic and Optical Systems (Advanced)
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

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

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 Countermeasures Test	21*	1,310	1,509	1,644	Continuing	Continuing

* Formerly Program Element 63796N.

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Airborne electro-optical countermeasures project continues the Navy's share of a joint service effort to develop an Electro-Optical Countermeasures system and development of techniques and equipment 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue Engineering Development Model definition on Compass Hammer. Continue to monitor second Advanced Development Model fabrication by U.S. Army of Optical Warning Locator-Detection. Commence Engineering Development Model (EDM) fabrication on the Laser Warning Set for the ALR-67. Commence Advanced Development model fabrication on Laser Rangefinder/Designator countermeasure and Forward Looking Infrared countermeasures. Complete Operational Evaluation of AVR-2 Laser Warning Receiver and obtain Approval for Serivce Use. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are the result of changes in scope, refined cost estimates and budget adjustments. Project W0646 showed decreases of -1197 in FY 1981, -143 in FY 1982, -231 in FY 1983. Electro-Optical Guided Weapons Countermeasures Test has been delayed and will begin in FY 1982. This delay caused the following changes in Project W0659; FY 1981 -1,205, FY 1982 -321, and FY 1983 -274.

Program Element: 63786N
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: Airborne Electromagnetic and Optical Systems (Advanced)
Budget Activity: 2 - Advanced Technology Development

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,469*	6,675*	8,521	9,295	Continuing	Continuing
WO646	Airborne Electro-Optical Countermeasures	2,464*	5,449*	6,890	7,512	Continuing	Continuing
WO659	Electro-Optical Guided Weapons Countermeasure	5*	1,226	1,631	1,783		

*Formerly Program Element 63796N.

(U) OTHER APPROPRIATION FUNDS: NONE

Program Element: 63786N
Title: Airborne Electromagnetic and Optical Systems (Advanced)
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD)
Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Extensive enemy use of visually directed Anti-Aircraft Artillery in Southeast Asia, together with intelligence estimates of optical or Electro-Optical tracking on most modern Soviet Weapons, provide the requirement for development of optical countermeasures systems and tactics. Tactical technical intelligence collection systems and optical warning receivers were developed and facilities were established for countermeasures systems evaluation and for optical fire control evaluation and countertactics development. The Airborne Electro-Optical Countermeasures project continues to represent the Navy's share of the joint service effort to develop an Electro-Optical Countermeasures system and development of techniques and equipment that will enhance survivability of Navy/Marine aircraft in operations against visual, electro-optical or laser directed ship or shore based anti-aircraft or missile fire control systems. The Electro-Optical Guided Weapons Countermeasures Test Project commences in FY 1981. This Joint Services Test program was established by the Under Secretary of Defense for Research and Engineering as the focal point for coordinating, supporting, and evaluating countermeasures test and analysis activities applied to laser/electro-optical guided weapons.

(U) RELATED ACTIVITIES: Liaison with the Air Force, which has an Optical Countermeasure Program (P.E. 63743F) and the Army (P.E. 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 Laser Warning Receiver (AVR-2) are Army developments with U.S. Navy monitoring of progress and testing for Navy application. The laser warning development and the Joint Services Laser Guided Weapons Countermeasures Test Program are tri-service efforts.

(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: ; SWL Inc, McLean, VA; Westinghouse Electric Corporation, Baltimore, MD; Martin Marietta Corporation, Orlando, FL; Sanders Associates, Inc., Nashua, NH; Perkin-Elmer Corp., Norwalk, CT., Pacific-Sierra Research Corp., Santa Monica, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Joshua Ridge optical measurement facility was established for field evaluation of optical Countermeasure systems. The Electronic Warfare Threat Environment Simulation Facility at China Lake was augmented with electro-optical equipment for evaluation of Electronic Warfare target tracking capability and development of Electro-Optic counter tactics. Airborne Dual Detector Indicator was developed to provide an interim laser warning capability.

The Advanced Development Model of the AN/ALR-45 [ ]was developed and evaluated. The COMPASS HAMMER, Advanced Optical Countermeasure Pod development was initiated jointly with the Air Force and is in ADM Test and

Evaluation (T&E). Continue development of Laser Rangefinder/Designator Countermeasures. Continue development of Laser Warning Receiver, AVR-2 and Helicopter Optical Warning Location - Detection (ALQ-169) with the U.S. Army.

2. (U) FY 1982 Program: Continue flight testing and Engineering Development Model definition on COMPASS HAMMER. Commence Development and Operational Evaluation of AVR-2 Laser Warning Receiver. Continue Engineering Development Model definition on the Laser Warning Set to the ALR-67. Continue Advanced Development Model definition of Laser Rangefinder/Designator countermeasures. Commence Advanced Development definition of Forward Looking Infrared countermeasures. Continue to monitor second Advanced Development Model fabrication of ALQ-169 by the U.S. Army. Commence testing of [ ] electro-optical guided weapons countermeasures.

3. (U) FY 1983 Planned Program: Continue Engineering Development Model definition on COMPASS HAMMER. Continue monitor Advanced Development Model fabrication with U.S. Army on ALQ-169. Commence Engineering Development Model fabrication of the Laser Warning Set to the ALR-67. Commence Advanced Development model fabrication of Laser Rangefinder/Designator countermeasures and Forward Looking Infrared (FLIR) countermeasures. Complete Operational Evaluation of AVR-2 Laser Warning Receiver and obtain Approval for Service Use (ASU). Continue testing of [ ] electro-optical guided weapons countermeasures.

4. (U) FY 1984 Planned Program: Commence Engineering Development Model fabrication of COMPASS HAMMER. Commence Engineering Development Model fabrication with U.S. Army on ALQ-169. Continue Engineering Development Model fabrication on Laser Warning Set to ALR-67. Continue Advanced Development Model fabrication on Laser Rangefinder/Designator Countermeasures and Forward Looking Infrared Countermeasues.

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

6. (U) Milestones: Not Applicable.

Project: W0646 Title: Airborne Electromagnetic-Optical Countermeasures
Program Element: 63786N Title: Airborne Electromagnetic and Optical System (Advanced)
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

(U) DETAILED BACKGROUND AND DESCRIPTION: Extensive enemy use of visually directed anti-aircraft artillery in Southeast Asia together with intelligence estimates of optical or electro-optical tracking on most modern Soviet weapons provided the requirement for development of optical countermeasures systems and tactics. Tactical technical intelligence collection systems and optical warning receivers were developed and facilities were established for countermeasures systems calculation and for optical fire control evaluation and countertactics development. Project W0646 continues the Navy's Electro-Optical Countermeasures program with the objective of developing techniques and equipment to increase the survivability of Navy/Marine Aircraft in operation against visual, electro-optical or laser directed ship or shore based anti-aircraft or missile fire control systems.

(U) RELATED ACTIVITIES: Liaison with the Air Force, which has an optical countermeasure program (PE 63743F) and the Army (PE 63711A) will be maintained to keep abreast of their concepts, technology and equipment development to avoid duplication of effort. The pod-mounted laser countermeasures COMPASS HAMMER is a joint Navy/AF development. The Helicopter Optical Warning Location Detection and the AVR-2 helo laser warning receiver are Army developments with U.S. Navy monitoring of progress and testing for Navy application. Laser warning development is a tri-service effort.

(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: SWL, INC., McLean, VA; Westinghouse Electric Corporation, Baltimore, MD; Martin Marietta Corporation, Orlando, FL; Sanders Associates Inc., Nashua, NH; Perkin-Elmer Corp., Norwalk, CT., Pacific-Sierra Research Corp., Santa Monica, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Joshua Ridge Optical Measurement Facility was established for field evaluation of optical countermeasures systems. The Electronic Warfare Threat Environment Simulation at China Lake was augmented with electro-optical equipment for evaluation of electro-optic target tracking capability and development of counter tactics. Integrated-Laser Intercept Receiver, Staring Laser Intercept Receiver and Airborne Laser Intercept Receivers were developed and evaluated. Airborne Dual Indicator was developed to provide an interim laser warning capability. [ ] The advanced development model of the AN/ALR-45[ ]was developed and evaluated. The COMPASS HAMMER Advanced Optical countermeasures Pod was initiated jointly with the Air Force and is in Advanced Development Model Test and Evaluation. Continue development of Laser Rangefinder/Designator Countermeasures and Laser Warning Receiver, AVR-2, and Helicopter Optical Warning Location Detection with (ALR-169) the U.S. Army.

Project: W0646 Title: Airborne Electromagnetic-Optical Countermeasures
Program Element: 63786N Title: Airborne Electromagnetic and Optical System (Advanced)
DoD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

2. (U) FY 1982 Program: Continue flight testing and Engineering Development Model definition on COMPASS HAMMER. Commence Developmet and Operational Evaluation of AVR-2 Laser Warning Receiver. Continue Engineering Development Model definition on [ ] the ALR-67. Commence Advanced Development Model fabrication of laser rangefinder/designator countermeasures. Commence Advanced Development model fabrication of Forward Looking Infrared countermeasures. Complete Operational Evaluation of AVR-2 Laser Warning Receiver and obtain Approval for Service Use.

3. (U) FY 1983 Planned Program: Continue definition on COMPASS HAMMER. Continue to monitor second Advanced Development Model fabrication by the U.S. Army on Optical Warning Laser Detection (ALQ-169). Commence fabrication on the Laser Warning Set to the ALR-67. Comence fabrication on Laser Rangefinder/Designator countermeasures and Forward Looking Infrared countermeasures. Complete Operational Evaluation of AVR-2 Laser Warning Receiver and obtain Approval for Service Use.

4. (U) FY 1984 Planned Program: Commence Engineering Development Model fabrication of COMPASS HAMMER. Commence Engineering Development Model fabrication with U.S. Army on ALQ-169. Continue Engineering Development Model fabrication on Laser Warning Set for ALR-67. Continue Advanced Development Model fabrication of Laser Rangefinder/Designator Countermeasures and Forward Looking Infrared Countermeasures.

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

6. (U) Milestones: Not Applicable.

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
W0646	Airborne Electro-Optical Countermeasures	4,252*	6,747	7,281	7,779	Continuing	Continuing

* Formerly funded under Program Element 63796N.

FY 1983 RDT&E,N DESCRIPTIVE SUMMARY

Program Element: 11221N
Title: Fleet Ballistic Missile System
DOD Mission Area: 112 - Sea Based Strike
Budget Activity: 3 - Strategic Programs

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

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
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	10,085	14,656	Continuing	Continuing
B0005	LINEAR CHAIR	5,042	1,596	0	0	0	25,499
S1265	SSBN Unique Countermeasure Development	3,648	3,901	6,386	6,616	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds development and maintenance of the POSEIDON Strategic Weapon System as well as other improvement projects for Fleet Ballistic Missile Submarines. The Improved Accuracy Program was initiated in FY 1975 to develop the ability to predict with confidence the costs and schedules associated with achieving quantified accuracy improvement in future missile systems. 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 Fleet Ballistic Missile Weapon system.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue the vulnerability and effectiveness effort to support continuing assessment of survivability implications of weapon subsystem operations, and engineering investigations of applicable corrective measures. Continue development of Sonar Training Programs including initiation of procurement of first Towed Array Sonar Processing Equipment Trainer. Conduct planning and validation effort for installation of NAVSTAR Global Positioning System on fleet ballistic missile submarines. Project B0005, LINEAR CHAIR, will terminate in FY 1982, at the direction of Deputy Chief of Naval Operations, Submarine Warfare (OP-02). Complete development of the Towed Array Sonar Processing Equipment (restructured Improved Sonar Processing Equipment). Initiate effort to upgrade maintainability and reliability of other fleet ballistic missile submarine unique Sonar Equipment. Initiate reliability and maintainability upgrade effort for fleet ballistic missile submarine unique sonar equipment and complete modification to the AN/BQR-15 array. Expand development of the Mobile Submarine Simulator, Mark 57, MOD 0, improvements, continue AN/BLR-14 countermeasures receiving set improvements and project S1265, Fleet Ballistic Missile Submarine Unique Countermeasure Development. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only, except for projects B0005, LINEAR CHAIR, and J0094, Improved Accuracy Program, which will be completed or terminated in FY 1982, and for which the above funding profile is through FY 1982 only.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: an overall decrease of 2,466 in FY 1981, 104 in J0091, 885 in J0094, 224 in S0942, 46 in B0005, and 32 in S1265 due to revised inflation estimates, and 200 in J0091 and 975 in S0942 due to restructuring of the Improved Sonar Processing Equipment project; an overall reduction of 6,121 in FY 1982, 161 in J0091, 659 in J0094, 101 in S0942, 75 in B0005, and 55 in S1265 due to revised inflation estimates, 970 in S0942 due to restructuring of Improved Sonar Processing Equipment project, 100 in S1265 due to Navy application of DoD reductions, and 4,000 in B0005 due to the decision terminate the project in FY 1982; and an overall increase of 19,410 in FY 1983, reflecting a decrease of 1,437 in B0005 due to termination in FY 1982, an increase of 7,012 in J0091 for the development of Sonar Training Programs, an increase of 9,253 in S0942 due to reallocation of funding for the restructured Improved Sonar Processing Equipment project, now titled the Towed Array Sonar Processing Equipment project, and an increase of 4,582 in S1265, 45 due to revised cost estimates for AN/BLR-14 improvements, 200 for start up [redacted] and 4,337 due to restructuring the Mobile Submarine Simulator project to increase the scope of improvements.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	157,789	139,951	72,447	13,537	Continuing	Continuing
J0091	Fleet Ballistic Missile System	11,531	11,317	11,002	9,464	Continuing	Continuing
J0094	Improved Accuracy Program	103,142	94,529	44,481	0	0	626,545
S0942	SSBN Unique Sonar	28,663	25,337	7,237	832	Continuing	Continuing
B0005	LINEAR CHAIR	7,502	5,088	5,671	1,437	0	31,057
S1265	SSBN Unique Countermeasure Development	0*	3,680	4,056	1,804	Continuing	Continuing
R1373	Reward BRASS	6,951					

*Effort included under Program Element 64562N in FY 1980 and prior.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) OTHER APPROPRIATION FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
OPN 1/	72,727	51,679	53,992	40,974	Continuing	Continuing
OPN 2/	0	0	39,427	92,285	Continuing	Continuing
OPN 3/	6,000	6,800	9,500	11,400	Continuing	Continuing
OPN 4/	9,942	0	0	937	Continuing	Continuing
SCN 5/	45,300	1,100	3,400	4,300	198,000	252,100
Quantity	(1)				(1)	(2)
WPN 6/	47,100	48,700	33,700	35,025	Continuing	Continuing

1/ These funds provide 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.

2/ These funds procure the BQR-15 Array Modification and Towed Array Sonar Processing Equipment.

3/ These funds will procure service approved Submarine Acoustic Warfare Systems equipments.

4/ These funds will procure Mobile Submarine Simulator, Mark 57, Mod 0 systems in FY 1981 and FY 1984.

5/ Funding through the budget timeframe provides for the conversion of two cargo ships to Fleet Ballistic Missile capability (FY 1981 and FY 1985) and the replacement of the TAGM-22 (USS Range Sentinel) Range Instrumentation Ship.

6/ These funds, in support of the POSEIDON missile and missile modification programs (which includes production of POSEIDON MK-3 reentry body nosetips 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.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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 inflict such damage on his country as to deny him any gain from initiating a war. Project J0091, Fleet Ballistic Missile System - Effort since completion of POSEIDON development has been related to improvements in Fleet Ballistic Missile Submarine unique sonars and the Strategic Weapon System which are aimed at extending the effectiveness and the survivability of the Fleet Ballistic Missile Weapon System. Project J0094, Improved Accuracy Program - Commenced in FY 1975 in response to a Secretary of Defense initiative. Purpose of this technology program is to develop the ability to predict with confidence the costs and schedules associated with achieving quantified accuracy improvements in future missile systems. A specific objective is that the program be compatible with providing an improved accuracy capability for the Sea Launched Ballistic Missile Modernization Advanced Development Program. Project B0005, LINEAR CHAIR - Objective is to advance the state-of-the-art and to establish the technology base which will permit the engineering design of effective countermeasures[redacted] Project S0942, Fleet Ballistic Missile Submarine Unique Sonar - Develop restructured Improved Sonar Processing Equipment including a modification to the BQR-15 array designed to improve Fleet Ballistic Missile Submarine sonar capability to counter the mid 1980's Soviet threat and perform continuing assessment of vulnerability and effectiveness of Fleet Ballistic Missile Submarine Unique Sonar systems. Project S1265, Fleet Ballistic Missile Submarine Unique Countermeasure Development - Develop improvements for the Mobile Submarine Simulator, AN/BLR-14 countermeasure receiving set,[redacted] to increase strategic submarine survivability and protection against current and post-1985 threat.

(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; and Fleet Ballistic Missile Submarine Security improvements under Program Element 11224N.

(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; Naval Surface Weapons Center, White Oak, Silver Spring, MD; Naval Surface Weapons Center, Dahlgren, VA; Naval Coastal System Center, Panama City, FL; Naval Ocean Systems Center, San Diego, CA; 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; Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; The Analytic Sciences Corporation, Reading, MA; Charles Stark Draper Laboratory, Cambridge, MA; Rockwell International Corporation, Anaheim, CA; RCA Corporation, Princeton, NY; Tracor Incorporated, Austin, TX; Western Electric, Winston-Salem, NC; Honeywell, Incorporated, West Covina, CA; Ford Aerospace, Palo Alto, CA; Electronic Memories, Chatsworth, CA; Raytheon Company, Sudbury, MA; ORI Inc., Silver Spring, MD; International Business Machine Corporation, Manassas, VA; General Dynamics Corporation, Electric Boat Division, Groton, CT; Sperry Gyroscope, Great Neck, NY; Gould Inc., Cleveland, OH; and other laboratories and contractors.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishment: Project J0091, Fleet Ballistic Missile System - Completed Sonar Evaluation Program development to provide a continuing, objective assessment of Fleet Ballistic Missile sonar system performance in the operational environment. Started development of hardware and requirements for the Towed Array Sonar Processing Equipment Training Program and the AN/BQR-15 Array Modification Training Program. Continuing vulnerability and effectiveness investigations conducted to identify potential improvements to Fleet Ballistic Missile Weapon System to decrease potential vulnerabilities or increase effectiveness. Conducted development of contract drawings and specifications for conversion of cargo ship to Fleet Ballistic Missile cargo ship capability. Project J0094, Improved Accuracy Program - Capability of Satellite Missile Tracking System to evaluate TRIDENT missile flight test performance has been demonstrated and is now in use. Bottom mounted transponders and beacons have been installed in all Atlantic operational test launch areas to verify submarine position and velocity at launch. Precision reentry body instrumentation packages have been designed and produced. TRIDENT I test flights using precision reentry body instrumentation and the Satellite Missile Tracking System have been conducted. Detailed accuracy models of the TRIDENT I weapon system have been developed and are being refined based on the results of error measurements and estimates conducted on TRIDENT I operational tests to date. Modeling and error analysis activities have identified need for improved components and procedures and advanced development of same has been initiated. Examination and evaluation of various advanced concepts have been carried out and the most promising have been selected for further study. Project S0942, Fleet Ballistic Missile Submarine Unique Sonar - The Improved Sonar Processing Equipment design study completion was initiated in early 1976. Rockwell International and Western Electric were selected from seven bidders to define the Improved Sonar Processing Equipment design during competitive funded design studies. The design had been constrained to use of existing off-the-shelf and Navy standard processing and display hardware. Less than 10% of Improved Sonar Processing Equipment hardware would be new design. In March 1977, Rockwell International was selected as prime contractor and Full Scale Development was initiated. During FY 1978 all hardware design was completed. During FY 1980, hardware deliveries and unit testing was completed and system integration started. Major test and installation planning for Operational Test and Evaluation was initiated. In January 1981, the Improved Sonar Processing Equipment project was reduced in scope and restructured by Navy direction to provide an inboard electronics suite for use with the AN/BQR-15 Towed Array. Project B0005, LINEAR CHAIR - A preliminary threat assessment was completed supported by a preliminary vulnerability analysis. The analysis indicated a [redacted] threat could exist and countermeasures could be effective. A decision to proceed to a comprehensive threat and vulnerability analysis was made by the Assistant Secretary of the Navy for Research, Engineering and Systems in January 1979. Sensor, hardware, and range configuration design efforts were completed and the [redacted] range was installed and in operation in mid FY 1980. Theoretical model development continued. Signature data on targets of opportunity and vulnerability analysis was collected to validate the models and to acquire an expanded data base. Detailed net threat assessment was completed. Project S1265, Fleet Ballistic Missile Submarine Unique Countermeasures Development - Transfered Mobile Submarine Simulator and AN/BLR-14 development from Program Element 64562N, Project S0235, Submarine Acoustic Warfare. Completed improvement program planning and commenced development of hardware design for the Phase I Mobile Submarine Simulator improvements. Commenced engineering development model design for the AN/BLR-14 improvements.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

2. (U) FY 1982 Program: Project J0091, Fleet Ballistic Missile System - Continue vulnerability and effectiveness effort to identify improvements to Fleet Ballistic Missile weapon systems to counter vulnerabilities or increase system effectiveness. Complete cargo ship conversion development effort. Complete development of capability to launch two Navy Navigation Satellites on one Scout Booster. Continue development of Sonar Training Program for Towed Array Sonar Processing Equipment and AN/BQR-15 Array Modification. Project J0094, Improved Accuracy Program - Completion of measurements and estimates on TRIDENT I Demonstration and Shakedown Operation flights from fleet ballistic missile submarines. Continue advanced development of selected improved components and advanced concepts which could not be completed in FY 1981 due to technology or funding limitations and documentation of final program results. Project S0942, Fleet Ballistic Missile Submarine Unique Sonar - Continue development of the restructured Improved Sonar Processing Equipment project which is now titled the Towed Array Sonar Processing Equipment project. Continue array modification development. Project B0005, LINEAR CHAIR - Document development of technology base which characterizes sources]] Terminate project. Project S1265, Fleet Ballistic Missile Submarine Unique Countermeasures Development - Continue engineering development of Mobile Submarine Simulator and AN/BLR-14 countermeasures receiving set improvements and commence development [Complete engineering development model design and commence fabrication of AN/BLR-14 improvements. Conduct feasibility investigations and component analyses]]

3. (U) FY 1983 Planned Program: Project J0091, Fleet Ballistic Missile System - Continue vulnerability and effectiveness effort at a level to support continuing assessment of survivability implications of weapon subsystem operations and engineering investigations of applicable corrective measures. Continue development of Sonar Training Programs including initiation of procurement of first Towed Array Sonar Processing Equipment Trainer. Conduct planning and validation effort for installation of NAVSTAR Global Positioning System on fleet ballistic missile submarines. Project S0942, Fleet Ballistic Missile Submarine Unique Sonar - Complete development of the restructured Improved Sonar Processing Equipment. Initiate reliability and maintainability update studies for Fleet Ballistic Missile Submarine sonar equipment and complete evaluation of the BQR-15 array modification. Project S1265, Fleet Ballistic Missile Submarine Unique Countermeasure Development - Complete engineering development model fabrication and conduct technical and operational evaluations of AN/BLR-14 countermeasures receiving set improvements. Continue hardware fabrication of Phase I Mobile Submarine Simulator improvements. Complete engineering development specification and award design and fabrication contract [ ]

4. (U) FY 1984 Planned Program: Project J0091, Fleet Ballistic Missile System - Continue vulnerability and effectiveness efforts to identify threats to weapon system survivability, appropriate corrective measures and options of performance improvement. Continue development of Sonar Training Programs. Continue development of fleet ballistic missile submarine Global Positioning System capability. Project S0942, Fleet Ballistic Missile Submarine Unique Sonar - Continue reliability and maintainability upgrade studies and start production on selected components, and continue vulnerability and effectiveness studies. Project S1265, Fleet Ballistic Missile Submarine Unique Countermeasure Development - Obtain approval for service use for AN/BLR-14 improvements.

Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

Complete fabrication and conduct fleet operational test and evaluation of the Phase I Mobile Submarine Simulator improvements. Complete engineering development model design and fabrication.

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

6. (U) Milestones: Not applicable.

Project: J0091
Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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 that country as to deny it 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 weapon system. POSEIDON is a two-stage ballistic missile powered by solid fuel motors and guided by a self-contained inertial guidance system. The launching vehicle is the fleet ballistic missile submarine equipped for computing accurate positional and geoballistic data, and for launching 16 missiles. Each POSEIDON missile is able to carry up to 14 reentry bodies which can be directed against a single threat or against separate targets within an area of several thousand square miles. Variable POSEIDON payload provides flexibility needed to assure continued deterrent effectiveness of the existing force of fleet ballistic missile submarines in the face of a wide range of potential threats allowed by the terms of arms limitation agreements. Effort since completion of POSEIDON development in FY 1972 has been related to improvements in Fleet Ballistic Missile Submarine unique sonars and the strategic weapon system which are aimed at extending the effectiveness and the survivability of the Fleet Ballistic Missile weapon system.

(U) RELATED ACTIVITIES: Directly related to the TRIDENT I Missile System, Program Element 11228N, Project B0003; TRIDENT II Missile System, Program Element 63371N, Project B0951; Fleet Ballistic Missile Submarine Security Program, Program Element 11224N; and other projects within Program Element 11221N.

(U) WORK PERFORMED BY: In-House: Naval Surface Weapons Center, Dahlgren, VA; Naval Underwater Systems Center, New London, CT. Contractors: Sperry Systems Management Division, Great Neck, NY; ORI, Inc., Silver Spring, MD; Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; Kaman Sciences Corporation, Colorado Springs, CO; Rockwell International Corporation, Anaheim, CA; Lockheed Missiles and Space Company, Sunnyvale, CA; Honeywell, Inc., West Covina, CA; Control Data Corporation, Arlington, VA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Completed Sonar Evaluation Program development, provided a continuing, objective assessment of Fleet Ballistic Missile Submarine sonar system performance in an operational environment. Started development of hardware and requirements for the Towed Array Sonar Processing Equipment Training Program and the AN/BQR-15 Array Modification Training Program. Continuing vulnerability and effectiveness investigations are conducted to identify potential improvements to the Fleet Ballistic Missile weapon system including missile, launcher, fire control, and navigation subsystems, to decrease potential vulnerabilities or to increase effectiveness of the weapon system. Effort is dedicated to evaluation of new threat postulations, investigation of potential system performance improvements, assessment of survivability implications of subsystems operations and formulation of corrective measures. Conducted development of contract drawings and specifications for conversion

Project: J0091
Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Fleet Ballistic Missile System
Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

of a cargo ship to Fleet Ballistic Missile cargo ship capability to replace an aging ship in the fleet. Initiated effort to provide capability to modify navigation satellites to allow launch of two satellites on a single SCOUT launch booster.

2. (U) FY 1982 Program: Complete development of capability to launch two Navy navigation satellites on one SCOUT booster. Complete cargo ship conversion development effort. Continue vulnerability and effectiveness effort to identify improvements to the Fleet Ballistic Missile Weapon System to counter potential vulnerabilities or increase system effectiveness; continue investigations to support the implementation of improved navigation subsystem operating and monitoring procedures. Continue development of sonar training programs for Towed Array Sonar Processing Equipment and AN/BQR-15 Array Modification.

3. (U) FY 1983 Planned Program: 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; continue investigations for reducing navigation fix observability. Continue development of Sonar Training Programs including initiation of procurement of first Towed Array Sonar Processing Equipment Trainer. Conduct planning and validation effort for installation of NAVSTAR Global Positioning System on fleet ballistic missile submarines.

4. (U) FY 1984 Planned Program: Continue vulnerability and effectiveness efforts to identify threats to weapon system survivability, appropriate corrective measures, and options for performance improvement. Continue to develop Global Positioning System capability. Continue development of Sonar Training Programs.

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

6. (U) Milestones: Not applicable.

7. (U) Resource:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
J0091	Fleet Ballistic Missile System	11,013	10,841	16,476	22,341	Continuing	Continuing

Project: J0094 Title: Improved Accuracy Program
Program Element: 11221N Title: Fleet Ballistic Missile System
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: An Improved Accuracy Program commenced in FY 1975 in response to a Secretary of Defense initiative. Program objectives were provided by the Secretary of Defense in his posture statement of 4 March 1974 and subsequently by the Deputy Secretary of Defense in his letter of 14 March 1974. Direction was later modified by the Under Secretary of Defense Research and Engineering in his budget guidance of 8 January 1975. This guidance directs that an accuracy technology program be pursued, the purpose of which is to develop the ability to predict with confidence the costs and schedules associated with achieving quantified accuracy improvements in future missile systems. A specific objective is that the program be compatible with providing an improved accuracy capability for future Sea Launched Ballistic Missile Modernization.

(U) RELATED ACTIVITIES: Directly related to TRIDENT I Missile System (Program Element 11228N, Project B0003) and TRIDENT II Missile System (Program Element 63371N, Project B0951). The capability to meet specifiable accuracy objectives in the TRIDENT II development project is directly dependent upon progress that is achieved in the Improved Accuracy Program.

(U) WORK PERFORMED BY: In-House: Naval Surface Weapons Center, Dahlgren, VA; Eastern Space and Missile Center, Cocoa Beach, FL; Naval Air Development Center, Warminster, PA. Contractors: Lockheed Missiles and Space Company, Sunnyvale, CA; Sperry Systems Management Division, Great Neck, NY; Interstate Electronics Corporation, Anaheim, CA; The Analytic Sciences Corporation, Reading, MA; Charles Stark Draper Laboratory, Cambridge, MA; Dynamics Research Corporation, Wilmington, MA; Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; Rockwell International, Autonetics, Anaheim, CA; General Electric Co., Ordnance Systems Division, Pittsfield, MA; Automation Industries, Inc., Vitro Laboratories Division, Silver Spring, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Capability of the Satellite Missile Tracking System to provide precise definition of TRIDENT missile flight test performance has been demonstrated and is now in use. Bottom mounted transponders and beacons have been installed in all Atlantic operational test launch areas to verify submarine position and velocity at launch. Precision reentry body instrumentation packages have been designed, and produced. TRIDENT I test flights using precision reentry body instrumentation and the Satellite Missile Tracking System were conducted from FY 1978 through FY 1981. Detailed accuracy models of the TRIDENT I weapon system have been developed and are being refined based on the results of the error measurement and estimation being conducted on TRIDENT I operational tests. The modeling and error analysis activities have identified the need for improved components and procedures and advanced development of same has been initiated. Examination and evaluation of various advanced system concepts have been carried out and the most promising have been selected for further study. Changes in the TRIDENT submarine schedule have delayed Demonstration and Shakedown Operation tests from TRIDENT Fleet Ballistic Missile Submarines beyond the end of the Improved Accuracy Program. Advanced development of those components and concepts which earlier year effort has shown to be most promising and which can be accommodated within funding limitations were conducted.

Project: J0094
Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: Improved Accuracy Program
Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

2. (U) FY 1982 Program: Completion of error measurements and estimates on TRIDENT I Demonstration and Shakedown Opera-tion test flights; continue advanced development of selected improved components and advanced concepts which could not be completed in FY 1981 due to technology or funding limitations; and documentation of the final results.

3. (U) FY 1983 Planned Program: Not applicable.

4. (U) Program to Completion: Not applicable.

5. (U) Milestones: Project completes in FY 1982.

6. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
J0094	Improved Accuracy Program	93,644	43,822	0	0	0	625,001

Project: S0942 Title: SSBN Unique Sonar
Program Element: 11221N Title: Fleet Ballistic Missile System
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: Fleet Ballistic Missile Submarines (SSBNs) will be relied upon for a significant contribution to deterrence of nuclear war through the 1980s and into the early 1990s. To maintain the Fleet Ballistic Missile Submarine force as a credible strategic deterrent, the current Fleet Ballistic Missile Submarine acoustic advantage over the Soviet attack submarine force must be maintained. As threat attack submarine silencing techniques and sensor system improvements are attained the time available for U.S. Fleet Ballistic Missile Submarines to recognize the presence of a threat, localize the threat, and take evasive action prior to counter detection will be reduced. This problem is particularly acute in a multicontact environment which is routinely encountered today in the Mediterranean and North Atlantic patrol areas. U.S. Fleet Ballistic Missile Submarines must be equipped with a system which will[redacted] The Improved Sonar Processing Equipment development was initiated to provide this combination of signal processing and information processing, however, this effort was restructured in FY 1981 to provide an electronics suite for use with the AN/BQR-15. Development of a modified array for the AN/BQR-15 towed array system is proceeding, as well as initial planning for reliability and maintainability upgrades to numerous sonar systems to compensate for the loss of funding for the Improved Sonar Processing Equipment. In addition, continued studies are performed to assess the vulnerability and effectiveness of Fleet Ballistic Missile Submarine Unique Sonar Systems.

(U) RELATED ACTIVITIES: Directly related to Fleet Ballistic Missile System, Program Element 11221N, Project J0091; Advanced Signal Processor, Program Element 64266N; Tactical Towed Array Sonar, Program Element 64713N.

(U) WORK PERFORMED BY: In-House: Naval Underwater Systems Center, New London, CT; Naval Electronic Systems Command, Washington, DC; Naval Air Development Center, Warminster, PA. Contractors: Rockwell International, Anaheim, CA, Honeywell, Inc., West Covina, CA; Ford Aerospace, Palo Alto, CA; Electronic Memories, Chatsworth, CA; Raytheon Company, Sudbury, MA; International Business Machines Corporation, Manassas, VA; Tracor, Inc., Rockville, MD; Western Electric Company, Winston Salem, NC.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Improved Sonar Processing Equipment design study competition was initiated in early 1976. Rockwell International and Western Electric were selected from 7 bidders to define the Improved Sonar Processing Equipment design during competitive funded design studies. The design was constrained to use existing off-the-shelf and Navy standard processing and display hardware. Less than 10% of Improved Sonar Processing Equipment hardware was new design. In March 1977, Rockwell International was selected as prime contractor and full scale development was initiated. During FY 1979 all hardware design was completed. During FY 1980, hardware deliveries and unit testing was completed and system integration started. Major test and installation planning for Operational Test and Evaluation was initiated. During FY 1981, the Improved Sonar Processing Equipment program was restructured to provide an electronics suite for use with the AN/BQR-15.

Project: S0942
Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Unique Sonar
Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

2. (U) FY 1982 Program: Continue redirected Improved Sonar Processing Equipment development to effort of lesser scope and cost which will provide increased processing capability and enhanced reliability and maintainability. Complete towed array modification development. Commence planning for reliability and maintainability upgrades for existing sonar equipments.

3. (U) FY 1983 Planned Program: Complete development of the restructured Improved Sonar Processing Equipment Program. Initiate reliability and maintainability upgrade studies for Fleet Ballistic Missile Submarines.

4. (U) FY 1984 Planned Program: Continue vulnerability and effectiveness studies and reliability and maintainability upgrades.

5. (U) Program to Completion: Install AN/BQR-15 array modification and restructured Improved Sonar Processing Equipment on 31 Fleet Ballistic Missile Submarines and provide 5 trainers. Install reliability and mantainability upgrades on 31 Fleet Ballistic Missile Submarines and in all trainers.

6. (U) Milestones:

Milestone	Date
Approval for Service Use	FY 1983
Initial Operational Capability	FY 1985

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S0942	SSBN Unique Sonar	24,138	6,166	10,085	14,656	Continuing	Continuing

Project: S1265
Program Element: 11221N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Unique Countermeasure Developement
Title: Fleet Ballistic Missile System
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: Fleet Ballistic Missile Submarine unique countermeasures developments are aimed at extending the effectiveness and improving the survivability of the Fleet Ballistic Missile Weapons system. Efforts under this project will increase the performance capability of the AN/BLR-14 Acoustic Countermeasure receiving system[ ] and develop improvments for the Mobile Submarine Simulator, Mark 57, in order to increase strategic submarine survivability and protection against current and post-1985 threat.

(U) RELATED ACTIVITIES: TRIDENT I missile and TRIDENT submarine development under Program Element 11228N; Advanced sonar signal processor development under Program Element 64266N; TRIDENT II Missile development under Program Element 63371N; and Fleet Ballistic Missile Submarine Security improvements under Program Element 11224N.

(U) WORK PERFORMED BY: In-House: Naval Underwater Systems Center, New London, CT; Naval Ocean Systems Center, San Diego, CA. Contractors: Sperry Systems Management Division, Great Neck, NY; Gould Inc., Cleveland, OH.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishment: Completed transfer of Mobile Submarine Simulator and AN/BLR-14 development from Program Element 64562N, Project S0235, Submarine Acoustic Warfare. Completed improvement program planning and commenced development of Hardware design for the Phase I Mobile Submarine Simulator improvements. Commenced engineering development model design for the AN/BLR-14 improvements.

2. (U) FY 1982 Program: Continue engineering development of Mobile Submarine Simulator and AN/BLR-14 countermeasures receiving set improvements[ ] Complete engineering development model design and commence fabrication of AN/BLR-14 improvements. Conduct feasibility investigations and component analyses.

3. (U) FY 1983 Planned Program: Complete engineering development model fabrication and conduct technical/operational evaluation of the AN/BLR-14 countermeasures receiving set improvements. Continue hardware fabrication of the Phase I Mobile Submarine Simulator improvements. Complete engineering development specification and award design and fabrication contract

Project: S1265 Title: SSBN Unique Countermeasure Developement
Program Element: 11221N Title: Fleet Ballistic Missile System
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

4. (U) FY 1984 Planned Program: Obtain approval for service use for AN/BLR-14 improvements. Complete fabrication and conduct fleet operational test and evaluation of the Phase I Mobile Submarine Simulator improvements. Complete engineering development model design and fabrication and commence development testing.

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

6. (U) Milestones: Not applicable.

7. (U) Resource:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
S1265	SSBN Unique Countermeasure Development	3,648	3,901	6,386	6,616	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11224N
Title: SSBN Security Program
DOD Mission Area: 112 - Sea Based Strike
Budget Activity: 3 - Strategic Programs

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

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	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

(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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue assessments of individual threat mechanisms, initiate new project to formalize the evaluation of new technologies for application as threat countermeasures, and conduct major at-sea tests. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a reduction of 2,418 in FY 1981 due to inflation adjustments as well as a reprogramming of 2,500 between projects within the program element; a reduction of 5,628 in FY 1982, which includes 54 due to program restructuring, 574 for revision of inflation estimates, and 5,000 due to Navy budget reductions; and a reduction of 17,052 in FY 1983, which includes 1,688 for revision of inflation estimate, 3,567 due to Navy reductions, and 11,797 due to program restructuring, as well as an internal adjustments of 1,242 to establish Project R1585, Advanced Technology Concepts and Countermeasures.

Program Element: 11224N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Security Program
Budget Activity: 3 - Strategic Programs

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	42,440	44,730	42,357	53,743	Continuing	Continuing
J0092	SSBN Security	38,691	44,730	42,357	53,743	Continuing	Continuing
R0092	SSBN Security	3,749	0	0	0		

(U) OTHER APPROPRIATION FUNDS: None.

Program Element: 11224N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Security Program
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: SSBN Security Program is dedicated to maintaining continuing survivability of the U.S. sea based deterrent system. Research and development are specifically directed toward identifying technically feasible Soviet capabilities [redacted] and, where appropriate, application of new technologies toward development of countermeasures. Development of relevant technologies provides the basis for an authoritative assessment of the survivability of that force, permits maintaining its survivability and contributes to the technological base for future sea-based systems.

(U) RELATED ACTIVITIES: Director, Naval Warfare (OP-095) and Director, 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. The Defense Advanced Research Projects Agency's Nonacoustic Surveillance Program was transferred to the SSBN Security Program during FY 1980.

(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. Contractors: Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; TRW, Redondo Beach, CA; ORI Inc., Silver Spring, MD; Flow Research Incorporated, Seattle, WA; Dynamics Technology, Torrance, CA; Arete Associates, Encino, CA; Bendix Aerospace, Ann Arbor, MI; Poseidon Research, Los Angeles, CA; Science Applications, Inc., LaJolla, CA, Seattle, WA, McLean, VA, and Tucson, AZ; and North American Rockwell, Anaheim, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Effort under this program was initiated in FY 1970 and has been 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 has been 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 observables associated with [redacted] fleet ballistic missile submarines; the ambient characteristics that relate to such observables; and the counters to any potentially serious threats identified. A project is

Program Element: 11224N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Security Program
Budget Activity: 3 - Strategic Programs

terminated when an authoritative assessment can be made or, in the case of countermeasure technology, when proof of principle has been satisfactorily demonstrated. Major accomplishments during FY 1981 include the following: Acoustics - Conducted experiments evaluating the performance of and analyzed data from FY 1980 at-sea test to demonstrate the potential for Direct Observables - Conducted a major ocean test to assess the detectability of initiated studies of several countermeasure techniques for reducing completed breadboard development of designed to conducted an ocean test to assess the detectability of initiated detailed detection modeling of expected from a fleet ballistic missile submarine; conducted the first phase of preliminary analysis of the detectability of developed a countermeasure concept to reduce detectability in particular ocean areas; convened a major multi-contractor working group to quantify the detectability of submerged fleet ballistic missile submarines. Hydrodynamics - Completed analysis of data from FY 1980 Combined Hydrodynamics Experiment under varying conditions of detection, and establishment of requirements for advanced detection systems; conducted experiment; conducted background measurements using advanced sensors and analyzed data; obtained data ; conducted countermeasure-related investigations ; conducted needed supporting laboratory experiments; initiated advanced sensor development , completed work of Magneto-Hydrodynamic Phenomena (MHP) Task Force and initiated efforts on measurements program recommended by that Task Force; designed and prepared for FY 1982 detection experiment building on knowledge and capabilites to date. Magnetics - Assessed detectability of signatures using detection theory, taking into account (in addition to previously considered noise sources) Environment - Acquired and evaluated environmental data in (or representative of) submarine operational areas to support test and assessments related to fleet ballistic missile submarine security.

2.(U) FY 1982 Program: Acoustics - Continue analysis for detection of the fleet ballistic missile submarine ; initiate theoretical and experimental efforts toward assessing the threat potential of Direct Observables - Conduct an extensive analysis of the copious data gathered during FY 1981 testing to assess the detectability over a wide range of environmental and operational parameters; develop statistical models for use in an updated threat analysis; continue assessment of countermeasure techniques to reduce detectability examine the potential of several signal processing concepts for increasing the detectability of complete development of detection model to predict the from a submerged fleet ballistic missile submarine

Program Element: 11224N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Security Program
Budget Activity: 3 - Strategic Programs

for use in a preliminary detectability (threat) analysis; upgrade the capability of the developed during FY 1981; complete the preliminary assessment of the detectability of the ; conduct a comprehensive assessment of the long-range plans and goals for detection of ; conduct a major field test to assess the detectability of submarines; further categorize . Hydrodynamics - Conduct major detection experiment; complete analysis of data collected during experiment conducted in FY 1981; conduct expriment to obtain measurements using advanced sensors and analyze data therefrom; analyze data on and collect data ; conduct and exploit data from at-sea experiment to obtain preliminary data on a fleet ballistic missile submarine ; continue development and at-sea testing of advanced sensors for use in FY 1983 detection experiment; develop sensor system for use in FY 1983 fleet ballistic missile submarine; experiment; assess detection feasibility; conduct countermeasure related investigations ; conduct needed supporting laboratory experiments and theoretical studies. Magnetics - Complete threat element analysis of concept employing advanced sensors; . Environment - Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues pertaining to fleet ballistic missile submarine detectability at sea,

3. (U) FY 1983 Planned Program: Acoustics - Complete threat analysis of the effectiveness in detecting the fleet ballistic missile submarine ; continue assessment of fleet ballistic missile submarine detectability by Direct Observables - Complete the updated Threat Element Analysis based upon the FY 1982 analysis of the data from the FY 1981 detection experiment; assess whether detectability is increased by the use of ; conduct detection programs consistent with the FY 1982 long-range project plan recommendations ; analyze data gathered during FY 1982 testing. Hydrodynamics - Analyze FY 1982 data collected ; conduct detection experiment using advanced sensors; conduct experiment to obtain data on fleet ballistic missile submarine continue countermeasure related investigations; conduct needed supporting laboratory experiments and theoretical studies. Magnetics - Initiate any new efforts warranted by analysis to be completed in FY 1982. Environment - Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues pertaining to fleet ballistic missile submarine detectability at sea ;

Program Element: 11224N
DOD Mission Area: 112 - Sea Based Strike

Title: SSBN Security Program
Budget Activity: 3 - Strategic Programs

4. (U) FY 1984 Planned Program: Conduct a major at-sea experiment evaluating the performance of [conduct at-sea exercises to prove out] detection concepts in realistic interdisciplinary scenarios; evaluate effectiveness of proposed countermeasures; complete analyses from field tests and provide threat assessments. Focused emphasis on selected high-payoff ideas that are presently undergoing only preliminary evaluation is anticipated. The technology base program in support of the major thrust areas will be continued to interpret results and provide for conceptualization of threat concepts indicated by new information.

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

6. (U) Milestones: Not applicable.

