

UNCLASSIFIED

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 2000

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1999 ACTUAL	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Electronic Warfare Technology	22,399	37,459	26,043	28,510	28,848	28,880	28,651	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Navy Electronic Warfare (EW) Science and Technology (S&T) Program addresses identified technology requirements for EW in cooperation with the other Services, placing special emphasis on Naval EW roles in Information Warfare. This program develops technologies which support the effective utilization of Naval force capabilities in the conduct of the Navy's Joint Mission Areas defined by Office of the Chief of Naval Operations (OPNAV) (i.e., Strike, Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Command, Control, Communications, and Computers (C4) and Information Warfare, and Nuclear Deterrence/Counterproliferation of Weapons of Mass Destruction). It is also vitally associated with future joint warfighting capabilities of "maintaining near perfect real-time knowledge of the enemy and to counter the threat of cruise missiles to the Continental United States and deployed forces." The program is planned jointly in accordance with Defense S&T Reliance agreements that allocate various EW disciplines and their attendant technology development responsibilities between the Army, Air Force and the Navy. As part of the Integrated S&T EW Program, efforts are subject to review and execution oversight by the Director of Defense Research and Engineering (DDR&E) Technology Panel for Electronic Warfare (TPEW). This program is a primary technology feed for the newly established Platform Protection IPT to the ONR-091 Future Naval Capabilities initiative.

(U) The emergence of a polycentric strategic environment, the evolving and diversified nature of the threat, and the proliferation of arms and technology have contributed to shifting the focus of conflict to regional and littoral areas. Concurrently, the global arms industry continues to supply increasingly sophisticated sensors and weapons to the world-wide arms market. The heterogeneous combination of military and commercial systems dictates the need to develop more advanced EW technologies that will be able to adequately exploit and counter the use of new threats.

(U) The structure and balance of this program are responsive to OPNAV guidance and identified System Command warfighting requirements and needs. The program features the integration of 6.1 and 6.2 programs with 6.3 EW core

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programs and Advanced Technology Demonstrations (ATDs) which can produce prototypes suitable for naval force deployments and demonstrations. Program integration is achieved through the transition and implementation of program products. The program continues to support the Navy's highest priority need, Ship Self-Defense. It develops EW technologies to counter a range of threats (including multi-spectral/multi-modal sensors and seekers) and spans the entire electromagnetic spectrum by improving threat detection, identification, and location in the battle space. The program transitions new technologies to tactical aircraft (TACAIR), low observable aircraft, surface EW platforms, and Pre-Planned Product Improvement (P3I) programs through developmental upgrades and direct technology insertions.

(U) Due to the sheer volume of efforts included in this Program Element (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 (S&T) 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 APPLIED RESEARCH budget activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1999 ACCOMPLISHMENTS: Work continues on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance will continue. The development of micro and unmanned air vehicle designs for small radar cross section platforms and the infrared countermeasures (IRCM) development and stand-off jamming work continue to be of importance.
 - (U) THREAT WARNING - The objective is to develop small and inexpensive radio frequency (RF) receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying and countering the threat.
 - (U) Fabricated a miniaturized 12-bit prototype Specific Emitter Identification (SEI) system to perform within the confines of a platform such as a small unmanned air vehicle (UAV), providing specific target homing and

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discrimination capabilities for tactical aircraft, UAVs, and portable systems and making it attractive for application in weapons systems such as High Speed Anti Radiation Missile (HARM).

- (U) Designed and demonstrated a real-time prototype unit that extracts SEI information from modern tactical military radars possessing more stable, near flat, RF sources focusing on the tactical application of SEI to the commander in the field, onboard ship, or in the air.
 - (U) Developed a counterfire system based on microbolometer camera technology which is carried by the individual infantryman to detect and mark in space the location of small arms fire in real time and at ranges greater than or equal to the lethal range of the enemy weapon.
 - (U) Evaluated digital signal processing using wavelets, optical processing, and electrical micro-circuit realization of the wavelet filter bank. The most promising approach was selected for demonstrating an improved signal processing capability, for detection of frequency modulated, continuous wave (FMCW) signals with a signal-to-noise ratio of zero decibels. This addresses the Advanced Integrated Electronic Warfare System (AIEWS) program requirement for detection and identification of specific signals to provide early warning and cueing of ship self-defense weapons systems.
- (U) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard electronic warfare (EW) systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and Space and Electronic Warfare (SEW) Intelligence. The entire RF band from high frequency to millimeter wave is covered under this project. It also includes the protection of U.S. Naval platforms against electro-optic and infrared (EO/IR) guided weapons by the development of new infrared (IR) materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
 - (U) Analyzed designs of onboard laser guided weapons detection/protection systems and field tested prototype developmental systems for the integrated onboard/offboard countermeasures solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
 - (U) Determined most efficient jam codes against steering array sensors and transitioned most robust seductive waveforms to enhance capability of the AIEWS system against advanced IR guided anti-ship threats.
 - (U) Improved antenna isolation model to represent antennas mounted on Radar Absorbent Material (RAM) coated curved surfaces for all decoy platforms and finalized isolation improvement techniques and documented analysis methods to achieve higher decoy effective radiated power through improved antenna isolation.
 - (U) Performed field and at-sea tests of the Small Ship Jammer developed for physically small surface patrol crafts that have no active onboard EA self-protection capability (e.g., the PC-1 and MK V Special Operations Craft) and are currently involved in fleet littoral warfare operations.

