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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
 PROGRAM ELEMENT TITLE: Mine and Expeditionary
 Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2226 Mine and Expeditionary Warfare Advanced Technology									CONT.	CONT.
	39,624	43,222	48,711	45,869	46,873	48,030	49,167	50,339		
R2381 LCAC GPU-5 Gunpod									728	728
	728	0	0	0	0	0	0	0		
R2499 ALISS									998	998
	0	998	0	0	0	0	0	0		
TOTAL	40,352	44,220	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore.

(U) This Program Element (PE) transitions technologies responding to high-priority Naval Expeditionary Warfare mission requirements. The emphasis is on simulating and testing prototypes of technologies with the potential for providing Naval capabilities in six major areas:

- Mine Countermeasure (MCM) techniques for clandestine surveillance and reconnaissance; organic minehunting and clearance; and organic ship protection.
- Offensive Sea Mining
- Battlefield surveillance, reconnaissance, and targeting.
- Naval fire support.
- Command, control, communications, information processing, and mission planning supporting land battles.
- Force mobility and survivability.

(U) Task ADVANCED DEGAUSSING was begun in FY 1993, and is designed to enhance current and future ship passive mine self-defenses by lowering the magnetic signatures of the ship. Four main areas of improvement are: advanced deperming to reduce

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the vertical magnetic signature by 50% over current capabilities, advanced degaussing by using 3-axis sensing coils and controllers to reduce magnetic signatures by 75%, closed loop degaussing to maintain magnetic signatures in real-time, and secondary field signature reductions due to corrosion-related magnetic fields. ADVANCED DEGAUSSING is currently scheduled for completion in FY 1999 and will be transitioned to Amphibious Transport Dock (LPD-17) baseline design, PE 0603502N for the MCM ships, and PE 0603513N for steel-hulled ships.

(U) Task ADVANCED SURVEILLANCE/RECONNAISSANCE was begun in FY 1996 and is designed to utilize National Technical Means more efficiently in support of MCM operations and amphibious assaults. The focus is upon improving algorithms for detection of mines, minefields, and essential elements of information, together with improving the methods and types of data acquisition in a timely manner.

(U) Task MODELING AND SIMULATION is a continuing effort, designed to determine project utility via simulations, wargames, and system studies. Initially focused on mine warfare, the focus of the modeling and simulation effort is on the assessment of potential Expeditionary Warfare technologies (specifically those associated with naval surface fire support). The methodology is to utilize warfighter-technologist interactions and warfighter driven simulation/visualization based technology assessment to explore current and proposed advanced technologies in tandem with relevant concepts of operations.

(U) The JOINT COUNTERMINE ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (JCM ACTD) began in FY 1995 with funds provided by the Office of the Secretary of Defense under another PE. Funding support was transferred to this PE in FY 1996. The JCM ACTD is a joint Army-Navy program with significant participation by the Marine Corps. The ACTD will integrate emerging new technologies with those already existing in the field to demonstrate seamless sea-to-shore mine countermeasure/countermine operations with heavy emphasis on clandestine surveillance and reconnaissance in support of expeditionary warfare objectives. Major demonstrations were conducted in FY 1997 and FY 1998. Following completion of the demonstrations, selected "residuals" of new equipment will remain with field forces until FY 2000 to facilitate "user" feedback, refine the concept of operations, and develop tactical doctrine. A Joint Countermine Operational Simulation and a Command, Control, Communications, Computers and Intelligence appliqué will be developed to facilitate system integration, allow for mission planning, and provide improved displays for operational commanders.

(U) Task ADVANCED AIRBORNE TARGET DESIGNATOR was begun in FY 1996 and is designed to improve targeting of precision guided munitions (PGM) from over-the-horizon (OTH) battlefield objects in support of Naval Surface Fires (NSF). Efforts include laser target rangefinding and laser designation from unmanned and manned platforms, rapid reporting of targets in existing and compatible formats.