Project: J0092 Title: SSBN Security

Program Element: 11224N Title: SSBN Security Program

DOD Mission Area: 112 - Sea Based Strike Budget Activity: 1 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: SSBN Security provides a continuing authoritative assessment of potential Soviet capability to threaten the deterrent effectiveness of the U.S. Fleet Ballistic Missile Submarine Force. Research and development are specifically directed toward identifying technically feasible Soviet capabilities [redacted] and, where appropriate, developing countermeasures concepts. Development of relevant technologies provides the basis for an authoritative assessment of the survivability of the U.S. Fleet Ballistic Missile Force, permits maintaining its survivability and contributes to the technology base for future sea-based systems.

(U) RELATED ACTIVITIES: Director, Naval Warfare (OP-095) and Defense Advanced Research Projects Agency conduct related research and development. Although technologies are similar, emphasis of 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. The Defense Advanced Research Projects Agency's Nonacoustic Surveillance Program was transferred to the SSBN Security Program during FY 1980.

(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. Contractors: Applied Physics Laboratory, Johns Hopkins University, Laurel, MD; TRW, Redondo Beach, CA; ORI Inc., Silver Spring, MD; Flow Research Incorporated, Seattle, WA; Dynamics Technology, Torrance, CA; Arete Associates, Encino, CA; Bendix Aerospace, Ann Arbor, MI; Poseidon Research, Los Angeles, CA; Science Applications, Inc., LaJolla, CA, Seattle, WA, McLean, VA, and Tucson, AZ; and North American Rockwell, Anaheim, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Initiated in FY 1970. Effort has been directed toward research, technology development and systems applications related to the security of the U.S. Fleet Ballistic Missile Submarine Force. Because the development of a threat to that security could arise out of several technologies, the program has been 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 observables associated with [redacted] fleet ballistic missile submarines; the ambient characteristics that relate to such observables; and the counters to any potentially serious threats identified. A project is terminated when an authoritative

Project: J0092 Title: SSBN Security
Program Element: 11224N Title: SSBN Security Program
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 1 - Strategic Programs

assessment can be made or, in the case of countermeasure technology when proof of principle has been satisfactorily demonstrated. Major accomplishments during FY 1981 include the following: Acoustics - Conducted experiments evaluating the performance of and ; analyzed data from FY 1980 at-sea test to demonstrate the potential for Direct Observables - Conducted a major ocean test to assess the detectability of ; initiated studies of several countermeasure techniques for reducing ; completed breadboard development of designed to ; conducted an ocean test to assess the detectability of ; initiated detailed detection modeling of expected from a fleet ballistic missile submarine ; conducted the first phase of preliminary analysis of the detectability of ; developed a countermeasure concept to reduce detectability in particular ocean areas; convened a major multi-contractor working group to quantify detectability of submerged fleet ballistic missile submarines. Hydrodynamics - Completed analysis of data from FY 1980 Combined Hydrodynamics Experiment under varying conditions of detection, and establishment of requirements for advanced detection systems; conducted experiment; conducted background measurements using advanced sensors and analyzed data; obtained data on conducted countermeasure-related investigations conducted needed supporting laboratory experiments; initiated advanced sensor development completed work of Magneto-Hydrodynamic Phenomena (MHP) Task Force, and initiated efforts on measurements program recommended by that Task Force; designed and prepared for FY 1982 detection experiment building on knowledge and capabilities to date. Magnetics - Assessed detectability of signatures using the detection theory, taking into account (in addition to previously considered noise sources) Environment - Acquired and evaluated environmental data in (or representative of) submarine operational areas to support tests and assessments related to fleet ballistic missile submarine security.

2. (U) FY 1982 Program: Acoustics - Continue analysis for detection of the fleet ballistic missile submarine ; initiate theoretical and experimental efforts toward assessing threat potential of Direct Observables - Conduct an extensive analysis of the data gathered during FY 1981 testing to assess the detectability over a wide range of environmental and operational parameters; develop statistical models for use in an updated threat analysis; continue assessment of countermeasure techniques to reduce detectability ; examine the potential of several signal processing concepts for increasing the detectability of complete

Project: J0092
Program Element: 11224N
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Title: SSBN Security
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Budget Activity: 3 - Strategic Programs

development of a detection model to predict the from a submerged fleet ballistic missile submarine for use in a preliminary detectability (threat) analysis; upgrade the capability of the developed during FY 1981; complete the preliminary assessment of the detectability of the conduct a comprehensive assessment of the long-range plans and goals for detection of ; conduct a major field test to assess the detectability of submarine; further categorize . Hydrodynamics - Conduct major detection experiment; complete analysis of data collected during experiment conducted in FY 1981; conduct experiment to obtain measurements using advanced sensors and analyze data therefrom; analyze data on and collect data ; conduct and exploit data from at-sea experiment to obtain preliminary data on a fleet ballistic missile submarine ; continue development and at-sea testing of advanced sensors develop advanced sensor system for use in fleet ballistic missile submarine experiment; assess detection feasibility; conduct countermeasure related investigations ; conduct needed supporting laboratory experiments and theoretical studies. Magnetics - Complete threat element analysis of concept employing sensors . Environment - Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues pertaining to fleet ballistic missile submarine detectability at sea.

3. (U) FY 1983 Planned Program: Acoustics - Complete threat analysis of the effectiveness in detecting the fleet ballistic missile submarine , continue assessment of fleet ballistic missile submarine detectability by . Direct Observables - Complete the updated Threat Element Analysis of the detectability of the floating wire antenna based upon the FY 1982 anaysis of the data from the FY 1981 detection experiment; assess whether detectability is increased by the use of ; conduct detection programs consistent with the FY 1982 long-range project plan recommendations analyze data gathered during FY 1982 testing. Hydrodynamics - Analyze FY 1982 data collected conduct detection experiment using advanced sensors; conduct needed supporting laboratory experiments and theoretical studies. Magnetics - Initiate any new efforts warranted by analysis to be completed in FY 1982. Environment - Continue acquisition and evaluation of relevant environmental data needed to support resolution of technical issues to fleet ballistic missile submarine detectability at sea

Project: J0092 Title: SSBN Security
Program Element: 11224N Title: SSBN Security Program
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

4. (U) FY 1984 Planned Program: Conduct a major at-sea experiment evaluating the performance of conduct at-sea exercises to prove out detection concepts in realistic interdisciplinary scenarios; evaluate effectiveness of proposed countermeasures; complete analyses from field tests and provide threat assessments. Focused emphasis on selected high-payoff ideas that are presently undergoing only preliminary evaluation is anticipated. The technology base program in support of the major thrust areas will be continued to interpret results and provide for conceptualization of threat concepts indicated by new information.

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

6. (U) Milestone: Not applicable.

7. (U) Resources: (Dollars in thousands)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
J0092	SSBN Security	39,812	36,729	35,449	58,454	Continuing	Continuing

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FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11228N
Title: TRIDENT I
DoD Mission Area: 112 - Sea Based Strike
Budget Activity: 3 - Strategic Programs

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

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	90,565	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the continuing development of the TRIDENT System, leading to an Initial Operational Capability in September 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 presently deployed submarine ballistic missile systems (POLARIS and POSEIDON). These systems are a key element of the nation's strategic nuclear deterrent.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Funding in FY 1983 will continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerability or increase system effectiveness and maintain readiness posture for MK 500 Evader operational capability. Development aspects of the TRIDENT submarine program which support deployment will continue, as well as development efforts to establish an East Coast Base and a TRIDENT modernization program. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a reduction of 3,379 in FY 1981, 245 in B0003 due to reduction in inflation estimates, 633 in B0004 due to adjustments in the FY 1981 Supplemental/FY 1982 Amendment for inflation and economic reductions, and 2,501 in B0004 due to reprogramming; a reduction of 2,222 in FY 1982, 624 in B0003 and 1,598 in B0004 due to adjusted inflation estimates; and a reduction of 10,997 in FY 1983, 1,202 for adjusted inflation estimates and 2,606 for decreases to the MK 500 program in B0003, and 7,189 due to a combination of adjusted inflation estimates and program reductions in B0004.

Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	94,030	79,674	104,172	101,562	Continuing	Continuing
B0003	TRIDENT I Missile System	36,820	26,292	42,095	40,056	Continuing	Continuing
	QUANTITY						(30)
B0004	TRIDENT Submarine System	57,210	53,382	62,077	61,506	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
Ship Construction, Navy (SCN)	1,088,200	330,700	2,462,500	1,648,700	Continuing	Continuing
Quantity (TRIDENT Submarines)	(1)	(0)	(2)	(1)	(3)	(15)
Weapons Procurement, Navy (WPN) 1/	828,803	905,200	741,600	743,000	448,100	7,697,351
Quantity (TRIDENT I Missiles)	(72)	(72)	(72)	(72)	(30)	(630)
Military Construction (MILCON) 2/, 3/	56,600	118,000	188,300	387,000	Continuing	Continuing
Other Procurement, Navy (OPN) 3/	69,400	69,300	84,000	87,100	Continuing	Continuing

1/ Total TRIDENT I and Backfit. Excludes funds for replenishment spares, missile industrial facilities and first destination transportation, none of which are acquisition costs. Inventory objective (630 missiles) is predicated on the availability of a follow-on TRIDENT II missile in 1989.

2/ Excludes Backfit costs, which are reported in the Descriptive Summary for Program Element 11221N.

3/ Not subject to authorization.

Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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. TRIDENT, building on the success of POLARIS/POSEIDON, provides a counter to the Soviets' continuing build-up of their strategic forces and their improved early warning and Anti-Ballistic Missile defenses. TRIDENT consists of three major systems: Submarine System, Strategic Weapon System, and Integrated Logistic Support System. The principal objectives of the TRIDENT design and development are: (1) survivability in a vigorous, sophisticated anti-submarine warfare environment; (2) high reliability and maintainability, minimizing the frequency of overhauls and reducing their complexity and duration; (3) minimal personnel manning; (4) 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.

(U) RELATED ACTIVITIES: Close coordination is maintained with POSEIDON support included in the Fleet Ballistic Missile System and the Improved Accuracy Program projects, both under Program Element 11221N; the 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. Development benefited from the Air Force managed Advanced Ballistic Reentry System, Program Element 63311F, and required joint participation with the Department of Energy in TRIDENT re-entry vehicle development.

(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; and numerous others. Contractors: Electric Boat Division of General Dynamics Corp., Groton, CT; Lockheed Missiles and Space Company, Sunnyvale, CA; Charles Stark Draper Laboratory, Cambridge, MA; General Electric Company, Schenectady, NY; General Electric Co., Ordnance Systems, Pittsfield, MA; International Business Machines Corp., Manassas, Va; Hughes Aircraft Company, Fullerton, CA; Westinghouse Electric Corp., Pittsburgh, PA; Westinghouse Electric Corp., Sunnyvale, CA; RCA, Camden, NJ; Sperry Systems Management Division, Great Neck, NY; and numerous others.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Full scale C-4 Missile Development Flight Test Program was completed in July 1979. The C-4 missile was initially deployed on a backfitted POSEIDON Submarine in October 1979. The first TRIDENT submarine conducted sea trials June 1981 - September 1981, and demonstrated successful performance of all systems. Development efforts to support submarine deployment included Command and Control System evaluation, hardware procurement, software development and engineering integration, including system level test and evaluation at the Land Based Evaluation Facility, battery life testing, towed buoy antenna testing, integrated radio room full scale prototype fabrication, propulsion component long term evaluation, development of propulsion plant testing, operating and maintenance procedures and development of nuclear refueling procedures and class improve-

Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

ment program. U.S. Naval Submarine Base, Bangor, which will support the first squadron of TRIDENT submarines, was developed, and transferred to the command of Commander-in-Chief, U.S. Pacific Fleet in July 1981. Kings Bay, Georgia was selected as the site for an East Coast TRIDENT base, and planning and design work commenced.

2. (U) FY 1982 Program: Accept delivery of and deploy lead TRIDENT ship. Continue test and development in the areas of propulsion, system test and evaluation, command and control communications design and component improvement and continue TRIDENT modernization program efforts. Continue design and development efforts for the East Coast TRIDENT base. Effort necessary for deployment of the C-4 missile aboard a TRIDENT submarine will be completed, and efforts will continue to investigate improvements to counter potential C-4 missile system vulnerabilities or increase system effectiveness. An approximately three and one-half year readiness posture for MK-500 evader operational capability will be attained for the advanced evader by early CY 1982 and effort will continue to improve MK 500 penetration capability.

3. (U) FY 1983 Planned Program: Continue test and development in areas of propulsion and system test and evaluation. Continue TRIDENT modernization program and development of East Coast TRIDENT Base. Continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness. Maintain an approximate 3 1/2 years readiness posture to MK-500 operational capability and continue to improve penetration capability against advanced anti-ballistic missile systems. 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.

4. (U) FY 1984 Planned Program: Continue development aspects of the TRIDENT Program supporting TRIDENT submarine deployment, engineering and design effort to review and update TRIDENT specifications, TRIDENT modernization program, and East Coast TRIDENT Base development efforts. Maintain readiness posture for MK 500 operational capability and exercise engineering disciplines necessary to confirm maintenance of C-4 compatibility. Continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilites or increase system effectiveness.

5. (U) Program to Completion: An approximate 3 1/2 years readiness posture to acquire a MK-500 Evader operational capability will be maintained. Periodic participation (about once every fifteen months) of the MK-500 vehicle aboard C-4 missile flights-of-opportunity will exercise the engineering disciplines necessary to confirm maintenance of C-4 compatibility and to maintain critical vendor support. The flight tests will also provide a mechanism to test minor modifications to the evader vehicle that will keep the concept viable against a changing spectrum of enemy defensive threats. Development aspects of the TRIDENT submarine program which support TRIDENT submarine deployment will continue. Engineering and design effort to review and update TRIDENT specifications will continue as well as East Coast Submarine Support Base and TRIDENT modernization program efforts.

Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

6. (U) Milestones:

a. (U) TRIDENT I Missile System	Date
(1) Commence Program Planning Phase	10/71
(2) Technical Program Approval (Defense Systems Acquisition Review Council, Phase II)	3/74
(3) Missile Production Approval (Defense Systems Acquisition Review Council, Phase III)	12/76
(4) Operational Availability Date (Backfit into POSEIDON Configured SSBN)	10/79
(5) Initial Operational Capability Aboard TRIDENT Submarine (3/82)*	9/82

* Date shown in FY 1982 Descriptive Summary. Date Change caused by delay in delivery of lead TRIDENT Submarine. Delivery occurred in October 1981. Initial Operational Capability occurs eleven months after delivery.

b. (U) TRIDENT Submarine System	Date
(1) TRIDENT Decision Coordinating Paper approved	9/71
(2) Submarine baseline design completed	3/72
(3) Secretary of Defense Approval for full scale development (Defense Systems Acquisition Review Council, Phase II)	12/72
(4) Completed submarine contract design	5/73
(5) Award lead submarine construction contract	7/74
(6) Approval for production (Defense Systems Acquisition Review Council, Phase III)	10/74
(7) Award construction contract for second and third submarines	2/75
(8) Award construction contract for fourth submarine	2/76
(9) Conceptual goals identified	8/76
(10) Award construction contract for fifth submarine	6/77
(11) Start concept formulation	9/77
(12) Award construction contract for sixth and seventh submarines.	2/78
(13) Award construction contract for eighth submarine	1/81
(14) Final Site Selection - East Coast Base	10/80

Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

		Date
(15) Contract delivery date - lead submarine	(4/79)*	10/81 1/
(16) Delivery of lead submarine		10/81 1/
(17) Award construction contract for ninth submarine		1/82
(18) Initial Operational Capability		9/82 2/

* Date shown in FY 1982 Program Element Descriptive Summary.
1/ Contract modification of August 1981 revised contract delivery date to 10/81. Delivery occurred 10/81.
2/ Initial Operational Capability occurs eleven months after delivery.

Project: B0003
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: The TRIDENT I Strategic Weapon System provides and supports a new technology, longer range missile, designated C-4, with accuracy and effectiveness at longer range comparable to that of the POSEIDON (C-3) missile at half that range. This greater range capability of the C-4 missile significantly expands the ocean operating areas available, thereby enhancing the survivability of TRIDENT Fleet Ballistic Missile Submarines. The C-4 missile has already deployed in backfitted POSEIDON Fleet Ballistic Missile Submarines, opening additional ocean areas for their operations. The TRIDENT I Strategic Weapon System is comprised of five subsystems; the missile, missile guidance, launcher, missile fire control, and navigation. The C-4 development flight test program consisted of twenty-five test launches. Eighteen of these tests were development missiles (C-4X) flown from flat pads ashore into calibrated impact areas. Seven Performance Evaluation Missiles were launched from a submarine to demonstrate the ability of the production process to produce missiles which conformed to the tactical design disclosure package and which met 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 now being used in the tactical production program. Performance Evaluation Missiles were flown from a backfitted POSEIDON submarine, demonstrating underwater launch capability and proofing the design for backfitting POSEIDON fleet ballistic missile submarines to carry C-4 missiles. Concurrent with and included in TRIDENT I development is the advanced development of an evader maneuvering re-entry vehicle, designated MK-500. The evader is designed to perform pre-programmed evasive maneuvers during the final stages of re-entry. In combination with suitable penetration aids, the evader could be deployed, if necessary, to counter a broad spectrum of potential ballistic missile defenses.

(U) RELATED ACTIVITIES: TRIDENT I development has been implemented in conjunction with the TRIDENT Submarine System, Program Element 11228N, and in close coordination with POSEIDON support included in the Fleet Ballistic Missile System and Improved Accuracy Program projects, both under Program Element 11221N. Development benefited from the Air Force managed Advanced Ballistic Re-entry System Program and required joint participation with the Department of Energy in TRIDENT re-entry vehicle development.

(U) WORK PERFORMED BY: In-House: Naval Surface Weapons Center, Dahlgren, VA; Pacific Missile Test Center, Point Mugu, CA; Eastern Space and Missile Center, Cocoa Beach, FL; and others. Contractors: Lockheed Missiles and Space Company, Sunnyvale, CA; General Electric Co., Ordnance Systems, Pittsfield, MA; Westinghouse Electric Corporation, Sunnyvale, CA; Sperry Systems Management Division, Great Neck, NY; Interstate Electronics Corporation, Anaheim, CA; Charles Stark Draper Laboratory, Cambridge, MA; Automation Industries, Inc., Vitro Laboratories Division, Silver Spring, MD; Applied Physics Laboratory, Johns Hopkins University, Lauel, MD; Kaman Sciences Corporation, Colorado Springs, CO; and others.

Project: B0003
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT I
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Full scale C-4 missile development flight test program was completed in July 1979. The C-4 Missile was initially deployed on a backfitted POSEIDON submarine in October 1979. An advanced development phase to demonstrate TRIDENT I/MK-500 Evader compatibility on C-4X missile development flight tests was conducted. Effort started in FY 1979 on design modifications to improve the MK-500 penetration capability against advanced anti-ballistic missile systems, and to attain and maintain a posture of readiness to acquire and deploy an operational MK-500 capability in a shorter than normal engineering development and acquisition time span.

2. (U) FY 1982 Program: Support effort necessary for deployment of the C-4 missile aboard a TRIDENT submarine will be completed. Effort to provide the Pacific Missile Test Center with the capability to support a C-4 Follow-on Operational Test program will be continued. Investigation of improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness is being conducted. An approximate 3 1/2 year readiness posture to MK-500 evader initial operational capability for the advanced evader will be attained by early CY 1982. Upgraded evader performance will be demonstrated and effort to improve penetration capability against anti-ballistic missile systems continues.

3. (U) FY 1983 Planned Program: Continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness. Maintain an approximate 3 1/2 year readiness posture to MK-500 operational capability. Continue to improve MK 500 penetration capability and exercise engineering disciplines necessary to confirm maintenance of C-4 compatibility and to maintain critical vendor support.

4. (U) FY 1984 Planned Program: Maintain readiness posture to MK-500 operational capability and exercise disciplines necessary to confirm maintenance of C-4 compatibility. Continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness.

5. (U) Program to Completion: An approximate 3 1/2 year readiness posture to acquire a MK-500 evader operational capability will be maintained. Periodic participation (about once every fifteen months) of the MK-500 vehicle aboard C-4 missile flights-of-opportunity will exercise the engineering disciplines necessary to confirm maintenance of C-4 compatibility and to maintain critical vendor support. The flight tests will also provide a mechanism to test minor modifications to the evader vehicle that will keep the concept viable against a changing spectrum of enemy defensive threats. An ongoing effort will continue to investigate improvements to counter potential TRIDENT I Strategic Weapon System vulnerabilities or increase system effectiveness.

Project: B0003 Title: TRIDENT I
Program Element: 11228N Title: TRIDENT I
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

6. (U) Milestones:

	Milestone	Date
a.	Commence Program Planning Phase	10/71
b.	Technical Program Approval (Defense Systems Acquisition Review Council, Phase II)	3/74
c.	Missile Production Approval (Defense Systems Acquisition Review Council, Phase III)	12/76
d.	Operational Availability Date (Backfit into POSEIDON configured Submarine)	10/79
e.	Initial Operational Capability Aboard TRIDENT Submarines (3/82)*	9/82

* Date shown in FY 1982 Descriptive Summary. Date change caused by delay in delivery of lead TRIDENT Submarine.

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
B0003	TRIDENT I Missile System	26,047	41,471	36,248	38,641	Continuing	Continuing

Project: B0003 Title: TRIDENT I
Program Element: 11228N Title: TRIDENT I
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) TEST AND EVALUATION DATA:

1. (U) Development Test and Evaluation: 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:

MAJOR SUBSYSTEM	CONTRACTORS/AGENCIES
Missile System	Lockheed Missiles and Space Company (Prime)
Missile Propulsion	Hercules, Inc. and Thiokol (Joint venture) (Subcontractors to Lockheed Missiles and Space Company)
MK-500 Evader (Advanced Development)	General Electronic Company, Reentry and Environmental Systems Division (Subcontractor to Lockheed Missile and Space Company)
Guidance	C.S. 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

The path of development followed closely those of the POLARIS and POSEIDON programs. Steps have been taken to increase the probability that the desired TRIDENT I missile flight reliability will be achieved in production hardware before substantial numbers of missiles are deployed. 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 POSEIDON 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.

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 as 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 test was conducted.

Project: B0003
Program Element: 1122[illegible]
DoD Mission Area: 11[illegible] - Sea Based Strike

Title: TRIDENT I
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

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 the Space and Missile Test Center, Detachment 1, Cape Canaveral, 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 500 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 ability of the reentry bodies to survive reentry conditions and perform as specified, were specific examples of the items evaluated on C-4X flights.

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 monitored development testing.

2. (U) Operational Test and Evaluation. The initial operational assessment of the TRIDENT I Strategic Weapons System was conducted in conjunction with the Development Test and Evaluation 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. The objective of the Demonstration and Shakedown Operation program is to demonstrate the readiness of the TRIDENT Strategic Weapon System and its crew for deployment. In addition, this program 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. Demonstration and Shakedown Operation missile firings from backfitted POSEIDON Fleet Ballistic Missile Submarines commenced in August 1979 and seven missiles have been fired to date.

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Project: B0004 Title: TRIDENT Submarine System
Program Element: 11228N Title: TRIDENT I
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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. TRIDENT, building on the success of POLARIS/POSEIDON, provides a counter to the Soviets' continuing build-up of their strategic forces and their improved early warning and anti-ballistic missile defenses. TRIDENT consists of three major systems: submarine system, strategic weapon system, and integrated logistic support system. The principal objectives of the TRIDENT submarine design and development are: (1) survivability in a vigorous, sophisticated anti-submarine warfare environment; (2) high reliability and maintainability, minimizing the frequency of overhauls and reducing their complexity and duration; (3) minimal personnel manning; (4) 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. The TRIDENT submarine design provides for 24 missile launch tubes. Principal submarine characteristics are: speed (submerged), about __ knots; hull length, 560 feet; hull diameter (maximum beam), 42 feet; maximum navigational draft, 36.2 feet; maximum operating depth, _ ; crew of 15 officers and 142 enlisted; endurance, 90 days with 70 day patrols; 18 day refit periods plus 7 day turnaround period; overhaul of 12 months duration at intervals of not less than 9 years.

(U) RELATED ACTIVITIES: Close coordination is maintained with POLARIS/POSEIDON support included in the Fleet Ballistic Missile System and the Improved Accuracy Program projects, both under Program Element 11221N; the SSN 688 Class Attack Submarine, Program Element 24281N; SSBN Security, Program Element 11224N; Extremely Low Frequency (ELF) Communications, Program Element 11401N; and Navy Strategic Communications, Program Element 11402N. The TRIDENT I Missile System Project, Program Element 11228N/B0003, includes a new ballistic missile which will be carried by the TRIDENT submarine.

(U) WORK PERFORMED BY: In-House: TRIDENT System Project Office (Project Management), Washington, D.C.; Naval Sea Systems Command, Washington, DC; Strategic System 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; and numerous others. Contractors: Electric Boat Division of General Dynamics Corp., Groton, CT; General Electric Company, Schenectady, NY; International Business Machines Corp., Manassas, VA; Hughes Aircraft Company, Fullerton, CA; Westinghouse Electric Corp., Pittsburgh, PA; RCA, Camden, NJ; Singer Librascope, Glendale, CA; and numerous others.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: (Effort funded under Program Element 11228N). Established submarine baseline physical parameters and completed baseline and contract design and detailed specifications. The propulsion plant and nuclear reactor were designed, developed, and test and evaluation and qualification of maintenance procedures commenced. Development of nuclear refueling procedures commenced. The battery was designed, developed, and successfully completed life cycle testing. Navigation and missile system testing was conducted. Development testing of the carbon dioxide scrubber, carbon monoxide/hydrogen burner,

Project: 80004 Title: TRIDENT Submarine System
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and ship control station was completed. Testing of shock test vehicle for TRIDENT submarine hull penetrators commenced, and first three stages of testing completed. Command and Control System elements (defensive weapons system, sonar, and integrated radio room) were designed, developed, and engineering and integration testing conducted. Command and Control System configuration was updated with data acquired from shipboard phased testing. The Command and Control System was certified in 1980, and performed successfully during sea trials in 1981. The towed buoy antenna was fully installed on the lead ship, and performed successfully during sea trials. The lead ship was launched on 7 April 1979, and conducted sea trials June-September 1981, demonstrating successful performance of all ship systems. Installed aid to navigation system for the CABOB Bay Range. Developed and established Naval Submarine Base, Bangor, Washington, and transitioned base to major claimancy of Commander-in-Chief, U.S. Pacific Fleet in July 1981. Commenced development efforts to establish an East Coast Submarine Base. Kings Bay, Georgia was selected as preferred alternative site in October 1980, and planning and design effort commenced. A TRIDENT Modernization Program to develop an orderly and deliberate upgrade of the Command and Control System to meet emergent operational requirements and to keep pace with known and projected improvements in threat capabilities was established.

2. (U) FY 1982 Program: Lead ship will be delivered and deployed. Second ship will complete shipyard testing, conduct sea trials, and be delivered in September 1982. Third ship launched/christened in November 1981. Efforts to support deployment of follow-on ships will continue. Continue test and development in the areas of propulsion system, command, control and communications, TRIDENT design and component improvement, and establishment of East Coast TRIDENT Base.

3. (U) FY 1983 Planned Program: Deliver third ship; deploy second ship. Test and development in the areas of propulsion system, command, control and communications, TRIDENT design and component improvement will continue. TRIDENT Modernization Program and East Coast TRIDENT Base development efforts will continue.

4. (U) FY 1984 Planned Program: Major efforts in FY 1984 include test and development, TRIDENT Modernization Program, and East Coast TRIDENT Base development. Fourth ship will deliver, and third ship will deploy.

5. (U) Program to Completion: Continue development aspects of the TRIDENT submarine program supporting TRIDENT submarine deployment, engineering and design effort to review and update TRIDENT specifications, TRIDENT Modernization Program, and East Coast TRIDENT Base development efforts.

6. (U) Milestones:

	Milestone	Date
a.	TRIDENT Decision Coordinating Paper approved	9/71
b.	Submarine baseline design completed	3/72

Project: B0004 Title: TRIDENT Submarine System
Program Element: 11228N Title: TRIDENT I
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

	Milestone	Date
c.	Secretary of Defense approval for full scale development (Defense Systems Acquisition Review Council, Phase II)	12/72
d.	Complete submarine contract design	5/73
e.	Award lead submarine construction contract	7/74
f.	Approval for production (Defense Systems Acquisition Review Council, Phase III)	10/74
g.	Award construction contract for second and third submarines	2/75
h.	Award construction contract for fourth submarine	2/76
i.	Conceptual goals identified	8/76
j.	Award construction contract for fifth submarine	6/77
k.	Start concept formulation	9/77
l.	Award construction contract for sixth and seventh submarines.	2/78
m.	Award construction contract for eighth submarine	1/81
n.	Final Site Selection - East Coast Base	10/80
o.	Contract delivery date lead submarine (4/79)*	10/81 1/
p.	Delivery lead submarine	10/81 1/
q.	Award construction contract for ninth submarine	1/82
r.	Initial Operational Capability	9/82 2/

* Date shown in FY 1982 Program Element Descriptive Summary.
1/ Contract modification of August 1981 revised delivery date to 10/81. Delivery occurred 10/81.
2/ Initial Operational Capability occurs eleven months after delivery.

7. (U) Resources:)

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
B0004	TRIDENT Submarine System	50,248	60,479	54,317	98,440	Continuing	Continuing

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

(U) TEST AND EVALUATION DATA: 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: 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 _ sonar dome in lieu of 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 was 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.

Project: B0004 | Title: TRIDENT Submarine System
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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 indicate the Logistics/Escape Trunk met the goal of [redacted] shock factor. A failure of the lower hatch hinge bolts (an SSN 688 Class design) at [redacted] shock factor 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 redisigned hower hatch assembly. Results of the retests were satisfactory.

2. (U) Operational Test and Evaluation: 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/Escape Trunk):

Characteristics	Objectives: Threshold	Objectives: Goal	Demonstrated Performance
Maintaining structural integrity of Logistics/ Escape Trunk following shock factor of:	[redacted]	[redacted]	[redacted] (Preliminary assessment)

B. (U) Acoustic Quieting: 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. A contract for fabrication of at least two valves was awarded December 1975 to Vorias, Middletown, Massachusetts. The production valves were delivered to the shipbuilder in January 1977.

b. (U) Torpedo Turbine Pump Ejection System - Testing of the prototype was accomplished at the Naval Underwater Systems Center, Newport, Rhode Island, 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 on the first TRIDENT submarine. The third and fourth units have also been delivered. The third unit was used on the second TRIDENT. The fourth unit will be used as a major shore spare.

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Title: TRIDENT Submarine System
Title: TRIDENT I
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2. (U) Operational Test and Evaluation: (a) *Initial Operational Test and* Evaluation of the Torpedo Turbine Pump Ejection System was conducted concurrently with Development Testing Phase IIIB at the Naval Underwater Systems Center, Newport, between September 1976 and March 1977. Based on demonstrated performance, Commander, Operational Test and Evaluation Force concluded that Torpedo Turbine Pump Ejection System has the potential to be operationally effective and operationally suitable. (b) Follow-on Operational Test and Evaluation is being conducted by Commander, Operational Test and Evaluation Force on the lead ship. This testing has been combined with Production Acceptance Test and Evaluation, "Acoustic Trials" and other pre-deployment schedule events.

3. (U) System Characteristics: The acoustic quieting goal for the TRIDENT design is:

Characteristic	Goal	Demonstrated Performance
Radiated Noise at 5 knots (measured in 1/3 octave bands)	Equivalent to [redacted]	Not yet demonstrated

Specific equipment objectives are:

Characteristics	Objectives: Threshold	Objectives: Goal	Demonstrated Performance
Hovering System Four-Way Valve			
Structureborne Noise Level	≤ Acoustic quieting goal	< MIL-STD 740 B as modified by TRIDENT Shipbuilding Specifications under any normal operating conditions.	Threshold requirements have been demonstrated
Torpedo Turbine Pump Ejection System			
Structureborne Noise Level	≤ Ram pump levels based on land based test site data	At least 10dB better than *Ram Pump System* based on land based test site data	The peak structureborne noise is [redacted] lower than the ram pump depending on the accelerometer location.

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DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

II. (U) COMMAND AND CONTROL SYSTEM: The TRIDENT Command and Control System 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, MK 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/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 designated equipments.
- To maintain receipt of strategic communications and to communicate with other fleet units as required.

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,
- MK 118 Fire Control System, and
- Integrated Radio Room.

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 at Naval Underwater Systems Center, Newport. Extensive integration testing is being conducted to verify software and hardware compatibility and to demonstrate specified performance prior to installation in the lead submarine. Command and Control System Engineering and Integration is being accomplished by the Command and Control System Engineering and Integration contractor (Electric Boat Division/International Business Machines). Integrated Land Based Evaluation Facility testing commenced in 1976 with Commander, Operational Test and Evaluation Force participation. Integrated testing has been completed through Command and Control System Revision 3, and the Command and Control System (Revision 2.1) has been installed in the lead TRIDENT submarine. Further operational evaluation will be conducted at sea during shakedown of the lead ship. Command and Control System Revision 3 is scheduled for installation on the lead TRIDENT Submarine during Post Shakedown Availability (PSA).

A. (U) AN/BQQ-6 Sonar System: 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.

Project: B0004 Title: TRIDENT Submarine System
Program Element: 11228N Title: TRIDENT I
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

1. (U) Development Test and Evaluation: All units of the AN/BQQ-6 Sonar are required to undergo Development Test and Evaluation. 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)

In-plant Development Test and Evaluation has been completed at International Business Machines, Manassas, Virginia, on all AN/BQQ-6 hardware scheduled for installation in the first two TRIDENT submarines. The in-plant portion of Development Test and Evaluation did not uncover any significant design problems. The AN/BQQ-6 production system, less sensors, is undergoing 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, and the AN/BQQ-6 (Command and Control System Revision 2.1) has been installed in the lead TRIDENT submarine. The AN/BQQ-6 (Command and Control System Revision 3) is being installed on the second TRIDENT submarine. Command and Control System Revision 3, which contains a sonar software revision, is scheduled for installation on the lead TRIDENT Submarine during Post Shakedown Availability.

2. (U) Operational Test and Evaluation:

a. (U) Initial Operational Test and Evaluation has been conducted by Commander, Operational Test and Evaluation Force in combination with Development Test and Evaluation at the Land Based Evaluation Facility in order to certify Command and Control System Revision 2.1 and its subsystems, particularly the AN/BQQ-6 sonar, ready for installation in the lead ship. The system tested was the complete lead ship sonar, except for external arrays and transducers. Initial results of testing completed in June 1978 indicated than 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. The AN/BQQ-6 has been installed in the lead TRIDENT.

Project: B0004
Program Element: 1122RN
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

b. (U) Integrated testing of sonar software revision 4, which is a part of Command and Control System Revision 3, has been completed at the Land Based Evaluation Facility and reported by Commander, Operational Test and Evaluation Force message 031520Z NOV 80. Commander, Operational Test and Evaluation Force concluded that the AN/BQQ-6 Revision 4 sonar demonstrated the potential for operational effectiveness and operational suitability. Additional conclusions were:

- Most previous deficiencies were corrected.
-
-
- AN/BQQ-6 sonar effectiveness was reduced by newly reported deficiencies.
- Documentation, although improved, lagged system development.

Commander, Operational Test and Evaluation Force recommended correction of deficiencies relating to the following areas:

-
-
- [ ]
-
- Documentation;

and installation of the corrected AN/BQQ-6 software revision on the lead TRIDENT submarine at Post Shakedown Availability.

c.(U) Follow-on Operational Test and Evaluation will be conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and concurrent with scheduled operations.

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 goes to sea.

3. (U) System Characteristics: The following definitions are used in the specification of the Required Technical Characteristics:

a. (U) Software Failure - Occurrence of one of the following:
- Loss of most recent five minutes of passive broadband intermediate time average data history.
- 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 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.

Project: B0004
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e. (U) Figure of Merit - 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 GOALS" are based on sonar performances of specified sonar arrays, under specified operating modes at specified frequencies against a submarine threat (as described in Figure 1 of enclosure (2) to Naval Underwater Systems Center secret letter SA111-S539 of 30 July 1975). "Figure of Merit GOAL" values are indicative of system performance expected under in-plant test conditions using test stimulators to provide inputs to the system. Based on in-plant system certification, the Figure of Merit GOAL values have been met.

2. (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. "Figure of Merit THRESHOLD" values were obtained by reducing the corresponding "Figure of Merit GOAL" values by that amount considered necessary to account for the expected at-sea conditions.

3. (U) Opposite each listed Figure of Merit is the range expected if the [redacted] threat (as described in Figure 1 of enclosure (2) of the Naval Underwater Systems Center reference cited above) were running in the North Atlantic, with the detecting array at [redacted] 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.

Objectives

Characteristics	Threshold	Goal	Demonstrated Performance
Figure of Merit(decibels)	Figure of Merit(decibels)/ Range (kyd)	Figure of Merit(decibels)/ Range (kyd)	The Figure of Merit (decibels) goals have been achieved based on in-plant subsystem certification. 1/ Data for validation of Figures of Merit of the ship installed system will be collected during sonar certification and at other opportunities during predeployment.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

Objectives

Characteristics	Threshold	Goal	Demonstrated Performance
Passive Broadband Detection			
Spherical Array		2/	
Towed Array		2/	
Passive Broadband Tracking			
Spherical Array			
Towed Array			
Passive Narrowband Detection			
Spherical Array			
Towed Array		2/	
Passive Narrowband Tracking			
Spherical Array			
Towed Array			
Classification			
Spherical Array			
Towed Array		2/	
Reliability and Maintainability			
Hardware			
Mean Time Between Failure			
Passive Broadband			3/
Passive Narrowband			3/
Active Emission Detection			3/
Mean Time to Repair			4/

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

Characteristics	Objectives: Threshold	Objectives: Goal	Demonstrated Performance
Software			
Mean Time Between Failure			5/
Mean Time to Fault			5/
Mean Time to Repair			
Failure			
Fault			

1/ See AN/BQQ-6 System Design Certification Test Reports, IBM Document Numbers 76-916-019 through 76-916-028, April through July 1976.
2/ In addition to the direct path range given in the above table, achieving the goal Figures of Merit will permit acquiring the specified target in the first convergence zone for the specified environmental conditions.
3/ See IBM Document Number 77-E02-022 dated 15 March 1977; Reliability, Test, and Demonstration Report.
4/ See IBM Document Number 76-A71-023 dated 22 December 1976; AN/BQQ-6 Maintainability Demonstration Test Report.
5/ See IBM Document Number 78-916-002 dated 31 January 1977; Final Report, Software Reliability Demonstration.

B. (U) MK 118 Fire Control System. The MK 118 Modification 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 are used for its required computation, display generation, data storage and data retrieval functions. Standard Information Displays provide the system with interactive Cathode Ray Tube display capabilities. An Attack Control Console MK 92 Modification 1 indicates status and directs the firing of the Torpedo MK 48 Modification 1 and countermeasures devices. Two bearing and Range Indicators MK 116 Modification 0 provide remote display of selected data for command information. A Weapon Launch Console MK 96 Modification 0 provides the interface and conversion capabilities to pre set and control the Torpedo MK 48 Modification 1 and the Mobile Submarine Simulator MK 57 Modification 0.

The MK 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, both manually assisted and automatic.
- Perform weapons and countermeasures control.
- Perform defensive coordination.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

1. (U) Development Test and Evaluation:

a. (U) All units, including software, of the MK 118 Fire Control System are required to undergo the Development Test and Evaluation program specified by MIL-E-16400. The in-plant Development Test and Evaluation effort did not uncover any significant design problems.

b. (U) MK 118 Fire Control System integration testing at the Land Based Evaluation Facility has been completed for the first two TRIDENT submarines and is in progress for the third. Installation has been completed on the first submarine and is in progress for the second. Integrated testing of a MK 118 Fire Control System software revision, which is part of Command and Control System Revision 3, has been completed at the Land Based Evaluation Facility and is scheduled for installation on the lead TRIDENT submarine during Post Shakedown Availability.

2. (U) Operational Test and Evaluation:

a. (U) Initial Operational Test and Evaluation has been conducted by Commander, Operational Test and Evaluation Force in combination with Development Test and Evaluaation at the Land Based Evaluation Facility in order to certify Command and Control System Revision 2.1 and its subsystems, particularly the MK 118 Fire Control System, ready for installation in the lead ship. The System tested was the complete lead ship Fire Control System.

b. (U) Integrated testing of MK 118 Fire Control System software Revision 2, which is part of Command and Control System Revision 3, has been completed at the Land Based Evaluation Facility and reported by Commander, Operational Test and Evaluation Force message 031520Z NOV 80. Commander, Operational Test and Evaluation Force concluded that the MK 118 Fire Control System demonstrated potential for operational effectiveness and operational suitability. Additional conclusions were:

- Most of the previous deficiencies were corrected,
- MK 118 Fire Control System Revision 2 supports mission-oriented functions but newly reported deficiencies reduced its effectiveness,
- Documentation, although improved, lagged system development.

Commander, Operational Test and Evaluation force recommended correction of deficiencies relating to the following areas:

- Ekelund ranging,
- Fuel remaining calculations,
-
-
-
- Documentation;

and installation of the corrected MK 118 Fire Control System software revision in the lead TRIDENT submarine at Post Shakedown Availability.

c. (U) Follow-on Operational Test and Evaluation is being conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and concurrent with scheduled operations.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

3. (U) System Characteristics: The Required Technical Characteristics for the fully operational state of the MK 118 Fire Control System are:

Characteristics	Objectives: Threshold	Objectives: Goal	Demonstrated Performance 1/
Contact Motion Analysis			
Range, course and speed solution	simultaneous contacts	simultaneous contacts	simultaneous contacts
Position keeping (continuous tracking capability)	simultaneous contacts	simultaneous contacts	simultaneous contacts
Independent methods of bearings only contact motion analysis	methods	methods	methods
Weapons and Countermeasure Control			
Torpedo remote set and fire	[redacted]	[redacted]	Thresholds have been demonstrated by subsystem tests.
Wireguide Torpedoes 2/	simultaneously	simultaneously	Thresholds and goal have been demonstrated by subsystem tests.
Remote launch countermeasures from MK 118 Fire Control System	Two 3" countermeasures	Two 3" countermeasures; Eight external countermeasures	Threshold and goal objectives have been demonstrated by subsystem simulation test. 3/
Remote set and fire Mobile Submarine Simulator from MK 118 Fire Control System	Set pre-sets and fire	Set pre-sets, display pre-set tracks and fire	Threshold and goal objectives have been demonstrated by subsystem simulation test. 3/

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

Objectives

Characteristics	Threshold	Goal	Demonstrated Performance 1/
Defensive Coordination			
Hostile torpedo defense			
Reaction time to release first 3-inch countermeasure after firing circuit activated. (Assume tubes loaded, additional devices in 30 second intervals)	15 seconds	10 seconds	Will be demonstrated during at-sea test.
Status of Launchers	Display status of all torpedo tubes	Display status of torpedo tubes, 3" and external countermeasure launchers	Thresholds have been demonstrated by subsystem tests. 3/
Hardware 4/			
Reliability (Failure) 5/			
Contact Motion Analysis			
Generate Target Position			
Weapon Order Generation			
Software 7/ 8/ 9/			
Mean Time between failure			
Mean Time to fault			
Mean Time to repair			
Failure			
Fault			

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

1/ See Defensive Weapon System/Combat System Design Certification Test Report IBM-78-T52-012 dated 20 October 1978.
2/ It is not specifically required that two torpedoes be wireguided at sea to demonstrate this capability.
3/ See Defensive Weapon System/Combat System Design Certification Test Report IBM-78-T52-012 dated 20 October 1978. Additional validation will be obtained during at-sea Combined Operability Test.
4/ Hardware reliability is defined as the reliability of the Fire Control System hardware only (not the Data Processing System).
5/ Probability of performing the function for a period without an interruption caused by a hardware failure.
6/ See Standard Information Display Failure/Malfunction Report dated 30 November 1979 and Attack Control Console MK 92/Weapon Launch Console MK 96 Failure/Malfunction Report dated 5 November 1979.
7/ Software failure is defined as a MK 118 Fire Control System degradation resulting in loss of greater than five minutes of the 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/ Software fault is defined as a MK 118 Fire Control System degradation without loss of more than the most recent five minutes of target, solution, and Weapon Order Generation data. A Checkpoint 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.
9/ See Defensive Weapon System/Combat System Software Reliability Test Report, IBM-78-T52-008 dated 25 September 1978.

C. (U) Integrated Radio Room. The AN/BSC-1 Integrated Radio Room 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 including antenna control and switching;
2) Very Low Frequency/Low Frequency equipments;
3) Data Switching equipments;
4) High Frequency/Ultra High Frequency equipments;
5) Control, Monitor, and Test functions including the control and message processors; and
6) Support equipments.

The Integrated Radio Room is a principal component of the TRIDENT Exterior Communications system which also includes the Integrated Submarine Communications Antenna system. 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.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

1. (U) Development Test and Evaluation: The Integrated Radio Room completed the three phases of developmental testing at Radio Corporation of America, Camden, New Jersey, and Springfield, Virginia (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.

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 lead TRIDENT submarine. Additional Development Test and Evaluation for deficiency corrections and verification of additional modifications will occur on follow ship-set Integrated Radio Rooms being sequenced through the Land Based Evaluation Facility. This deficiency correction will continue through lead ship Post Shakedown Availability to support implementation of changes prior to first patrol. Testing will include certification of revision packages of deficiency corrections that will be available for lead ship implementation prior to deployment.