(U) Task EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING was begun in FY 1996 and is designed to improve the connectivity between sea and land forces, particularly in support of NSF and for OTH operations. Concepts to be examined will include: prototype ship-to-shore, high data rate, digital, dynamically controlled network for timely sensor-to-shooter connectivity supporting littoral operations such as close air support, and Naval fire support including existing or planned systems for linking organic and theater surveillance assets such as Joint Surveillance Target Attack Radar System, EP-3, ES-3, and Airborne Warning and Control System. High Frequency (HF)/Very HF (VHF) /Ultra HF(UHF), cellular, and satellite communications

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systems such as Joint Tactical Information Distribution System, Common High Bandwidth Datalink, Military Strategic and Tactical Relay, and wideband line-of-sight tactical video will be included. Prototypes to be considered should be interoperable with the Improved Data Modem and Automated Target Handoff System and be capable of transitioning to the Navy's Communication Support System.

(U) Task SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE was begun in FY 1996 and is designed to improve the Navy's ability to monitor and survey the land battlespace for PGM from OTH in all-weather conditions from either manned or unmanned vehicles in support of NSF.

(U) Task MINE IDENTIFICATION was begun in FY 1998 and is designed to provide the capability to conduct rapid mine identification. Rapid mine identification has been identified as crucial to improving mine countermeasures timelines and for organic mine countermeasures. This effort focuses on the application of commercial off the shelf (streak tube technology for underwater imaging for mine identification.

(U) Task LITTORAL SEA MINE begins in FY 1999 and is designed to provide the technologies for development of an affordable littoral sea mine. The focus of this effort is on the development and demonstration of technologies for a wide area, littoral sea mine with remote control.

(U) Task VERY SHALLOW WATER (VSW)/EXPLOSIVE ORDNANCE DISPOSAL RECONNAISSANCE begins in FY 1999 and is designed to provide technologies to improve the capability to conduct MCM operations in VSW. The near term objective of this task is to improve the efficiency of our current diver operations in VSW through the demonstration and transition of improved diver technologies and Unmanned Underwater Vehicle (UUV) technologies which improve the efficiency of current VSW diver operations. The long term goal of this task is to demonstrate and transition technologies which fully replace the functions which are currently performed by divers.

(U) Task ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES begins in FY 1999 and is directed at providing the technologies for transition of naval MCM capabilities from dedicated to organic.

(U) Task SZ NEUTRALIZATION OF MINE AND OBSTACLES begins in FY 1999 and is directed at developing and demonstrating small, autonomous minehunting vehicles capable of detection, classification, identification and neutralization of small mines in surf zone environments.

(U) Due to the sheer volume of efforts included in this PE, the programs described in the Accomplishments and Plans section are representative selections of the work included in this PE.

(U) The Navy Science and & Technology program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity because it encompasses design, development, simulation, or experimental testing or prototype hardware to validate

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technological feasibility and concept of operations and reduce technical risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>
(U) FY 1999 President's Budget	\$36,876	\$41,710	\$48,930
(U) FY 1999 Appropriated Value:		\$42,710	
(U) Adjustments from 1999 PRESBUDG:	\$ 3,476	\$2,510	\$ -219
(U) FY 2000 President's Submission	\$40,352	\$44,220	\$48,711
(U) CHANGE SUMMARY EXPLANATION:			

(U) Funding: The FY 1998 increase is due to Actual Execution Update (+3,476). The FY 1999 increase is due to Execution Update (+2,000), Revised Economic Assumptions (-98), Civilian Personnel Underexecution (-70), Contract Advisory and Assistance reduction (-295), FFRDC (-27) and Congressional Plus-up for ALISS (+1000). FY 2000 decreases reflect adjustments for NWCF Rates, Civilian Pay Rates, and Inflation (-219).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1.(U) FY 1998 ACCOMPLISHMENTS:

- (U) (\$6,500) ADVANCED MINE AND OBSTACLE CLEARANCE: Demonstrated 1/5 scale beach zone (BZ) array (inert) and deployment system for neutralization of BZ mines. Transitioned beach zone array deployment technology to program element (PE) 0603502N. Demonstrated inert explosive line charges, Surf Zone (SZ) array, and Landing Craft, Air Cushion fire control in Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD) as part of Maritime Combined Operational Training (MARCOT98)/Unified Spirit (a combined Canadian/North Atlantic Treaty Organization (NATO) exercise).
- (U) (\$4,400) ADVANCED MINE SWEEPING: Completed integration of acoustic spark gap source and conductively cooled, low temperature superconducting magnetic subsystems on demonstration platform. Conducted final tests of both systems and performed field tests. Demonstrated Advanced Lightweight Influence Sweep System

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technologies in the JCM ACTD as part of MARCOT98/Unified Spirit (a combined Canadian/NATO exercise). Transitioned magnetic and acoustic technologies to PE 0603502N.

- (U) (\$5,100) ADVANCED DEGAUSSING: Completed tests of first generation closed-loop degaussing algorithms, advanced deperming, and stray field minimization technologies. Initiated transition of degaussing technologies to PE 0603513N, PE 0603502N, and to the Amphibious Transport Dock (LPD-17) program.
- (U) (\$4,200) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continued utilizing advanced sensors to measure critical battle space parameters and quantify their effectiveness. Demonstrated surveillance and reconnaissance of beach defense obstacles in the JCM ACTD demonstration. Began focused efforts to develop algorithms for determining beach topography, off-shore currents, and surf conditions in real-time.
- (U) (\$1,224) MODELING AND SIMULATION: Initiated modeling and simulation to conduct concept based assessment of potential Mine and Expeditionary Warfare technologies. The effort has emphasized warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and proposed advanced technologies in tandem with relevant concepts of operations (e.g. Operational Maneuver From The Sea, Sea Dragon).
- (U) (\$7,300) JCM ACTD: Completed analysis of JCM ACTD demonstration I data. Conducted second JCM ACTD demonstration as part of MARCOT98/Unified Spirit military exercise (combined Canadian/NATO exercise in Newfoundland, Canada). The JCM ACTD demonstration II included the demonstration of 10 novel mine countermeasures technologies plus demonstration of Joint Countermine Operational Simulation (JCOS) and JCM Command, Control, Communications, Computer and Intelligence (C4I) appliqué. Began post exercise analysis of JCM ACTD demonstration II. Began support for "residual" equipment to be left with operational forces for further evaluation.
- (U) (\$1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Conducted field tests of airborne target designator with live fires to determine accuracy of targeting to resulting fire locations. Completed documentation of field

test results and quantification of localization accuracy. Initiated efforts to improve navigational accuracy of airborne test bed.

- (U) (\$1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Conducted communication system interoperability tests in a laboratory and range environment. Demonstrated the shipboard integration and operation of advanced high capacity radio frequency links between ships at sea, as well as ship to an objective ashore. Began analysis and assessment of high capacity radio linkages between ships and ship to objective ashore.

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- (U) (\$3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Demonstrated emerging commercial off the shelf (COTS) technologies for real-time management and visualization of the Littoral Battlespace. Initiated analysis to assess potential increase in effectiveness and commensurate reduction of vulnerabilities of expeditionary forces.
- (U) (\$4,300) MINE IDENTIFICATION: Initiated effort to develop a prototype underwater imager, using COTS Streak Tube technology for rapid identification of mines from Air Mine Countermeasures helicopters and remote minehunting systems. Completed preliminary design review of Streak Tube Imaging Laser (STIL) mine identification prototype. Initiated laboratory testing of receiver and laser optical components.