2. (U) Operational Test and Evaluation:

a. (U) Initial Operational Test and Evaluation of the AN/BSC-1 Integrated Radio Room was conducted concurrent 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 Revision 2 was conducted from September to November 1980 and reported by Commander, Operational Test and Evaluation Force message 191905Z DEC 80. Commander, Operational Test and Evaluation Force concluded that Integrated Radio Room Revision 2

Commander, Operational Test and Evaluation Force recommended:

- Installing Integrated Radio Room Revision 2 in the TRIDENT submarine,
- Prior to deployment;
  - -- provide Integrated Radio Room Revision 2 operating procedures and adequate technical manuals, and
  - -- conduct additional operational testing at sea to determine operational effectiveness, and
- Correct the remaining reported deficiencies and test at the Land Based Evaluation Facility.

c. (U) Follow-on Operational Test and Evaluation will be conducted by Commander, Operational Test and Evaluation Force on the lead ship during its predeployment period and concurrent with scheduled operations.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

3. (U) System Characteristics: The Required Technical Characteristics for the fully operational state of the Integrated Radio Room are:

Characteristics	Threshold	Objectives	Goal	Demonstrated Performance
Communication Capabilities				
Very Low Frequency/Low Frequency/ LORAN Capability				Demonstrated goal performance.
Very Low Frequency Anti-Jam Capability				Demonstrated goal performance at Land Based Evaluation Facility.
Very Low Frequency/Low Frequency Availability				Exceeds goal due to system redundancy
Medium Frequency/High Frequency Capability				Demonstrated goal performance at Land Based Evaluation Facility.

Project: B0004
Program Element: 11228N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT Submarine System
Title: TRIDENT I
Budget Activity: 3 - Strategic Programs

Characteristics	Objectives: Threshold	Objectives: Goal	Demonstrated Performance
Ultra High Frequency Capability	[redacted]	[redacted]	Demonstrated goal performance at Land Based Evaluation Facility.
Maintainability (Mean Time to Repair) 1/ (Decision Coordinating Paper 67 states that mean time between failure does not apply because of system redundancy.)			

1/ Maintainability includes Integrated Radio Room hardware only and excludes the Antenna System. Software maintainability is not defined.

III. (U) PROPULSION/ELECTRICAL SYSTEM: The TRIDENT submarine propulsion plant consists of:

Reactor Plant - The TRIDENT submarine reactor plant design is an extension of existing and operationally proven submarine reactor plants.

Steam and Electric Plant - The TRIDENT submarine steam and electric plant will be capable of producing [redacted] Shaft Horsepower.

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).

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FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11401N
DoD Mission Area: 333 - Strategic Communications
Title: Extremely Low Frequency Communications
Budget Activity: 3 - Strategic Programs

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

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	2,478	34,755	49,827	54,262	Continuing	Continuing
X0792	ELF Communications	2,478	34,755	49,827	54,262	Continuing	Continuing

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Extremely Low Frequency communications system will reduce the detectability and enhance the operational effectiveness of U.S. Fleet Ballistic Missile and Attack Submarines by extending the operational envelope in which U.S. submarines can receive communications from a near surface, low speed posture to several hundred feet depth at high speeds. On October 8, 1981, a Presidential decision was received to proceed with ELF communications system deployment in order to make critical improvements in connectivity to the submarine forces. Further, the Navy was requested to provide an initial operating capability in fiscal year 1985.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue full-scale development which includes the development of antenna fault detection devices, ground fault detection devices, low step potential grounds, transmitters, antennas, and receivers. Commence construction of the Michigan site. Continue system evaluation operations and environmental monitoring of the system. The increased FY 1983 funding reflects the amount of effort required 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. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: the decrease of 119 in FY 1982 results from refinement of cost estimates including inflation; the outyear funding changes are due to a change in program scope based on Presidential decision. For FY 1983, the funding is estimated to be 49,827; for FY 1984, 54,262.

Program Element: 11401N
DoD Mission Area: 333 - Strategic Communications

Title: Extremely Low Frequency Communications
Budget Activity: 3 - Strategic Programs

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY (Amended):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	2,478	34,874	TBD	TBD	TBD
X0792	ELF Communications	0	2,478	34,874	TBD	TBD	TBD

(U) OTHER APPROPRIATION FUNDS: None

Program Element: 11401N
DoD Mission Area: 333 - Strategic Communications

Title: Extremely Low Frequency Communications
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: The Extremely Low Frequency communications system is a unique system that is designed to allow constant communications with deployed U.S. Fleet Ballistic Missile and Attack Submarines. Current communication systems used with deployed submarines require them to interrupt their operational maneuvering, ascend to shallow depths, and slow their speed in order to receive communications. The increased threat of detection increases the vulnerability of the strategic submarine force. This project develops a system using extremely low frequency electromagnetic radiation, at low power levels, which can send signals to submarine operating areas and which can penetrate sea water hundreds of feet. Therefore, the submarines can remain at safe operating depths and speeds which enhances their mission effectiveness and greatly reduces the threat of detection. 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 56 miles of overhead antenna. The other site is at the Wisconsin Test Facility near Clam Lake in the Chequamegon National Forest. The Wisconsin site will use its existing 28 miles of overhead antenna 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. This project was the subject of a Presidential decision received on October 8, 1981, in which the SECDEF was directed to proceed with the system in order to make critical improvements in connectivity to the submarine force.

(U) RELATED ACTIVITIES: ELF will be installed in TRIDENT (11228N), FBM (11221N), and Attack (24281N) Submarines.

(U) WORK PERFORMED BY: Contractors: GTE Sylvania, Needham Heights, MA; IIT Research Institute, Chicago, IL; Computer Sciences Corporation, Falls Church, VA; Spears Associates, Inc., Needham, MA; Mission Research Corporation, Santa Barbara, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Basic research on extremely low frequency commenced in 1958. The Wisconsin Test Facility was completed in 1969 to successfully demonstrate that any electromagnetic interference caused by the conceptual SANGUINE system could be mitigated. Prior to 1975 Project SANGUINE completed the Concept Development and Concept Validation phases of the system acquisition cycle. In February 1975 a prime contract was awarded to GTE Sylvania to perform Design Validation of the System. Shortly thereafter the Government decided to abandon the design objective of direct nuclear attack survivability. During the ensuing period of redesign and optimization the system designation was changed from SANGUINE to SEAFARER, and reduced in size. A preliminary design review was successfully completed in November 1977. The full scale development funding for FY 1978 was withheld by Congress and SEAFARER was scaled down to a smaller two-site Austere system in Michigan and Wisconsin. While respecification and redesign efforts were in progress, constraints on FY 1979 funds, due to lack of Presidential decision on the need for the system, resulted in a two-year program hiatus and the release of only minimal funds for caretaker maintenance at the Wisconsin Test Facility. In July 1981, system redefinition work resumed and reactivation work on the Wisconsin Test Facility began.

Program Element: 11401N
DoD Mission Area: 333 - Strategic Communications
Title: Extremely Low Frequency Communications
Budget Activity: 3 - Strategic Programs

2. (U) FY 1982 Program: Full-scale development commences with respect to transmitters, antennas, submarine receivers and all related software. System evaluation operations continue. Survey of the Michigan site begins. A contract was negotiated and awarded to IIT Research Institute for continued interference mitigation and environmental compatibility efforts. Award of a new prime contract with GTE Sylvania for full scale development and system evaluation operations is planned. The award of a follow-on contract with Computer Sciences Corporation for System Engineering and Technical Assistance to the Navy Program Manager is expected.

3. (U) FY 1983 Planned Program: Continue full scale development and system evaluation operation. Commence construction of the Michigan site. Award contract to Mission Research Corporation to conduct electromagnetic pulse survivability test and evaluation is planned. Award several cost contracts to university and industry Laboratories.

4. (U) FY 1984 Planned Program: Continue full scale development, begin producing prototype submarine receivers, complete Wisconsin site upgrade and commence technical evaluation. Continue system evaluation operations. Award of a follow-on contract to IIT Research Institute for continued interference mitigation and environmental compatibility assurance.

5. (U) Program to Completion: This project is scheduled for completion at the end of FY 1987 when it will attain final operational capability. During FY 1985, the following is planned: full scale development terminates; prototype submarine receiver development terminates; shore equipment development and installation terminates; technical and operational evaluation terminates; the system achieves an initial operating capability; and fleet receiver production is initiated. In FY 1986, the Michigan site construction is completed. Environmental and safety development and monitoring and system evaluation operation continue until the project is completed. These latter two efforts continue through FY 1986 and FY 1987. Receiver production is planned to conclude at the end of FY 1986 unless a requirement for a larger number of them is approved.

6. (U) Milestones:

	Event	Date
a.	Develop Environmental Protection Plan	FY 1982
b.	Commence Michigan Site Surveys	FY 1982
c.	Commence Wisconsin Test Facility Improvement	FY 1982
d.	Commence Construction - Michigan	FY 1983
e.	Commence Technical Evaluation	FY 1984
f.	Complete Operational Evaluation	FY 1985
g.	Initial Operational Capability	FY 1985
h.	Complete Michigan Site	FY 1986
i.	Final Operational Capability	FY 1987

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

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

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	99,542	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

(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 anticipated 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, POSEIDON Communications Improvement Program, Integrated Submarine Communications Antenna System, 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue development of TACAMO Improvement Program for improved airborne relay communications. Continue TACAMO electromagnetic effects hardness assurance program; accelerate the development of Electro-magnetic Pulse hardening kits for installation in operational aircraft; accelerate the development of Electromagnetic Pulse hardening assurance techniques and procedures; ensure electromagnetic pulse hardening efforts are transferable to TACAMO replacement airframe (ECX). Continue development of the Dynamic Tuning and High Efficiency Power Amplifiers for fixed very low frequency submarine broadcast sites. Continue with fixed very low frequency program from station upgrade and improvements in the areas of reliability and efficiency. Continue development of the Very Low Frequency system as a part of the overall Survivable/Enduring Communication network. Continue investigation into defining Cryptographic modernization for submarines. Provide systems engineering support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology. Increased funding requirements between FY 1982 and FY 1983 are due to increased efforts on strategic

Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

communications and a new start of Project W1438, ECX. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: an overall decrease of 731 in FY 1981 due to inflation adjustments, distributed by reducing X0793, TACAMO, by 2,400 in order to increase X1083, Shore-to-Ship Communications, by 922 to advance efforts in that area, and to provide 747 to W1438, ECX, to initiate efforts to procure a replacement airframe for the TACAMO mission; and an increase of 2,084 in FY 1982 due to program adjustments and to support initial research and development efforts for the ECX TACAMO replacement aircraft. The FY 1983 funding To Be Determined in the FY 1982 Descriptive Summary is now estimated to be funded at the 69,314 level.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY (Amended):

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENTS	12,287	20,477	22,260	TBD	Continuing	Continuing
X0793	TACAMO	5,129	11,452	13,099	TBD	Continuing	Continuing
X1083	Shore-to-Ship Communications Systems	7,158	9,025	9,161	TBD	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
OPN (PE 11315N)	11,551	6,549	13,290	16,867	Continuing	Continuing
Quantity						
1600 CPS Kits	0	20	13	8		
CP 1071A/WR Processor	13	7	15	80		
Cesium Beam Tubes	20	0	0	0		
Fixed Very Low Frequency Equipment	Var	Var	Var	Var	Continuing	
Cesium Beam Frequency/Time Standards	0	0	10	0		
Submarine Keyboard Printer	0	111	0	0		
Modular Interface Multiplexing and Switching Unit	0	0	0	35		
Medium Frequency/High Frequency Multicouplers	0	0	17	17		

Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

Standard Buoyant Cable Antennas	0	0	17	17	
Data Collection Equipment	31	6	5	Var	Var
Circuit Mayflower Silent Tuner Test Sets	134	0	0	0	
Circuit Mayflower Shore Rehabilitation Systems	0	0	0	5	3

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
APN-4 (PE 11315N)						
EC-130Q Aircraft	44,680	74,600	36,800	0	Continuing	Continuing
Quantity	1	2	0	0	0	
APN-5 (PE 11315N)						
EC-130Q Mod Aircraft	17,131	36,700	62,700	23,900	Continuing	Continuing
Quantity	Var	Var	Var	Var	Continuing	
APN-6 (PE 11351N)						
EC-130Q Mod Aircraft Spares	8,612	7,669	4,259	TBD	Continuing	Continuing
Quantity	Var	Var	Var	Var	Continuing	

Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: Many possible techniques have been investigated for Shore-to-Fleet Ballistic Missile Submarine communications covering the entire frequency spectrum. These have included: extremely low frequency, communication satellites, multiple fixed very low frequency radio stations, multiple fixed phased array very low frequency antenna systems, transportable land mobile very low frequency systems using balloon lifted antennas, very low frequency facsimile systems, underwater acoustic systems, underwater explosive systems, seismic wave signaling techniques, airborne very low frequency (Project TACAMO), shipboard mobile very low frequency, communications superimposed on Long Range Aid to Navigation (LORAN-C) signals (Project PILGRIM), VERDIN very low frequency/low frequency modulation and receiving subsystems, and Navy/Air Force compatible modes for an Enhanced VERDIN systems. Of these systems, Extremely Low Frequency, TACAMO, VERDIN, Enhanced VERDIN, PILGRIM, Very Low Frequency, (fixed/shipboard mobile/transportable land mobile) were selected for further development. Integrated Antenna System and POSEIDON Communications Improvement projects were also initiated. The transportable land mobile very low frequency system was discontinued in 1968 because of a demonstrated lack of all weather capability, but is currently under reconsideration as a survivable asset. Extremely Low Frequency Communications became a separate program element (11401N) in FY 1973. Fixed Very Low Frequency, VERDIN and TACAMO projects are operational. TACAMO aircraft are an integral part of the Minimum Essential Emergency Communications Network. The TACAMO project, a subsystem of the Navy Strategic Communications Program, provides an airborne communications platform for a survivable link for command and control of fleet ballistic missile submarines. TACAMO aircraft are equipped with a 200 kilowatt transmitter and VERDIN transmit terminal. A major phased TACAMO Improvement Program was initiated in FY 1973. This program includes elements to enhance the survivability of TACAMO to establish and maintain connectivity required of TACAMO as a Minimum Essential Emergency Communications Network asset and to improve communications capabilities and reliability. The first phase of the TACAMO Improvement Program modifications was completed for all aircraft in July 1978. Eight TACAMO Improvement Program Phase II modifications have been completed as of 1 December 1981. Follow-on developments maintain Minimum Essential Emergency Communications Network compatibility. A service life extension program started in FY 1979 to permit continued operations of the older ten aircraft in the FYs 1981-1985 time. Contract was awarded 2 March 1979 for replacement of the aircraft lost in June 1977. FYs 1980 and 1981 funds were programmed for force increase to 18 aircraft to accommodate the TRIDENT Pacific deployment. A replacement program for the current TACAMO aircraft has been initiated with project 41438 (ECX) as has a project to focus on networks and systems that are either survivable or reconstitutable in the trans- and post-attack time frame.

(U) RELATED ACTIVITIES: Fleet Ballistic Missile System (Program Element 11221N) and the TRIDENT Submarine System (Program Element 11228N). 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).

(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. Contractors: RCA Corporation, Camden, NJ; KAMAN Sciences Corporation, Colorado Springs, Co; Electrospace Systems, Inc., Richardson, TX; General Telephone and Electronics Laboratories, Inc., Waltham, MA;

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Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

Rockwell International Corporation (Collins and Autonetics), Richardson, TX, and Newport Beach, CA; Spears Associates, Newton, MA; Jaycor, Alexandria, VA; General Electric, Philadelphia, PA; MITRE Corporation, McLean, VA; and International Business Machines, Gaithersburg, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Developed and procured VERDIN very low frequency/low frequency modulation and receiving subsystem. Completed development of Enhanced VERDIN Processor incorporating Navy/Air Force compatible modes into VERDIN/TACAMO transmitter and receiver terminals and Fleet Ballistic Missile Submarine receiver terminals. Commenced procurement in FY 1981. Commenced development of Dynamic Tuning and High Frequency Power Amplifier for fixed very low frequency submarine broadcast sites. Conducted supporting technology and research in measurement, processing and prediction of extremely low frequency and very low frequency propagation data; in network simulation; in information transfer signal design; in message handling engineering; modulation/coding/compression; network analysis; configuration management and management assistance. Proposed military improvement for the POSEIDON Communications Improvement Program was approved. Continued development of the modular interface multiplexing and switching unit. Completed testing of the Submarine Advanced Keyboard Printer, and obtained approval for service use in May 1981. Completed the POSEIDON Communications Improvement Platform test bed facility. Factory tested the upgraded towed buoy antenna and installed on a submarine for Development Test, Phase III/Operational Test, Phase III, at sea. Completed operational evaluation of the towed buoy antenna system on a fleet ballistic missile submarine and requested approval for service use. Completed laboratory development of the Integrated Submarine Communication Antenna System standard buoyant cable antenna system components and prepared a specification and procurement package for a Service Test Model of a related Buoyant Cable Antenna coupler. Fabricated and tested an advanced development model of a medium frequency/high frequency switching system with an active multicoupler. Tested a high altitude balloon meteor burst relay and completed a system description for a rocket launched very low frequency balloon relay. Awarded cost plus fixed fee contracts in 1969 and 1979 to Lockheed for TACAMO high power transmitter. Awarded a firm fixed price contract to Collins Radio in 1971 for TACAMO IV conversion prototype, followed by cost plus fixed fee contracts for TACAMO Improvement Program Phase I in 1974 through 1976 to improve communications effectiveness and reliability and to complete TACAMO Improvement Program Phase II prototype. Conducted tests and studies to assess the vulnerability of TACAMO aircraft to electromagnetic pulse effects. Delivered TACAMO Improvement Program Phase I kits. Completed delivery of TACAMO Improvement Program Phase I to the fleet in FY 78. Initiated TACAMO Improvement Program Phase II production/conversion. TACAMO Improvement Program Phase II provides: satellite communications subsystems; additional VERDIN with KG-30 CRYPTO equipment for Minimum Essential Emergency Communications Network compatibility; TACAMO message processing system for full input capability for all TACAMO uplinks; very low frequency spectrum filter; improved very low frequency notch filter; and reduction of high frequency equipment. Completed test and installation of TACAMO prototype hardening to electromagnetic pulse effects. Completed TACAMO Electromagnetic Pulse hardening Assessment Test (TEMPAT) of TACAMO R&D aircraft. Provisional approval for service use of Electromagnetic Pulse hardening of TACAMO aircraft recommended by Commander, Operational Test and Evaluation Force. Completed TACAMO Improvement Program Phase II operational evaluation. Continued TACAMO Improvement Program Phase II production and installation.

Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

Contracted for final aircraft for force level increase to 18 unit equipped aircraft. Conducted analyses and preliminary work leading to start-up of ECX project.

2. (U) FY 1982 Program: Continue development of Dynamic Tuning and high efficiency power amplifiers for fixed very low frequency submarine broadcast sites. Determine technical feasibility of the preferred approach for modernization of submarine cryptographic system and interfaces. Procure the Submarine Advanced Keyboard Printer (111 units). Continue development of the modular interface multiplexing and switching unit. Deliver standard buoyant cable antenna coupler service test model and other system components for Development Test Phase III/Operational Testing Phase III. Install prototypes of the medium frequency/high frequency multicoupler and switching system on a POSEIDON submarine for tests. Award development contract for a new very low frequency/low frequency multicoupler. Begin development of high frequency/very high frequency system for the overall survivable/enduring communications network. Provide engineering system analysis and support in the areas of configuration management, systems performance models and production and installation. Continue follow-on TACAMO Improvement Program developments to provide: improved very low frequency receive antenna (employing adaptive null steering and/or H-Field and/or Transverse Electric/Transverse Magnetic diversity); improved time standard; Enhanced VERDIN transmit and receive; and replacement high frequency equipment. Continue TACAMO nuclear vulnerability assessment and hardening including evaluation of hardness and maintenance techniques. Commence installation of three Electromagnetic Pulse Hardening Kits. Continue ECX developmental analyses and issue Request for Proposals for replacement aircraft.

3. (U) FY 1983 Planned Program: Install Submarine Keyboard Printers. Procure 17 standard buoyant cable antenna systems and 17 medium frequency/high frequency multicouplers. Continue development of dynamic tuning and high efficiency power amplifiers for fixed very low frequency submarine broadcast sites. Continue with fixed very low frequency program for station upgrade and improvement in the areas of reliability and efficiency. Continue investigation into defining cryptographic modernization for submarines. Provide systems engineering support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology. Continue TACAMO Improvement Program Phase II production and installation. Award contract for acquisition of follow-on TACAMO ECX aircraft. Continue production and installation of five additional electromagnetic pulse hardening kits for a total of eight. Initiate third year of procurement of Enhanced VERDIN Processors. Continue development of the High Frequency/Very High Frequency system as part of the overall survivable/enduring communications network.

4. (U) FY 1984 Planned Program: Finalize development of dynamic tuning and high efficiency power amplifiers for fixed very low frequency submarine broadcast sites. Continue with Fixed Very Low Frequency Program for station upgrade and improvements in the areas of reliability and efficiency in lieu of major overhauls. Continue procurement and installation of the improved Towed Buoy Antenna, the Buoyant Cable Antenna standardized system, and the medium frequency/low frequency signal distribution systems. Commence Development Testing Phase III/Operational Testing Phase III of the Integrated Submarine Communications Antenna System

very low frequency multicoupler service test model. Provide systems engineering support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology. Complete production and installation of TACAMO electromagnetic pulse hardening kits and certification test. Continue follow-on TACAMO Improvement Program development and initiate production and installation as developments mature. Continue efforts on ECX development. Enter final year of Enhanced VERDIN Proessor procurement. Initiate procurement of Circuit Mayflower Shore Rehabilitation systems. Continue development of the basic Survivable/Enduring Communications Network. Demonstrate balloon relay rocket launch.

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

6. (U) Milestones: Not applicable.