2. (U) FY 1999 PLAN:

- (U) (\$3,770) ADVANCED DEGAUSSING: Complete all efforts in advanced deperming, closed loop degaussing, and algorithm development. Complete documentation of algorithms and demonstration results. Complete transition of degaussing technologies to PE 0603513N, PE 0603502N, and the LPD-17 construction program.
- (U) (\$3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused efforts on environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious assaults. Continue transitioning critical battle space products to the Naval Oceanographic Office. Demonstrate littoral remote sensing products during Fleet Battle Experiment (FBE) Echo (Kernal Blitz).
- (U) (\$1,500) MODELING AND SIMULATION: Continue simulation based concept based assessment focusing on assessment of technologies for naval surface fire support. The effort will continue to emphasize warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and advanced technologies in tandem with relevant concepts of operations. Initiate concept visualization of naval surface fire support technologies.
- (U) (\$2,700) JCM ACTD: Complete post exercise analysis of JCM ACTD Demonstration II. Document demonstration results. Continue logistics support for ACTD "residual" equipment left with operational forces. Complete JCOS and C4I documentation. Demonstrate C4I and JCOS during FBE-Echo (Kernal Blitz) as part of the residual phase. Incorporate "user" comments into final ACTD documentation.
- (U) (\$1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete field tests and demonstrations with live fires to determine accuracy of targeting to resulting fire locations. Continue documentation of field test results and quantification of localization accuracy. Initiate transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and Unmanned Aerial Vehicles (UAVs).

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- (U) (\$1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue demonstration of advanced high capacity radio frequency links between ships at sea, focusing on beyond line of sight communications between ships and objectives ashore. Complete assessment of high capacity radio technologies between ships at sea.
- (U) (\$3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Initiate development of component technologies for demonstration of a low cost, high speed guided projectile for Naval guns. Begin development of actuated aerodynamic control surfaces for control of high velocity projectiles. Begin development of an ultracompact, high G (>40,000 G) Global Positioning System/Inertial Measuring Unit (GPS/IMU) guidance package for guidance of high velocity naval ordnance.
- (U) (\$5,213) MINE IDENTIFICATION: Begin integration of component technologies together in the laboratory. Begin fabrication of final design suitable for tow-body configuration. Begin integration and performance of final design. Conduct tank tests of preliminary system.
- (U) (\$4,531) LITTORAL SEA MINE: Initiate design of littoral sea mine technology demonstration model. Initiate fabrication/testing of individual components. Begin development of data fusion algorithms and assured communication algorithms.
- (U) (\$5,769) VERY SHALLOW WATER/EXPLOSIVE ORDNANCE DISPOSAL (VSW/EOD) RECONNAISSANCE: Initiate integration of diver-portable detection, classification, and identification technologies such as diver-portable sonar, underwater imaging Light Detection and Ranging, and autonomous underwater vehicles. Develop simulation which provides for the evaluation of the approach and effectiveness of Unmanned Underwater Vehicles (UUVs) under varying environmental conditions to perform critical Mine Countermeasure VSW missions including search and inspection. Initiate trade-off studies of technical and operational concepts to include directed versus autonomous operation, deployment, recovery, command, control and communication. Prototype low-cost acoustic and magnetic induction navigation transponders and receivers to enable localization in VSW. Begin demonstrating technologies during training exercises to assess operational effectiveness.
- (U) (\$4,500) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Begin demonstration of advanced technologies for organic minehunting during Fleet training exercises to assess operational effectiveness and develop concept of operations. Demonstrate rapid, organic mine identification using electro-optic sensor (laser line scan technology) and synthetic aperture sonar during FBE Echo (Kernal Blitz). Demonstrate high speed influence minesweeping using ALISS technologies during FBE Echo (Kernal Blitz).
- (U) (\$4,700) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Initiate development a system of small, autonomous minehunting vehicles capable of detection, classification, identification, and neutralization of mines and

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obstacles in the SZ environments. Demonstrate navigation and communications capabilities of unmanned bottom vehicles operating in the surf zone environment. Demonstrate capability to achieve area coverage using random, programmed, and co-located group strategies.

- (U) (\$439) Portion of extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN

- (U) (\$3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious operations. Continue transition of critical battle space products to the naval oceanographic office.
- (U) (\$1,800) MODELING AND SIMULATION: Continue simulation based concept based assessment of technologies for naval surface fire support. Continue concept visualization of naval surface fire support technologies focusing on air space deconfliction.
- (U) (\$1,500) JCM ACTD: Continue logistics support for select ACTD "residual" equipment left with operational forces for further evaluation.
- (U) (\$462) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete documentation of field test results and quantification of localization errors. Complete transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and UAVs.
- (U) (\$3,000) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue evaluation of advanced high capacity communications links between ships at sea and ship to objectives ashore through assessment during Amphibious Ready Group deployments. Complete analysis and assessment of high capacity radio linkages between ships at sea and ships to objective ashore.
- (U) (\$5,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Complete development of actuated control surface for high speed projectile. Conduct wind tunnel tests. Complete development of ultracompact, high G GPS/IMU guidance package for high speed projectile. Integrate components and demonstrate guidance and control of an inert, high velocity 5 inch projectile. Begin development of composite metal fleschette and packaging and distribution warhead.

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- (U) (\$6,200) MINE IDENTIFICATION: Complete integration of component STIL technologies in airborne minehunting sonar (AQS-20) towbody. Initiate development of automated mine identification algorithms. Demonstrate mine identification at operational speeds from a surface ship tow. Quantify performance as a function of operational parameters. Demonstrate mine identification from a helicopter tow. Begin transition of STIL mine identification technology to PE 0603502N and PE 0604373N (Airborne Mine Countermeasures).
- (U) (\$5,000) LITTORAL SEA MINE: Demonstrate and evaluate assured communications between an underwater testbed and an external surface and subsurface control authority. Demonstrate and evaluate long baseline target detection and tracking sensor hardware and algorithms against quiet underwater targets.
- (U) (\$5,930) VSW/EOD RECONNAISSANCE: Develop search strategies which are optimized based on information provided by environmental survey data acquired by search and reconnaissance UUVs. Develop sensing technologies and capability to conjunctively employ sensed information between communicating platforms employing independently acquired sensed data. Demonstrate coordinated navigation and positioning in very shallow water through actual deployments of a search vehicle and inspection vehicle.
- (U) (\$7,319) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Complete analysis of Fleet Battle Experiment demonstration of advanced technologies for organic minehunting. Demonstrate and evaluate the use of a scaleable, interoperable tactical control system common to both UAVs and remote minehunting vehicles. Initiate development of a prototype H-60 compatible, conductively cooled, low temperature superconducting magnetic solenoid for organic sweeping of influence mines.
- (U) (\$4,000) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Demonstrate coordinated navigation and positioning in the SZ through actual deployments of an unmanned bottom crawling vehicle. Demonstrate autonomous detection and classification of threat-like bottom objects in the presence of natural and man-made clutter in the SZ. Demonstrate group search (up to 5 vehicles), report back of target information, and marking of targets.
- (U) (\$5,000) BZ NEUTRALIZATION OF OBSTACLES: Initiate development of Inverse Guidance Law concept which allows guidance of air dropped ordnance with GPS position and velocity state data only. Assess performance of against conventional GPS updated inertial navigation concepts. Begin development of air delivered, reactive, intermetallic darts for neutralization of mines on the beach.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

(U) PE 0601153N (Defense Research Sciences)

(U) PE 0602131M (Marine Corps Landing Force Technology)

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(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (MCM, Mining and Special Warfare Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0603502N (Surface and Shallow Water MCM)
(U) PE 0603513N (Shipboard System Component Dev)
(U) PE 0603528N (Non-Acoustic ASW)
(U) PE 0603612M (Marine Corps Mine Countermeasures)
(U) PE 0603640M (Marine Corps Advanced Technology)
(U) PE 0604373N (Airborne Mine Countermeasures)
(U) PE 0604784N (Distributed Surveillance System)

D. (U) SCHEDULE PROFILE: Not Applicable.

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