Project: X0793
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: TACAMO
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: TACAMO aircraft are an integral part of the Joint Chiefs of Staff directed Minimum Essential Emergency Communications Network. The TACAMO Project, a subsystem of the Navy Strategic Communications program, provides an airborne communications platform for a survivable link for command and control of Fleet Ballistic Missile submarines. TACAMO IV aircraft are equipped with a 200 kilowatt transmitter and VERDIN transmit terminal. A major phased TACAMO Improvement Program was initiated in FY 1973. This program includes elements to enhance the survivability of TACAMO, to establish and maintain connectivity required of TACAMO as a Minimum Essential Emergency Communications Network asset, and to improve communications capabilities and reliability. The first phase of the TACAMO Improvement Program modifications was completed for all aircraft in July 1978. First aircraft for TACAMO Improvement Program Phase II modification was completed 29 June 1979, and nine are currently operational: seven in the Atlantic and two in the Pacific. Follow-on developments maintain Minimum Essential Emergency Communication Network compatibility. A service life extension program started in FY 1979 to permit continued operations of the older ten aircraft in the FY 1981-1985 time. Contract was awarded 2 March 1979 for replacement of an aircraft lost in June 1977. FY 1980 and FY 1981 funds were programmed for force expansion to 18 aircraft to establish 100% airborne operations in the Pacific in support of TRIDENT deployment while maintaining 100% airborne in the Atlantic. Nine airframes (without communications suites) were programmed in FY 1982 through FY 1985 to replace EC-130s reaching the end of their extended service life. It is intended that communications suites will be removed, refurbished and installed in the replacement airframes; however, planning is now underway to purchase a follow-on aircraft, ECX, to perform the TACAMO mission rather than the nine programmed replacement EC-130s. Reprogramming of a portion of the FY 1982 replacement airframe funds may be requested for initiation of the ECX project. Continuing evolution of the communications suite will determine the configuration which will be transplanted into the ECX.

(U) RELATED ACTIVITIES: Fleet Ballistic Missile System (Program Element 11221N) and TRIDENT I System (Program Element 11228N).

(U) WORK PERFORMED BY: In-House: Naval Air Systems Command, Washington, DC; Naval Avionics Center, Indianapolis, IN; Naval Air Test Center, Patuxent River, MD; Naval Air Development Center, Warminster, PA; Naval Weapons Engineering Support Activity, Washington, DC; Naval Surface Weapons Center, Silver Spring, MD; Naval Electronic Systems Engineering Activity, Patuxent River, MD; Naval Electronics Systems Command, Washington, DC. Contractors: Rockwell International Corporation (Collins and Autonetics Divisions), Richardson, TX, and Anaheim, CA, respectively; Electrospace Systems, Inc., Richardson TX; Lockheed Georgia Company, Marietta, GA; KAMAN Sciences Corporation, Colorado Springs, CO; Computer Sciences Corporation, Falls Church, VA; Science Applications, Inc., McLean, VA; J.S. Lee Associates, Arlington, VA; Eaton Corporation, AIL Division, Arlington, VA.

Project: X0793
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: TACAMO
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Contracted for the final EC-130 aircraft for the authorized force level increase to 18 unit equipped aircraft. In 1969 and 1979 awarded cost plus fixed fee contracts to Lockheed for TACAMO high power transmitter. Awarded a firm fixed price contract to Collins Radio in 1971 for TACAMO IV conversion prototype, followed by cost plus fixed fee contracts for TACAMO Improvement Program Phase I in 1974 through 1976 to improve communications effectiveness and reliability and to complete TACAMO Improvement Program Phase II Prototype. Conducted tests and studies to assess the vulnerability and certify the effects of electromagnetic pulse on TACAMO aircraft. Delivered TACAMO Improvement Program Phase I kits. Completed delivery of TACAMO Improvement Program Phase I aircraft to the Fleet in FY 1978. Initiated TACAMO Improvement Program Phase II production/conversion. TACAMO Improvement Program Phase II provides: satellite communications subsystem; additional VERDIN with KG-30 CRYPTO equipment for Minimum Essential Emergency Communications Network compatibility; TACAMO message processing system for full input capability for all TACAMO links; Very Low Frequency spectrum filter; improved very low frequency notch filter; and high frequency equipment reduction. Completed TACAMO Improvement Program Phase II operational evaluation. Completed installation and test of prototype electromagnetic pulse hardening kits on TACAMO research and development aircraft. Completed TACAMO Electromagnetic Pulse Assessment Test Phase II on research and development aircraft and approved for Operational Evaluation. Received provisional approval for service use for electromagnetic pulse hardening of TACAMO aircraft. Continued TACAMO Improvement Program Phase II production and installation. Conducted follow-on TACAMO Improvement Program development. Contracted for replacement of aircraft lost in June 1977. Conducted analyses and preliminary work leading to start-up of ECX program.

2. (U) FY 1982 Program: Continue TACAMO nuclear vulnerability assessment and hardening including evaluation of hardness assurance and maintenance techniques. Continue development of follow-on TACAMO Improvement Program to provide: improved Very Low Frequency Receive Antenna (employing adaptive null steering and/or 'H' Field or Transverse Electric/Transverse Magnetic diversity); improved time standard; and, Enhanced VERDIN transmit and receive. Continue ECX developmental analyses and issue Request for Proposals for replacement aircraft.

3. (U) FY 1983 Planned Program: Continue follow-on TACAMO Improvement Program development.

4. (U) FY 1984 Planned Program: Complete electromagnetic pulse hardening certification test. Continue follow-on TACAMO Improvement Program developments.

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

6. (U) Milestones: Not applicable.

Project: X0793
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: TACAMO
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

7. (U) Resource:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
X0793	TACAMO	9,052	16,393	14,853	11,768	Continuing	Continuing

Project: X1083
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Shore-to-Ship Communications Systems
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: Many possible techniques have been investigated for Shore-to-Fleet Ballistic Missile Submarine communications covering the entire frequency spectrum. These have included: extremely low frequency, communication satellites, multiple fixed very low frequency radio stations, multiple fixed phased array very low frequency antenna systems, transportable land mobile very low frequency systems using balloon lifted antennas, very low frequency facsimile systems, underwater acoustic systems, underwater explosive systems, seismic wave signaling techniques, airborne very low frequency (Project TACAMO), shipboard mobile very low frequency, communications superimposed on Long Range Aid to Navigation (LORAN-C) signals (Project PILGRIM), VERDIN very low frequency/low frequency modulation and receiving subsystems, and Navy/Air Force compatible modes for an Enhanced VERDIN system. Of these systems, Extremely Low Frequency, TACAMO, VERDIN, Enhanced VERDIN, PILGRIM, Very Low Frequency (fixed, shipboard and transportable land mobile) were selected for further development. Integrated Antenna System and POSEIDON Communication Improvement projects were also initiated. The transportable land mobile very low frequency system was discontinued in 1968 because of a demonstrated lack of all-weather capability, but is currently under reconsideration as a reconstitutable asset. Extremely Low Frequency Communications became a separate program element (11401N) in FY 1973. Fixed Very Low Frequency, VERDIN and TACAMO are operational.

(U) RELATED ACTIVITIES: Navy Strategic Communications provides secure, reliable shore-to-ship communications support to the Fleet Ballistic Missile System (Program Element 11221N) and the TRIDENT I System (Program Element 11228N). Error detection and coding techniques are developed under the Defense Communications Agency's Minimum Essential Emergency Communication Network (Program Element 33131K).

(U) WORK PERFORMED BY: In-House: Naval Ocean Systems Center, San Diego, CA; Naval Civil Engineering Laboratory, Port Hueneme, CA; Naval Underwater Systems Center, Newport, RI; Naval Research Laboratory, Washington, DC; Naval Surface Weapons Center, Silver Spring, MD; Naval Air Development Center, Warminster, PA; Naval Air Test Center, Patuxent River, MD; Naval Weapons Engineering Support Activity, Washington, DC; Naval Electronic Systems Engineering Activity, Patuxent River, MD; and Naval Electronic Systems Security Engineering Center, Washington, DC. Contractors: Computer Sciences Corporation, Falls Church, VA; RCA Corporation, Camden, NJ; Electrospace Systems, Inc., Richardson, TX; Rockwell International, Richardson, TX; Newport Beach, CA; SPEARS Associates, Norwood, MA; Jaycor, Delmar, CA; General Electric, Philadelphia, PA; MITRE Corporation, McLean, VA; and International Business Machines (IBM), Gaithersburg, MD.

Project: X1083
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Shore-to-Ship Communications Systems
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. (U) FY 1981 and Prior Accomplishments: Shore-to-Ship Communications effort was conducted under Project X0793 prior to FY 1980. Developed and procured VERDIN very low frequency/low frequency modulation and receiving subsystem. Completed development of Enhanced VERDIN Processor incorporating Navy/Air Force compatible modes into VERDIN/TACAMO transmitter and receiver terminals and Fleet Ballistic Missile Submarine receiver terminals and commenced procurement in FY 1981. Commenced development of dynamic tuning and high efficiency power amplifier for fixed very low frequency submarine broadcast sites. Conducted supporting technology and research in measurement, processing and prediction of extremely low frequency and very low frequency propagation data; in network simulation; in information transfer signal design; in message handling engineering; in modulation/coding/compression; in network analysis; in configuration management and management assistance. Proposed military improvement for the POSEIDON Communications Improvement Program was approved. Continued development of the modular interface multiplexing and switching unit. Completed testing of the Submarine Advanced Keyboard Printer; obtained approval for service use in May 1981. Completed a POSEIDON Communications Improvement Program development test bed facility. Factory tested and installed the Integrated Submarine Communications Antenna System upgraded towed buoy antenna service test model on a submarine for Development/Operational Testing, Phase III, at sea. Completed operational evaluation of the towed buoy antenna system on a fleet ballistic missile submarine and requested approval for service use. Completed laboratory development of the Integrated Submarine Communications Antenna System standard buoyant cable antenna system components and prepared a specification and procurement package for a Service Test Model of a related buoyant cable antenna coupler. Fabricated and tested advanced development model of a medium frequency/high frequency switching system with an active multicoupler. Tested the high altitude balloon meteor burst relay and completed a system description for a rocket launched Very Low Frequency balloon relay. Provided systems engineering support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology.

2. (U) FY 1982 Program: Continue development of Dynamic Tuning and High Efficiency Power Amplifiers for Fixed Very Low Frequency submarine broadcast sites. Determine the technical feasibility of the preferred approach for modernization of submarine cryptographic systems and interfaces. Continue development of the Modular Interface Multiplexing and Switching unit. Procure the Submarine Advanced Keyboard Printer (111 units) and the Integrated Submarine Communications Antenna System standard buoyant cable antenna coupler Service Test Model and other system components for Operational Testing at sea. Install prototype of the Integrated Submarine Communications Antenna System medium frequency/high frequency multicoupler and switching system on a POSEIDON submarine for tests. Award development contract for a new very low frequency/low frequency multicoupler. Begin development of a reconstitutable Very Low Frequency system for the overall survivable/eduring communications network. Provide engineering system analysis and support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology in the area of reconstitutable very low frequency communications.

Project: X1083
Program Element: 11402N
DoD Mission Area: 333 - Strategic Communications

Title: Shore-to-Ship Communications Systems
Title: Navy Strategic Communications
Budget Activity: 3 - Strategic Programs

3. (U) FY 1983 Planned Program: Install Submarine Keyboard Printers and Secure Teletype Switch. Procure 17 standard Buoyant Cable Antenna Systems and 17 medium frequency/high frequency multicouplers. Continue development of the Dynamic Tuning and High Efficiency Power Amplifiers for Fixed Very Low Frequency submarine broadcast sites. Continue with Fixed Very Low Frequency program for station upgrade and improvements in the areas of reliability and efficiency. Continue investigation into defining cryptographic modernization for submarines. Provide systems engineering support in the areas of configuration management, systems performance models and analysis, message compression techniques and investigation of advanced technology. Continue development of the reconstitutable Very Low Frequency system as part of the overall Survivable/Enduring Communications Network. Initiate third year procurement of Enhanced VERDIN Processors. Increased funding is for the development, test and evaluation of a new frequency/time standard and increased survivable and enduring communications efforts.

4. (U) FY 1984 Planned Program: Finalize development of the Dynamic Tuning and High Efficiency Power Amplifiers for Fixed Very Low Frequency submarine broadcast sites. Continue with Fixed Very Low Frequency program for station upgrade and improvements in the areas of reliability and efficiency in lieu of major overhauls. Continue procurement and installation of the improved towed buoy antenna, the buoyant cable antenna standardized system, and the medium frequency/high frequency signal distribution systems. Commence Development/Operational Testing, Phase III, of the very low frequency multicoupler Service Test Model. Provide systems engineering support in the areas of configuration manangement, systems performance models and analysis, message compression techniques and investigation of advanced technology. Continue development of the basic survivable and enduring communications network. Demonstrate balloon relay rocket launch. Enter final year of Enhanced VERDIN Processor procurement. Procure the Modular Interface Multiplexing and Swithcing Unit.

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

6. (U) Milestones: Not applicable.

7. (U) Resource:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
X1083	Shore-to-Ship Communications Systems	9,947	7,961	12,903	10,304	Continuing	Continuing

Project: W1438 — Title: ECX
Program Element: 11402N — Title: Navy Strategic Communications
DoD Mission Area: 333 - Strategic Communications — Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: ECX is the planned replacement for the air vehicle currently supporting the TACAMO strategic communications mission. TACAMO/ECX is the manned airborne relay platform within the Minimum Essential Emergency Communications Network (MEECN) that provides survivable communications connectivity from the National Command Authority (NCA) to the Fleet Ballistic Missile Submarines and other Single Integrated Operations Plan (SIOP) and Strategic Reserve Forces. It is the Navy system for the delivery of Emergency Action Messages (EAM). To accomplish this mission, TACAMO/ECX must be airborne and capable of communications with the World-Wide Military Command and Control System at all times. It must be able to monitor and transmit on a wide variety of frequencies. TACAMO/ECX must be airborne beginning in 1988. It must be able to withstand the Electromagnetic Pulse (EMP) effects of a nuclear detonation detect and evade hostile action and be self-sufficient for extended periods with only fuel and oil support from various ground . 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 in light of upcoming mission requirements. A Request for Proposals (RFP) is in preparation and will be issued to industry in March 1982, with a contract award anticipated by February 1983. The program envisioned would utilize a currently in-production aircraft that has been hardened against the Electromagnetic Pulse threat, and integrate the 1984 version of the AN/USC-13( ) mission avionics into the new aircraft.

(U) RELATED ACTIVITIES: Navy Strategic Communications/TACAMO (Program Element 11402N/Project X0793).

(U) WORK PERFORMED BY: In House: Naval Air Development Center, Warminster, PA; Naval Air Test Center, Patuxent River, MD; Naval Avionics Center, Indianapolis, ID. Contractor: TBD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments: The CNO Executive Board (CEB) decision to pursue an ECX program was made in November 1979 but was delayed for inclusion in the FY 1983 budget. Efforts commenced to prepare a Request for Proposals for solicitation of proposals to produce some fifteen aircraft (number dependent on aircraft selected) and integrate the AN/USC-13( ) mission avionics package.

2. (U) FY 1982 Program: Continue work on the Request for Proposals, planned for release in March 1982. Initial research and development efforts will commence at the Navy field activities on the integration and interface of the mission avionics. Investigations into potential product improvements will also be undertaken. Proposal evaluation, negotiations and milestone review preparation will also be completed.

Project: W1438 Title: ECX
Program Element: 11402N Title: Navy Strategic Communications
DoD Mission Area: 333 - Strategic Communications Budget Activity: 3 - Strategic Programs

3. (U) FY 1983 Planned Program: A combination Defense/Navy Systems Acquisition Review Council Milestone II/III review will be completed and a contract awarded. All efforts leading to commencement of manufacture of the pre-production prototype will begin.

4. (U) FY 1984 Planned Program: Engineering design efforts pass the 50% complete point. Preliminary and Critical Design Reviews to be accomplished. Layout of Mission System Integration Facility (MSIF) begun. Long-lead items for production aircraft to be procured in FY 1985 will be ordered.

5. (U) Program to Completion: Aircraft are planned to be procured at the following rate: FY 1985, 3; FY 1986, 3; FY 1987, 3; FY 1988, 3; and FY 1989, 2. This allows for the removal of mission avionics from the present aircraft with minimal adverse affect on the required operational force level. Navy Preliminary Evaluation and Technical Evaluation will be conducted on the production prototype during the first and second quarter FY 1987. Electromagnetic Pulse Hardening Evaluation and Operational Evaluation will commence in the second quarter of FY 1987.

6. (U) Milestones:

Milestone		Date
1.	Request for waiver of Approval for Service Use	January 1983
2.	D/N SARC	February 1983
3.	Contract Award	March 1983
4.	Commence Full Scale Development/Production	April 1986
5.	Contract Test	October 1986
6.	Technical Evaluation	January 1985 - April 1987
7.	Electromagnetic Pulse Evaluation	March 1987 - April 1987
8.	Operational Evaluation	May 1987
9.	Production Deliveries Commence	March 1987
10.	Initial Operational Capability	1988

7. (U) Resource:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
W1438	ECX	747	*	41,558	71,003	Continuing	Continuing

* FY 1982 ECX efforts in the amount of 5359 are funded under Navy Strategic Communications/TACAMO, (Program Element 11402N/Project X0793).

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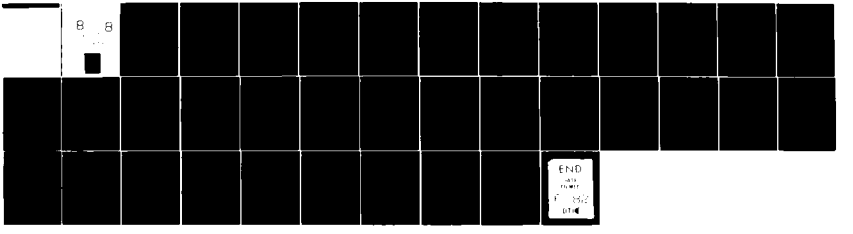

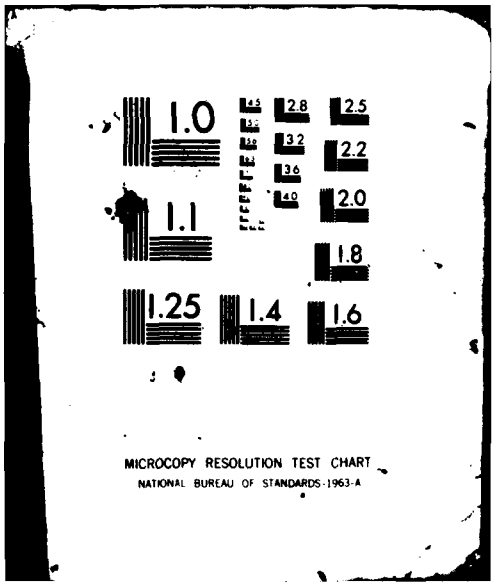
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FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11403N
Title: HYDRUS
DoD Mission Area: 333 - Strategic Communications
Budget Activity: 3 - Strategic Programs

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

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	1,000	888	0	0	0	1,888
X0794	Ship-to-Shore/HYDRUS	1,000	888	0	0	0	1,888

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: HYDRUS is an integrated development program to provide for improved communications systems which will enable Submarine Commanding Officers to communicate to command authorities ashore on a secure and reliable basis while reducing their vulnerability to an electronic countermeasure threat.

(U) BASIS FOR FY 1983 RDT&E REQUEST: This Program Element is not funded after FY 1982. Intention is to incorporate ship-to-shore efforts into the Navy Strategic Communications Program Element (11402N) beginning in FY 1983 inasmuch as two-way communications is an intrinsic part of a consolidated strategic communications effort. The above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a decrease of 22 in FY 1982 due to inflation adjustments and a decrease of 1,016 in FY 1983 due to discontinuance of this Program Element (11403N).

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENTS	0	1,000	910	1,016	Continuing	Continuing
X0794 SB	Ship-to-Shore/HYDRUS	0	1,000	910	1,016	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12427N
Title: Naval Space Surveillance System
DoD Mission Area: 332 - Strategic Surveillance and Warning
Budget Activity: 3 - Strategic Programs

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

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	539	550	501	521	1,570	5,152*
X0125	NAVSPASUR	539	550	501	521	1,570	5,152*

*Includes 1,239 funded in project R0125 in FY 1979 and prior.

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The U.S. Naval Space Surveillance System is a bistatic, 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, VA, where ocean area as well as unit-specific reconnaissance vulnerability reports are compiled and transmitted to fleet units. A part of the North America Aerospace Defense Space and 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 and receivers with solid state components which will increase system high altitude detection capabilities.

(U) BASIS FOR FY 1983 RDT&E REQUEST: To maximize the quality of the data collected and improve its distribution, engineering analyses/investigations leading to the improvement of the efficiency of the modernized Naval Space Surveillance System will continue. The engineering analyses/investigations will emphasize improvement in the efficiency of modernized transmitter stations. Also, selected computational algorithms used in deriving system output data will be improved. Other hardware/software in the system will be the subject of continued system analyses and where indicated, improvements instituted based on life cycle cost considerations. The long range project planning for development of CY 2000 era system will be continued in order to obtain the information needed for preparation of a Development Concept Plan. The above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary (a reduction of 102 for FY 1981 through FY 1983) are due to refinement of cost estimates including inflation.

Program Element: 12427N
Title: Naval Space Surveillance System
DoD Mission Area: 332 - Strategic Surveillance and Warning
Budget Activity: 3 - Strategic Programs

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	232	542	562	588	1,797	5,010*
X0125	NAVSPASUR	232	542	562	588	1,797	5,010*

*Includes 1,239 funded in Project R0125 in FY 1979 and prior.

(U) OTHER APPROPRIATION FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
OPN TOTAL	3,940	3,359	5,322	4,521	5,027	25,294
Receiving Stations (OPN)	2,627(a)	2,126(c)	0	0	0	7,854
Transmitting Stations (OPN)	1,313(b)	1,245(d)	5,389(e)	4,583(e)	5,112	17,642

(a) Hawkinsville, GA and Elephant Butte, NM
(b) Jordan Lake, AL
(c) San Diego, CA and Headquarters Digital Signal Processor Eqipment
(d) Gila River, AZ
(e) Lake Kickapoo, TX

Program Element: 12427N
Title: Naval Space Surveillance System
DoD Mission Area: 332 - Strategic Surveillance and Warning
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: The Naval Space Surveillance System was developed by the Naval Research Laboratory in 1958 and commissioned February 1, 1961. The system consists of the operational and computational center at Dahlgren, Virginia, and nine field stations located on a great circle inclined at 33 degrees to the equator. The three transmitters emit a fan-shaped pattern of continuous wave radio energy across the continental United States in the plane of the great circle. The central transmitter, at Lake Kickapoo, Texas, has a power output of 810 KW from a two mile long antenna array. The other two transmitters, Gila River, Arizona, and Jordan Lake, Alabama, have power outputs of 45 KW. Satellites passing through the fan of energy reflect energy back to the six receiver sites which detect and measure phase differences in the reflected energy waves. Receiver site data is transmitted to the computational center, where satellite ephemeris is calculated. Most of the original hardware, including vacuum tube electronic components, is still in use. Hardware degradation, the changing electromagnetic environment, and difficulty obtaining spares require that the system be modernized if surveillance is to be maintained. The replacement of receiving and transmitting station electronics and data processing equipment will also result in substantial gains in both accuracy and sensitivity. These improvements are consonant with specific Joint Chiefs of Staff objectives regarding U.S. space surveillance and will greatly enhance Naval Space Surveillance System support to afloat forces.

(U) RELATED ACTIVITIES: There are no other RDT&E activities currently in the Navy which directly relate to this development.

(U) WORK PERFORMED BY: In-House: Naval Research Laboratory, Washington, DC. Contractors: To be determined.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Investigations initiated in FY 1979 led to specifications and plans for modernization of the three transmitting stations in FYs 1981-1986 with OPN funds. In FY 1980, the Naval Research Laboratory continued engineering analyses and tests of hardware and software associated with the modernization of the six receiving stations. FY 1981 funds were used to continue engineering investigations to improve system efficiency, to conduct analyses of system output data accuracy, and to initiate technical studies which will support concept formulation of space surveillance system for the CY 2000 era.

2. (U) FY 1982 Program: Continue system analysis on the modernized system to identify more effective ways of using the system. Included in the system analysis will be transmission lines, antennas, manpower, power requirements and peripheral site hardware and software associated with the modernized receivers and transmitters. Continue to develop and test methods to enhance fleet support. Continue long range concept formulation engineering investigations to identify space surveillance requirements and project plans for the CY 2000 era in conjunction with the National Space Defense program.

3. (U) FY 1983 Planned Program: Engineering analyses/investigations will be continued with emphasis on the improvement of efficiency of the modernized transmitter stations. Selected computational algorithms used in deriving system output will be improved.

Other hardware/software in the overall modernized system will be subject to system analysis and, where indicated, improvements instituted on the basis of life cycle cost considerations. Long range project planning for the development of a CY 2000 era system will be continued in order to obtain the information needed for preparation of a Development Concept Plan.

4. (U) FY 1984 Planned Program: Initiate preparation of Development Concept Plan for future (CY 2000) system.

5. (U) Program to Completion: Initiate Navy Decision Coordinating Paper for future (CY 2000) Space Surveillance System. Initiate Advanced Development Project as required.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33131N
DoD Mission Area: 333 - Strategic Communications

Title: Minimum Essential Emergency Communications Network
Budget Activity: 3 - Strategic Programs

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

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	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Navy is acquiring 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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Conduct interoperability Operational Evaluation of the Minimum Essential Emergency Communications Network Message Processing Modes on Fleet Ballistic Missile Submarines, TACAMO aircraft and National Emergency Airborne Command Post. Obtain Joint Chiefs of Staff approval of the mode. Obtain Navy Initial Operational Capability. The increase of 7,584 from the FY 1982 to the FY 1983 program supports the effort required by the President's strategic deterrent program to ensure interoperability of Navy and Air Force strategic Very Low Frequency/Low Frequency communications. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: decreases of 21 in FY 1981 and 92 in FY 1982 due to inflation adjustments; and an increase of 8,465 in FY 1983 which supports the emphasis on implementing message processing mode changes to three existing Navy inventory systems; VERDIN, the Fixed Very Low Frequency/Low Frequency and TRIDENT Integrated Radio Room in addition to TACAMO and National Emergency Airborne Command Post aircraft mentioned above, as well as the interoperability of strategic communications.

Program Element: 33131N
DoD Mission Area: 333 - Strategic Communications

Title: Minimum Essential Emergency Communications Network
Budget Activity: 3 - Strategic Programs

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,092	2,358	3,181	2,208	3,617	31,092
X0795	Support of Minimum Essential Emergency Communications Network	2,092	2,358	3,181	2,208	3,617	31,092

(U) OTHER APPROPRIATIONS FUNDS:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
OPN	1,642	0	0	0	TBD	TBD
Quantity (Software modules)	(44)	TBD	TBD	TBD	(163)	(207)
O&M,N	324	2,896	2,545	708	Continuing	Continuing

OPN will procure software modules for implementation of Message Processing Mode in the Enhanced VERDIN Processor.

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.

Program Element: 33131N
DoD Mission Area: 333 - Strategic Communications

Title: Minimum Essential Emergency Communications Network
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: The Navy was assigned responsibility by the Joint Chiefs of Staff for the development of the message processing system to reduce the transmission time and improve the throughput for emergency action messages transmitted via the low frequency/very low frequency systems. The Navy is also responsible for developing the hardware system to be used for the Minimum Essential Emergency Communications Network Message Processing Mode on the Worldwide Airborne National Command Post Aircraft. The Minimum Essential Emergency Communications Network Message Processing Mode will comprise software which will be integrated into various processing equipment at the low frequency/very low frequency transmitter and receiver sites of the three services. The Navy systems affected are the existing Integrated Submarine Automatic Broadcast Processing System and Integrated Radio Room systems and the enhanced VERDIN Processor being produced for the VERDIN system. Air Force systems affected are the Strategic Air Command Data Information Network, the Survivable Low Frequency Communication System, the 616A Modem, and the Diversity Reception Equipment.

(U) RELATED ACTIVITIES: Navy Strategic Communications (Shore-to-ship Communications) (Program Element 11402N/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).

(U) WORK PERFORMED BY: In-House: Naval Ocean Systems Center, San Diego, CA. Contractors: Control Data Corporation, San Diego, CA; General Telephone and Electronic Corporation, Sylvania, Boston, MA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Program commenced in FY 1972. Redirection by the Joint Chiefs of staff in FY 1979 resulted in changing the development to a software vice hardware implementation based upon a Concept Formulation completed in FY 1978. This concept limited the application of the Minimum Essential Emergency Communications Network Message Processing System to the very low frequency/low frequency systems. Development of the Minimum Essential Emergency Communications Network Message Processing Mode which defines the software for implementing the Minimum Essential Communications Network Message Processing System was commenced in FY 1979 at Naval Ocean Systems Center using General Telephone and Electronic Corporation studies contract for signal design support. System design and preliminary design reviews were completed. The mode requirement specifications and program performance specifications were issued. Critical design review was held in October 1980. FY 1981 began the procurement of software modules for implementation of Message Processing Modes in the Enhances VERDIN processor.

2. (U) FY 1982 Program: Complete development of the communications mode at Naval Ocean Systems Center and commence testing of the Minimum Essential Emergency Communications Network Message Processing Mode. Continue development of the processing system for the Worldwide Airborne National Command Post aircraft. Initiate integration into the Enhanced VERDIN Processor. Initiate planning for integration into the Navy fixed Very Low Frequency sites and TRIDENT Integrated Radio Room.

Program Element: 33131N
DoD Mission Area: 333 - Strategic Communications

Title: Minimum Essential Emergency Communications Network
Budget Activity: 3 - Strategic Programs

3. (U) FY 1983 Planned Program: Conduct interoperability Operational Evaluation of the Minimum Essential Emergency Communications Network Message Processing Modes on Fleet Ballistic Missile submarines, TACAMO aircraft and National Emergency Airborne Command Post. Obtain Joint Chiefs of Staff approval of the mode. Obtain Navy Initial Operational Capability.

4. (U) FY 1984 Planned Program: Final deployment of Message Processing Modes in Navy Very Low Frequency/Low Frquency systems begins. Interoperability aspects with U.S. Air Force and National Command Authorities continue to be finalized.

5. (U) Program to Completion: Implement Minimum Essential Emergency Communications Network Message Processing Modes which are fully interoperable with U.S. Air Force and National Command Authorities strategic communications systems. After FY 1984, this program will decrease to a level of effort program for system architecture, configuration control management and hardware and software maintainance.

6. (U) Milestones:

Milestone	
Navy Initial Operational Capability	FY 1983
Navy Full Operational Capability	FY 1985
Tri-Service Initial Operational Capability	FY 1986
Tri-Service Full Operational Capability	FY 1988

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63371N
Title: TRIDENT II
DoD Mission Area: 112-Sea Based Strike
Budget Activity: 3 - Strategic Programs

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

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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

- 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.

- Collect geodetic/geophysical data in support of TRIDENT II (D-5) error reduction effort.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue TRIDENT II (D-5) Advanced Development Program to completion 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. Complete fabrication and testing of the Geodetic/Geophysical satellite, a radar altimeter satellite designed to collect gravity and other geodetic data in support of the TRIDENT II (D-5) error reduction effort. Provides for efforts to identify necessary subsystem changes to incorporate an advanced missile in the TRIDENT submarine baseline. As this is a continuing program, the above funding includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only, except for project R1452, for which the above funding includes all work or development phases now planned or anticipated.

Program Element: 63371N
Title: TRIDENT II
DoD Mission Area: 112-Sea Based Strike
Budget Activity: 3 - Strategic Programs

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands): The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a decrease of 914 in FY 1981 due to adjusted inflation estimates; a decrease of 3,648 in FY 1982, 3,042 in Project B0951, 237 in Project R1452, and 369 in Project B1546 due to adjusted inflation estimates; and an increase of 12,667 in FY 1983, comprised of decreases of 10,012 in Project B0951, 391 in Project R1452, and 913 in Project B1546 due to adjusted inflation estimates, an increase of 35,483 in Project B0951 for procurement of long lead items for the engineering development program, a further increase of 8,500 in Project B0951 due to repricing, and a decrease of 20,000 in Project B1546 due to transfer of ship design functions to the SCN appropriation; and finally, an increase of 1,173 in the Total Estimated Cost of Project R1452 due to inflation resulting from delaying some tasks by up to one year, and by delay of program start.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	25,640	97,597	242,880	354,034	Continuing	Continuing
B0951	TRIDENT-II Missile System	25,640	97,597	201,692	305,058	Continuing	Continuing
R1452	Geodetic/Geophysical Satellite	0	0	16,188	18,976	5,588	40,752
B1546	TRIDENT-II Submarine System	0	0	25,000	30,000	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS. Not applicable.

Program Element: 63371N
Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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 on 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 Submarine 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 selection of 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 Submarine Launched Ballistic Missile in his Decision Memorandum of 2 February 1981. The Deputy Secretary of Defense, in his Program Decision Memorandum of 2 October 1981, directed the Navy to fund the development of the D-5 missile with a [redacted] 1989 IOC. Increased accuracy for the advanced development program missile will require an extensive effort to reduce all error sources. As Circular Error Probable is reduced, geodetic/geophysical errors become an increasing portion of total error budget. These errors can be reduced by improving the earth gravitational model. This can be accomplished by providing a data base which can be collected by a radar altimeter satellite. Object of this program is to produce such a satellite, which would be similar to the SEASAT satellite launched in 1978. The satellite will be injected into orbit by an ATLAS-F or F launch vehicle and will collect necessary data over all ocean areas during an eighteen month period. The advanced development missile will be designed to be carried and launched from the TRIDENT submarine; however modifications may be required to some ship subsystems to accommodate this large missile. Efforts will commence in FY 1982 to identify the necessary changes to these subsystems.

(U) RELATED ACTIVITIES: TRIDENT Submarine System, Program Element 11228N/B0004; TRIDENT I Missile System, Program Element 11228N/B0003; POSEIDON support included in the Fleet Ballistic Missile System, Program Element 11221N. Development will benefit from the Air Force managed Advanced Ballistic Re-entry System, Program Element 63311F, and will require joint participation with the Department of Energy in re-entry vehicle development. The capability to meet specified accuracy objectives in a TRIDENT II Strategic Weapon System development is directly dependent upon progress that is achieved in the Improved Accuracy Program, Program Element 11221N/J0094.

(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; Navy Space Systems Activity, Los Angeles, CA; Naval Oceanographic Office; Defense Mapping Agency, Washington, DC; Naval Research Laboratory, Washington, DC; National Security Agency, Laurel, MD: U.S. Air Force/Space Division, 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; Vitro Corporation, Silver Spring, MD; Interstate Electronics Corporation, Anaheim, CA; Rockwell International Corp., Anaheim, CA; Johns Hopkins University/Applied Physics Laboratory, Laurel, MD; Aerospace Corporation, El Segundo, CA; Electric Boat Division of General Dynamics Corp., Groton, CT.

rogram Element: 63371N
oD Mission Area: 112 - Sea Based Strike

Title: TRIDENT II
Budget Activity: 3 - Strategic Programs

U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

. (U) FY 1981 and Prior Accomplishments: Concept formulation effort started in FY 1978 and continued through FY 1980. TRIDENT-I (D-5) Advanced Development Program initiated in FY 1981.

. (U) FY 1982 Program: Continue Advanced Development Program, including consideration of options which increase payload using lark 4 and/or modified MX Mark 12A Re-entry Bodies, enhanced range, and significantly improved accuracy over that of the currently leployed TRIDENT I (C-4) missile; review Geodetic/Geophysical satellite plans; negotiate contracts for satellite start in first uarter FY 1982; commence detailed design and fabrication of satellite and refurbishing of launch vehicle; commence efforts to dentify changes in ship support systems required as a result of the increased weight and volume of the new missile.

. (U) FY 1983 Planned Program: Continue Advanced Development Program to completion wih an end of FY 1983 Defense Systems cquisition Review Council Milestone II decision to select a weapon system option to proceed into full scale engineering develop-ent in FY 1984; conduct preliminary design and engineering studies to support incorporation of missile into TRIDENT Submarine; omplete fabrication and testing of geodetic/geophysical satellite in preparation for launch in FY 1984.

. (U) FY 1984 Planned Program: Start full scale engineering development of selected TRIDENT II (D-5) weapon system option. omplete preliminary designs of ship systems to incorporate the TRIDENT II missile, and start full scale engineering development; omplete final testing of geodetic/geophysical satellite; launch and operate, and begin data analysis.

. (U) Program to Completion: Continue full scale engineering development leading to a flight test program beginning approxi-nately January 1987, and an initial operating capability in 1989; contract design work to accommodate the TRIDENT II D-5) missile in the TRIDENT Submarine will be completed; collect eighteen months of radar altimeter data from geodetic/ eophysical satellite; analyze data; complete reduction and distribution of data products in FY 1986.

Program Element: 63371N
DoD Mission Area: 112 - Sea Based Strike

Title: TRIDENT II
Budget Activity: 3 - Strategic Programs

6. (U) Milestones:

	Date
a. (U) TRIDENT II Missile System	
(1) (U) Commence Sea Launched Ballistic Missile Modernization Advanced Development Program	October 1980
(2) (U) Defense Systems Acquisition Review Council Milestone II Decision	Before end of FY 1983
(3) (U) Initial Operational Capability	1989
b. (U) Geodetic/Geophysical Satellite	
(1) (U) Launch	First Quarter FY 1984
(2) (U) Complete Data Collection	July 1985
(3) (U) Complete Data Reduction and Distribution	FY 1986
c. (U) TRIDENT II Submarine System	
(1) (U) Defense Systems Acquisition Review Council Milestone II Decision	FY 1984

Project: B0951 Title: TRIDENT II
Program Element: 63371N Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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 on 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 his Decision Memorandum of 2 February 1981. The Deputy Secretary of Defense, in his Program Decision Memorandum of 2 October 1981, directed the Navy to fund the development of the D-5 Missile with a [redacted] 1989 IOC.

(U) RELATED ACTIVITIES: TRIDENT Submarine System, Program Element 11228N/B0004-SB; TRIDENT I Missile System, Program Element 11228N/B0003; POSEIDON support included in the Fleet Ballistic Missile System, Program Element 11221N. Development will benefit from the Air Force managed Advanced Ballistic Re-entry System, Program Element 63311F, and will require joint participation with the Department of Energy in re-entry vehicle development. The capability to meet specified accuracy objectives in a TRIDENTII Strategic Weapon System development is directly dependent upon progress that is achieved in the Improved Accuracy Program, within Program Element 11221N/J0094.

(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; and other contractors and government activities to be selected. 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 Missile and Space Company, Sunnyvale, CA; Vitro Corporation, Silver Spring, MD; Interstate Electronics Corporation, Anaheim, CA; Rockwell International Corporation, Anaheim, CA; Johns Hopkins University, Applied Physics Laboratory, Laurel, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Concept formulation effort started in FY 1978 and continued through FY1980. Sea Launched Ballistic Missile Modernization Advanced Development Program initiated in FY 1981.

2. (U) FY 1982 Program: Continue Advanced Development Program. Candidate missile options include three variations of the D-5 Missile: three stage through-deck similar to the C-4 concept; three stage clear deck; and two stage clear deck. Each option provides increased payload, using Mark 4 and/or modified MX Mark 12A Re-entry Body, enhanced range, and significantly improved accuracy over that of the currently deployed TRIDENT I (C-4) missile.

Project: B0951 Title: TRIDENT II
Program Element: 63371N Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

3. (U) FY 1983 Planned Program: Continue Advanced Development Program to completion 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.

4. (U) FY 1984 Planned Program: Start full scale engineering development of selected TRIDENT II (D-5) Weapon System option.

5. (U) Program to Completion: Continue full scale engineering development leading to a flight test program beginning approximately January 1987, and an initial operating capability in [redacted] 1989.

6. (U) Milestones:

		Date
a. (U)	Commence Sea Launched Ballistic Missile Advanced Development Program	October 1980
b. (U)	Defense Systems Acquistion Review Council Milestone II Decision	Before End of FY 1983
c. (U)	Initial Operational Capability	[redacted] 1989

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
B0951	TRIDENT II Missile System	96,683	198,650	339,029	1,401,297	Continuing	Continuing

Project: B0951 Title: TRIDENT II
Program Element: 63371N Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) TEST AND EVALUATION DATA:

1. (U) Development Test and Evaluation: Detailed information for this phase of Test and Evaluation is not available at this time as the program is in the first 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: 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: The TRIDENT II (D-5), if it is the selected missile option, will provide the TRIDENT Fleet Ballsitic Missile Submarines with a larger missile with greater range/payload capability and improved accuracy. Specific characteristics are to be determined during the Advanced Development Program.

Project: R1452 Title: Geodetic/Geophysical Satellite
Program Element: 63371N Title: TRIDENT II
DOD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: This project will build a satellite that increases accuracy for advanced Sea Launched Ballistic Missile systems by reducing error sources. As Circular Error Probable 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 Satellite (launched in 1978) was to provide such data, but failed shortly after launch. 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/F 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.

(U) RELATED ACTIVITIES: Directly related to TRIDENT I (Program Element 11228N), and TRIDENT II Missile System (Program Element 63371N). The capability to meet specific accuracy objectives in sea launched ballistic missile system development is directly dependent upon data to be obtained by Geodetic/
eophysical Satellite.

(U) WORK PERFORMED BY: In-House: Naval Surface Weapons Center, Dahlgren, VA; Navy Space Systems Activity, Los Angeles, CA; Naval Oceanographic Office; Defense Mapping Agency; Naval Research Laboratory, Washington, DC; National Security Agency, Laurel, MD; US Air Force Space Division, Los Angeles, CA. Contractors: Johns Hopkins University/Applied Physics Laboratory, Laurel, MD; Aerospace Corp., El Segundo, CA.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not applicable. New start in FY 1982.

2. (U) FY 1982 Program: Review program plan and negotiate contracts for start in first quarter FY 1982. Begin detailed design and fabrication of the Geodetic/Geophysical Satellite Experiment, refurbishing of the launch vehicle, and adaptation of the Geodetic/Geophysical Satellite to this mission.

3. (U) FY 1983 Planned Program: Complete fabrication and testing of the Geodetic/Geophysical Satellite in preparation for launch in first quarter of FY 1984.

4. (U) FY 1984 Planned Program: Final testing, launch and on orbit operation. Begin data analysis.

Project: R1452
Program Element: 63371N
DOD Mission Area: 112 - Sea Based Strike

Title: Geodetic/Geophysical Satellite
Title: TRIDENT II
Budget Activity: 3 - Strategic Programs

5. (U) Program to Completion: Take eighteen months of on-orbit altimeter data in coordination with the Naval Oceanographic Office and the Defense Mapping Agency. Analyze data concurrently with orbital operations and complete reduction and distribution of data in FY 1986.

6. (U) Milestones:

	Date
Launch	1st quarter FY 1984
Complete Data Collection	July 1985
Complete Data Reduction and Distribution	FY 1986

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
R1452	Geodetic/Geophysical Satellite	0	15,951	18,585	6,816	573	41,925

Project: B1546 Title: TRIDENT II Submarine System
Program Element: 63371N Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: 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. 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 Acquistion 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. A Deputy Secretary of Defense Program Decision Memorandum of 2 October 1981 directed funding of the development of the TRIDENT II missile with a 1989 IOC. This TRIDENT II Missile may require modifications to the TRIDENT submarine baseline. Effort will commence in FY 1982 to identify the necessary subsystem changes to incorporate the TRIDENT II Missile in the TRIDENT Submarine baseline.

(U) RELATED ACTIVITIES: TRIDENT Submarine System (Program Element 11228N/B0004); TRIDENT I Missile System (Program Element 11228N/B0003); POSEIDON support included in the Fleet Ballistic Missile System Program (Program Element 11221N). The TRIDENT II Missile System (Program Element 63371N/B0951) contains an improved missile which will be carried by the TRIDENT Submarine.

(U) WORK PERFORMED BY: In-House: Naval Sea Systems Command, Washington, DC; Strategic Systems Project Office, Washington, DC. Contractors: Electric Boat Division of General Dynamics Corp., Groton, CT.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: New start in FY 1982.

2. (U) FY 1982 Program: Effort will consist of preliminary design and engineering studies to support the incorporation of the TRIDENT II (D-5) weapons system in the TRIDENT submarine and improved operation arrangement and maintainability of hull, mechanical, electrical and Command and Control ship systems. Work will include trade-off studies to determine the modifications to the ship support systems based on increased weight and volume of new missiles.

3. (U) FY 1983 Planned Program: Continue preliminary design and engineering studies to support the incorporation of the TRIDENT II (D-5) weapons system in the TRIDENT submarine and improved operation, arrangement and maintainability of hull, mechanical, electrical and Command and Control ship systems. Continue trade-off studies to determine the modifications to the TRIDENT submarine baseline and to support the Defense Systems Acquisition Review Council Milestone II decision to be made in FY 1984.

4. (U) FY 1984 Planned Program: Produce preliminary designs of ship systems to support incorporation of the Sea Launched Ballistic Missile modernized weapons system. Proceed to Full Scale Engineering Development if approved.

Project: B1546 — Title: TRIDENT II Submarine System
Program Element: 63371N — Title: TRIDENT II
DoD Mission Area: 112 - Sea Based Strike — Budget Activity: 3 - Strategic Programs

5. (U) Program to Completion: Contract design work to accommodate the TRIDENT II (D-5) weapon system in the TRIDENT submarine will be completed. This effort will study and define all areas of the submarine requiring modification to support the weapon system.

6. (U) Milestones:

	Date
a. (U) Defense Systems Acquisition Review Council Milestone II Decision	FY 1984

7. (U) Resources:

Project No.	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
B1546	TRIDENT II Submarine System	0	24,631	9,087	5,437	Continuing	Continuing

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63588N
DoD Mission Area: 112 - Sea-Based Strike

Title: SSBN Subsystem Technology Program
Budget Activity: 3 - Strategic Programs

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

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
S0001	SSBN Subsystem Technology	13,808	4,508	4,898	12,325	Continuing	Continuing

(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 500 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: a self-contained missile tube complex, presently being considered as a viable support system concept for the TRIDENT II (D-5) Weapon System, which includes all the strategic weapon support systems required for each tube as an integral part of the missile tube; a simplified torpedo tube turbine ejection pump; seawater conversion to fresh water by electrodialysis; 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.

Program Element: 63588N
DoD Mission Area: 112 - Sea-Based Strike

Title: SSBN Subsystem Technology Program
Budget Activity: 3 - Strategic Programs

(U) BASIS FOR FY 1983 RDT&E REQUEST: Approximately 25% of the FY 1983 budget will involve a continuing effort to identify and assess cost-effective subsystem concepts. The remainder of the budget will be used for major development efforts which include fabrication of structural elements for a composite superstructure; testing of prototype components for the simplified air system; model testing and analysis of missile compartment structures; prototype design and fabrication of spring powered countermeasures launcher; fabrication of breadboard catapult torpedo launcher, and breadboard testing of sanitary tank flame sprayed coating. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases now planned or anticipated through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a reduction of 2,759 in FY 1981, 6,382 in FY 1982, and 21,408 in FY 1983 resulting from revised inflation adjustments and Navy application of undistributed general reductions. The 80% reduction in FY 1983 will require delay or termination of efforts to (1) design and manufacture a prototype simplified torpedo tube turbine ejection pump; (2) procure a prorotype electrodialysis seawater conersion module; and (3) fabricate components, missile tube structure and control system, and testing of electric hatch operator for the missile tube complex.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	13,588	16,567	10,890	26,306	Continuing	Continuing
S0001	SSBN Subsystem Technology	13,588	16,567	10,890	26,306	Continuing	Continuing

(U) OTHER APPROPRIATIONS FUNDS: None

Program Element: 63588N
DoD Mission Area: 112 - Sea-Based Strike

Title: SSBN Subsystem Technology Program
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: The Fleet Ballistic Missile Submarine (SSBN) is the sea-based element of our strategic deterrent forces. Acquisition and operational costs of SSBN 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 area 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; and (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.

(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/B0004; 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 Subs 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. An SSBN Technology Review Board within Naval Sea Systems Command functions to ensure coordination and prevent redundancy between this program and other Navy R&D programs.

(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; Ionics, Watertown, MA; Franklin Research Center, Philadelphia, PA; Rockwell International, Autonetics and Rocketdyne Divisions, Los Angeles, CA; Swedlow Corporation, Garden Grove, CA: and Southwest Research Institute, Austin, TX.

Program Element: 63588N
DoD Mission Area: 112 - Sea-Based Strike

Title: SSBN Subsystem Technology Program
Budget Activity: 3 - Strategic Programs

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This program was a new initiative in FY 1977. The FY 1977 effort and a portion of the FY 1978 effort involved a survey and evaluation of technologies to identify those which offer the greatest potential for improving the cost effectiveness of fleet ballistic missile submarine subsystems. The state of technology in each area is continuously being evaluated and technical approaches are being defined to advance each technology. The life cycle cost benefit of using each technology is being evaluated. Technologies offering a potential for substantial improvement in subsystem cost effectiveness are being advanced to full scale development. The output of the FY 1977 effort was a recommended list of candidate concepts which included the - quisition and life cycle cost benefit of using the concept as well as a development plan to fully evaluate each concept. The primary efforts during FY 1978 through FY 1981 were technology development. The major developments included: design initiation of composite superstructure; decentralized ventilation system air revitalization studies and breadboard equipment testing; missile tube complex fluid system design and component procurement, tube structural analysis, missile heating and cooling system breadboard testing and full scale mockup construction; spring powered internal countermeasures launcher breadboard unit design and manufacture; electrodialysis breadboard unit design; fabrication and test of breadboard units for simplified air system; breadboard composite gas flask design and procurement; design and manufacture of two breadboard simplified torpedo tube turbine ejection pumps; testing of missile compartment design procedures model; qualification testing of flat position flux cored weld rod specimens; and manufacture and test of two models to evaluate deep frame design criteria. Several cost saving concepts (such as increased frame web aspect ratio, increased cable hanger spacing, and high heat welding) have completed development and action to invoke them in a submarine shipbuilding contract has been initiated. For one of the concepts (deletion of the spectacle flanges) the Navy and the contractor have agreed to an equitable reduction in contract cost.

2. (U) FY 1982 Program: The FY 1982 program includes the continuing effort to identify and assess cost effective subsystem concepts. This effort is the source for the new developments that will be initiated this fiscal year. The major continuing efforts include: completion of detailed design of a complete composite superstructure; complete qualification testing of flux cored arc welding rods; manufacture and qualification test of a breadboard composite flasks; completion of testing of all breadboard components for simplified air system and development of required military specifications; initiate testing of breadboard electrodialysis seawater conversion module; complete structural drawings of missile tube complex and complete fabrication of mockup, procurement of fluid system components, complete detail system level drawings; initiate manufacture and test of missile tube complex electric missile hatch operator concept; develop inelastic general instability design criteria for missile compartment structure and initiate fabrication of third missile compartment model for failure analysis; testing of spring powered internal countermeasures launcher full breadboard unit; test and select simplified torpedo tube turbine ejection pump for prototype development; test and analyze two additional models for structural deep frame design criteria evaluation; breadboard design of catapult torpedo launcher; and fabrication and breadboard test of sanitary tank flame sprayed coating.

Program Element: 63588N
DoD Mission Area: 112 - Sea-Based Strike

Title: SSBN Subsystem Technology Program
Budget Activity: 3 - Strategic Programs

3. (U) FY 1983 Planned Program: The FY 1983 program includes the continuing effort to identify and assess cost effective subsystem concepts. This effort is the source for the new developments that will be initiated this fiscal year. The major continuing efforts include: fabrication of a structural elements of composite superstructure; specification development and procurement of a prototype composite flask; procurement and testing of prototype components for simplified air system; catapult torpedo launcher breadboard fabrication; fabricate and test a missile compartment model for verification of revised missile compartment design procedures; initiate prototype design and fabrication of spring powered internal countermeasures launcher; breadboard test of sanitary tank flame sprayed coating; and, test one model and design and fabricate an additional model for structural deep frame design criteria analysis.

4. (U) FY 1984 Planned Program: The FY 1984 program includes the continuing effort to identify and assess cost effective subsystem concepts. This effort is the source for the new developments that will be initiated this fiscal year. The major continuing efforts include: fabrication of a full scale section of composite superstructure; manufacture of prototype composite gas flasks; completion of prototype simplified air system component testing; fabrication of prototype missile tube complex components including missile tube, missile heating and cooling module, indication, control and alarm modules, and gas storage containers and testing of prototype electric hatch operators; initiate procurement of prototype electrodialysis seawater conversion module; catapult torpedo launcher breadboard test and analysis; prototype spring powered internal countermeasures launcher test; missile compartment design procedures development model; test two verification models to support deep frame design procedures development; and procure prototype torpedo tube turbine ejection pump test.

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

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63735N

Title: Worldwide Military Command and Control System Architecture Support

DoD Mission Area: 331 - Strategic C2

Budget Activity: 3 - Strategic Warfare

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

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

(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.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Continue system engineering studies, engineering plans and technical analyses/cost estimates for validated Commander-in-Chief Atlantic and Commander-in-Chief Pacific Worldwide Military Command and Control Systems Required Operational Capabilities. Continue analyses of Joint Chiefs of Staff sponsored Worldwide Military Command and Control initiatives to assess short and long term impact on Navy command, control, and communications systems. Initiate system engineering studies/analysis of Navy interface requirements with the Worldwide Military Command and Control Information System. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work or development phases through FY 1984 only.

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands) The changes between the funding profile shown in the FY 1982 Descriptive Summary and that shown in this Descriptive Summary are a decrease in FY 1981 of 9 due to revised inflation factors and 300 due to Navy reprogramming. The decrease in FY 1982 is due to 14 for revised inflation factors and 210 due to Congressional reductions. The reduction of 1,076 in FY 1983 reflects the decision to reduce Worldwide Military Command and Control Systems Architecture support in favor of the establishment of a separate Navy Worldwide Military Command and Control Information System program.

Program Element: 63735N

Title: Worldwide Military Command and Control System Architecture Support

DoD Mission Area: 331 - Strategic C2

Budget Activity: 3 - Strategic Warfare

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands)

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,902	905	1,086	1,979	Continuing	Continuing
X0749	Worldwide Military Command and Control Architecture Support	802	905	1,086	1,979	Continuing	Continuing
X1365	Computer Security	1,100	0	0	0	0	1,100*

*FY 1981 and outyear funding for Computer Security provided in Program Element 63526N, Advanced Software Computer Technology.

(U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 63735N

Title: Worldwide Military Command and Control System Architecture Support

DoD Mission Area: 331 - Strategic C2

Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: This program supports Worldwide Military Command and Control System architecture. This continuing advanced development program will provide systems engineering and advanced development to integrate and incorporate Navy Command, Control and Communications systems with the Worldwide Military Command and Control System. This program provides system engineering studies, engineering plans, and technical analysis/cost estimates for validated Commander-in-Chief Atlantic and Commander-in-Chief Pacific Worldwide Military Command and Control Systems Required Operational Capabilities; provides system development efforts to assure Navy Command, Control and Communications systems compatibility with the Worldwide Military Command and Control System Selected Architecture Program Joint Crisis Management Capability; provides system engineering studies and analysis of Navy Command and Control System interface requirements with the Worldwide Military Command and Control System.

(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 63735A, 63735F, 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.

(U) WORK PERFORMED BY: In-House: Naval Electronic Systems Command, Washington, DC; Naval Research Laboratory, Washington, DC; Naval Electronic Systems Security Engineering Center, Washington, DC; 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: VITRO Laboratories, Silver Spring, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments: Worldwide Military Command and Control Systems Architecture consisted of planning studies through FY 1976 with development of architectural alternatives for an integrated system. Deficiencies were identified and the Worldwide Military Command and Control Systems Architecture Plan was defined. Dovetailing with the Architecture Plan, the current project commenced in FY 1976 and initiated systems engineering/design efforts for the Joint Chiefs of Staff Worldwide Military Command and Control System. Through FY 1979/1980 this program continued Worldwide Military Command and Control System/ Navy Command, Control and Communications engineering and design efforts; completed installation and checkout of data conferencing; evaluated results of Pacific Command Secure Voice and Data Conferencing test, completed equipment integration tests; and continued systems engineering/integration effort for Pacific Command Crisis Action Information Distribution System. System development was initiated to assure Navy Command, Control and Communications systems compatibility with the Joint Crisis Management Capability. In FY 1981 this program continued system engineering in support of unified commanders required operational capabilities, supported

Program Element: 63735N

Title: Worldwide Military Command and Control System Architecture Support

DoD Mission Area: 331 - Strategic C2

Budget Activity: 3 - Strategic Programs

the development of Worldwide Military Command and Control System studies for the Navy Command and Control System transition program and provided design issues for Navy Command and Control connectivity with Worldwide Military Command and Control System.

2. (U) FY 1982 Program: Continue systems engineering studies, engineering plans, and technical analysis/cost estimates for validated Commander-in-Chief Atlantic and Pacific Worldwide Military Command and Control System Required Operational Capabilities. Assess Navy-supported sites unique requirements for data transfer and initiate developments of performance standards. Initiate systems engineering studies of Worldwide Military Command and Control System/Navy Command and Control System interoperability and establish a five year plan. Support Unified Commanders' Required Operational Capabilities.

3. (U) FY 1983 Planned Program: Continue system engineering design and development efforts, continue technical analysis/cost estimates supporting the Command-in-Chief Atlantic and Pacific Required Operational Capabilities. Establish Navy Command and Control System/Worldwide Military Command and Control System modeling facility. Continue systems engineering study effort to ensure interoperability of Navy Command, Control and Communications systems with Joint Crisis Management Capability. Support Unified Commanders' Required Operational Capabilities.

4. (U) FY 1984 Planned Program: Continue support for Worldwide Military Command and Control System design, development and system engineering for architecture, joint command and control systems, and tactical system interfaces. Pursue effort for interoperability with Joint Crisis Management Capability. Provide support for the Navy-supported Unified Commanders' Required Operational Capabilities and prepare technical analyses and cost estimates. Continue work on Navy Command and Control System/Worldwide Military Command and Control Systems interoperability.

5. (U) Program to Completion: 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 Commander-in-Chiefs Required Operational Capabilities, and validated Worldwide Military Command and Control Selected Architecture programs.

6. (U) Milestones: Not applicable.

FY 1983 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65856N
Title: Strategic Technical Support
DOD Mission Area: 140 - Strategic Support
Budget Activity: 3 - Strategic Programs

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

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
M0100	Biomedical Support for Submarine Systems	548	631	598	641	Continuing	Continuing
R0128	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

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced Strategic Missile Systems Support - Identify to the Manager, Advanced Strategic Missile System (U.S. Air Force PE 63311F) the unavailable technology which is required for the development of potential Navy strategic systems. 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 and fire control systems. Management and Technical Support, Strategic - Program to develop strategic and theater nuclear concepts, determine technology requirements, define systemsand 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 ground simulation of aerodynamic and aerothermal conditions required for design and performance evaluation of reentry bodies and hypervelocity interceptors.

(U) BASIS FOR FY 1983 RDT&E REQUEST: Advanced Strategic Missile Systems Support - A continued level of effort in reviewing the technology generated by Advanced Strategic Missile Systems. Biomedical Support for Submarine Systems - Continue identification of psychological factors for Fleet Ballistic Missile Submarine sonar visual and aural display and multiple sonar tracking. Management and Technical Support, Strategic - Continue development of strategic and theater nuclear concepts and requirements; continue to assess tradeoffs relating to weapons configuration, targeting policy, ASW threat, and operational requirements for current and future sea-based strategic and theater nuclear forces. Appraise ability of sea-based strategic and theater nuclear forces to meet the future needs of national policy. Hypervelocity Wind Tunnel - Continue to provide ground test support to strategic/theater nuclear weapons programs of all three services. As this is a continuing program, the above funding profile includes outyear escalation and encompasses all work for development phases now planned or anticipated through FY 1984 only.

Program Element: 65856N
DOD Mission Area: 140 - Strategic Support

Title: Strategic Technical Support
Budget Activity: 3 - Strategic Programs

(U) COMPARISON WITH FY 1982 DESCRIPTIVE SUMMARY: (Dollars in Thousands). The changes between the funding profile shown in the FY 1982 Descriptive Summary and this Descriptive Summary are as follows: a total increase of 73 in FY 1981 due to refinement of cost estimates, resulting in decreases of 50 in project J0093, 1 in project M0100, and 113 in project Z1259, and an increase of 237 in project R0128; a total reduction of 1,139 in FY 1982 due to Navy application of the Congressional general reduction for inflation, which includes reductions of 12 in project J0093, 8 in project M0100, 808 in project R0128, and 311 in project Z1259; and a total reduction of 1,061 in FY 1983 due to refined cost estimates and inflation reductions, which includes 148 in project J0093, 97 in project M0100, 645 in project R0128, and 171 in project Z1259.

(U) FUNDING AS REFLECTED IN THE FY 1982 DESCRIPTIVE SUMMARY:

Project No.	Title	FY 1980 Actual	FY 1981 Estimate	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,784	5,289	6,469	6,980	Continuing	Continuing
J0093	Advanced Ballistic Reentry Systems Support	760	869	910	1,016	Continuing	Continuing
M0100	Biomedical Support for Submarine Systems	500	549	639	695	Continuing	Continuing
R0128	Management and Technical Support, Strategic	2,024	2,315	3,165	3,445	Continuing	Continuing
Z1259	Hypervelocity Wind Tunnel	1,500	1,556	1,755	1,824	Continuing	Continuing

(U) OTHER APPROPRIATION FUNDS: None

Program Element: 65856N
DOD Mission Area: 140 - Strategic Support

Title: Strategic Technical Program
Budget Activity: 3 - Strategic Programs

(U) DETAILED BACKGROUND AND DESCRIPTION: Project J0093, Advanced Strategic Missile Systems Support - Identifies to the Air Force the unavailable technology which is required for potential Navy strategic systems, monitors current Advanced Strategic Missile Systems effort and collects and maintains pertinent data. Project M0100, Biomedical Support for Submarine Systems - Will provide biomedical knowledge necessary to increase performance of critical Fleet Ballistic Missile Submarine tasks. R0128, Management and Technical Support, Strategic - Provides for system studies, advanced technical investigations and analysis of potential future sea-based strategic and theater nuclear systems. Project Z1259, Hypervelocity Wind Tunnel - Located at the Naval Surface Weapons Center. Tunnel reflects latest state-of-the-art technology. One leg of the tunnel operating at Mach 14 was brought on the line in FY 1977. A second leg, started in FY 1979, operates at Mach 10.

(U) RELATED ACTIVITIES: Program Element 63311F, Advanced Strategic Missile Systems (technology exchange); Program Element 11221N, Fleet Ballistic Missile System (POSEIDON); 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.

(U) WORK PERFORMED BY: In-House: Naval Submarine Medical Research Laboratory, Groton, CT; Naval Surface Weapons Center, White Oak, Silver Spring, MD; Naval Surface Weapons Center, Dahlgren, VA. Contractors: Lockheed Missiles and Space Company, Sunnyvale, CA; Academy for Inter-Science Methodology and Control Data Corporation, Rockville, MD; Operations Research Inc., Silver Spring, MD; Boeing Corporation, Seattle, WA; Wagner Assoc., Paoli, PA; Kaman Sciences Corp., Colorado Springs, CO; TRW, McLean, VA; and Applied Physics Laboratory, Johns Hopkins University, Laurel, MD.

(U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Project J0093, Advanced Strategic Missile Systems Support - Specific technologies of Navy interest in reentry system accuracy, fuzing devices, penetration aids, and advanced reentry vehicles have been identified. Project M0100, Biomedical Support for Submarine Systems - Developed new method to increase sonar target detection sensitivity in audio mode. Developed synchronized audio-visual mode for rapid target classification. Demonstrated operability problems with and proposed corrections for Fleet Ballistic Missile Submarine Improved Sonar Processing Equipment. Developed test battery for better selection of sonar operators. Project R0128, Management and Technical Support, Strategic - Explored tradeoffs related to weapon configuration and operational requirements for current and future strategic sea based systems. Investigated the effect of future targeting policy and plans upon weapon system trade-offs. Completed Phase I development of Naval Nuclear Warfare Simulation model, analyzed theater campaigns of extended duration. Evaluated vulnerabilities of Soviet and U.S. strategic submarines in the face of varying anti-submarine warfare threat over time. Continued to examine support requirements for long term employment of sea-based strategic reserve forces. Continued analyses pertaining to strategic missiles, launch platforms, concept development, development, analytical support (nuclear vulnerability/weapon effects) and analytical methods for strategic analysis. Identified technology objectives to support promising future strategic and theater nuclear system concepts. Analyzed strategy for employment of the nuclear land-attack sea launched cruise missile in the theater role. Project Z1259, Hypervelocity Wind Tunnel - Conducted

design and performance testing for Army, Navy and Air Force reentry body and interceptor programs. The tunnel currently has operating two parallel legs providing simulation at speeds of Mach 10 and Mach 14.

2. (U) FY 1982 Program: Project J0093, Advanced Strategic Missile Systems Support - Continue to monitor the Advanced Strategic Missile Systems program for Fleet Ballistic Missile applicability. Project M0100, Biomedical Support for Submarine Systems - Continue investigations of human factors associated with complex sonar visual displays. Develop improved audio displays. Begin evaluation of vision correction device to increase number of candidates qualified for submarine duty. Project R0128, Management and Technical Support, Strategic - Use Navy Strategic Force Mix model to examine systems tradeoffs and evaluate submarine alternatives in future force mixes. Conduct analyses of pre-, trans-, and post-nuclear exchange survivability, command and control, and targeting requirements of sea-based forces. Evaluate TRIDENT II (D-5) employment options in a variety of scenarios. Develop Navy Nuclear Warfare Simulation to analyze theater level campaigns of extended duration. Evaluate anti-submarine warfare vulnerabilities of enemy and U.S. strategic submarines in the face of varying anti-submarine warfare threat over time. Determine the future theater nuclear roles for sea-launched cruise missiles. Examine support requirements for long term employment of sea-based strategic reserve forces. Project Z1259, Hypervelocity Wind Tunnel - Continue design and performance testing for Army, Navy, and Air Force reentry body and interceptor programs.

3. (U) FY 1983 Planned Program: Project J0093, Advanced Strategic Missile Systems Support - Continue review of the technology generated by the Advanced Strategic Missile Systems program as necessary to insure that the Navy can identify the technology required to enter advanced development or engineering development for future Navy systems. Project M0100, Biomedical Support for Submarine Systems - Apply new audio display to multiple sonar contact management. Begin computer model to permit automatic target acquisition. Project R0128, Management and Technical Support, Strategic - Continue development and use of Force Mix Model to account for phase-in and phase-out of Strategic Systems over time. Expand development of the Navy Nuclear Warfare Simulation to analyze all naval nuclear warfare areas in greater detail. Based on the theater roles for the sea launched cruise missile, determine their most cost-effective employment. Project Z1259, Hypervelocity Wind Tunnel - Provide test support for accuracy evaluations of Navy ballistic reentry bodies and derivatives of Mk 500 reentr systems; for Advanced Strategic Missile Systems programs related to maneuvering vehicles and decoys; for homing interceptor technology; and for space shuttle vhicles.

4. (U) FY 1984 Planned Program: Project J0093, Advanced Strategic Missile Systems Support - Continue to identify to tne Manager, Advanced Strategic Missile Systems program the required technology for development of potential Navy strategic weapons systems. Project M0100, Biomedical Support for Submarine Systems - Continue analysis of human factors problems in sonar design, with optimization of signature reference displays and evaluation of secondary displays. Complete evaluation of vision correction methods to enhance recruitment and retention of submarine personnel. Project R0128, Management and Technical Support, Strategic - Continue to assess tradeoffs relating to weapon configuration, targeting policy, ASW threat and operational requirements for current and future sea-based strategic and theater nuclear forces. Project Z1259, Hypervelocity Wind Tunnel - Continue design and performance testing for Army, Navy, Air Force reentry body and interceptor programs and testing of space shuttle and derivatives.

Program Element: 65856N
DOD Mission Area: 140 - Strategic Support

Title: Strategic Technical Program
Budget Activity: 3 - Strategic Programs

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

6. (U) Milestones: Not applicable.

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