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- (U) Demonstrated effectiveness of a new Optical Augmentation technique and feasibility of EO/IR countermeasures techniques against man-in-the-loop (MIL) threats. These technology improvements will be incorporated into the Multi-Band Anti-Ship Cruise Missile Defense Tactical Electronic Warfare System (MATES) testbed to provide an integrated multi-function, multi-band laser based countermeasures system for ship defense.
 - (U) Demonstrated a high-extinction obscuration material suitable for at-sea use for the advanced development of a vertically launched imaging IR decoy system for ships, to include a new obscurant, longwave material enhancement, and a subscale deployment vehicle.
 - (U) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual systems/platforms through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids which fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, electronic countermeasures (ECM) and other mission-support aircraft to improve situation awareness, to provide dependable combat identification and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.
 - (U) Demonstrated a partial payload of a Micro Air Vehicle capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman, for discreet Navy missions.
 - (U) Developed a visually rich command and control simulator capable of synthesizing realistic operations found in modern combat missions for assessing Naval operational situations, planning future operations, and evaluating system effectiveness.
 - (U) Validated the IR ship target and scene model for the cruise missile (CM) EW simulation to address the shortcomings of previous IR ship predictive codes.
 - (U) Plan and conduct tri-service field demonstration of the modified Little Monopulse Information Signal Processing Element (LMISPE) system capable of fingerprinting modern cellular radio communication systems from airborne platforms.
2. (U) FY 2000 PLAN: Work continues on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance will continue. The development of micro and unmanned air vehicle designs for small radar cross section platforms and the IRCM development and stand-off jamming work continue to be of importance.

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- (U) THREAT WARNING - The objective is to develop small and inexpensive RF receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive EO/IR technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying and countering the threat.
 - (U) Demonstrate and verify, in an operational test, specific target homing and discrimination capabilities with the use of extremely miniature components Analog-to-Digital (A/D) Converter, the pulse processor Application Specific Integrated Circuit (ASIC) and the Digital Signal Processor) packaged in sizes suitable for tactical aircraft, UAVs, and portable systems and making it attractive for application in weapons systems such as HARM.
 - (U) Integrate specific target homing and discrimination capabilities into a 4x4x1-inch package to create a miniature SEI system that is compact, lightweight, and power efficient. This will be accomplished using extremely miniature components packaged in sizes suitable for tactical aircraft, UAVs, and portable systems, making it attractive for application in weapons systems such as HARM.
 - (U) Optimize wavelet filterbank parameters and digital signal processing algorithms and fully demonstrate a system that extracts SEI information from modern tactical military radars possessing more stable, near flat, RF sources focusing on the tactical application of SEI to the commander in the field, onboard ship, or in the air. Transition to the AIEWS program.
 - (U) Develop and demonstrate technology building blocks to provide small, inexpensive integrated sensors to allow micro air vehicles (MAV) to detect and identify RF emitters, locate and navigate towards these emitters and deliver a sensor or countermeasure micro-payload for battlefield intelligence and situational awareness.
 - (U) Demonstrate an improved signal processing capability for detecting FMCW signals with a signal-to-noise ratio of less than zero decibels to address the AIEWS program requirement of detecting and identifying certain signals to provide early warning and cueing of ship self-defense weapons systems. Transition to the AIEWS program.
 - (U) Complete design and integration of an Compact Electronic Support (ES) System capable of being deployed on presently available remotely piloted vehicles to provide high quality threat information for strategic and tactical surveillance and reconnaissance missions.
 - (U) Develop and incorporate variable fidelity electromagnetic propagation models into the simulation providing a littoral capable force-on-force level simulator which establishes a common operating picture for the EW commander.

- (U) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard EW systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and SEW Intelligence. The entire radar frequency band

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from high frequency to millimeter wave is covered under this project. It also includes the protection of U.S. Naval platforms against EO/IR guided weapons by the development of new IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.

- (U) Complete integration and evaluation of the onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
 - (U) Incorporate a new mid-infrared solid state laser into the Multi-Band Anti-Ship Cruise Missile Defense Tactical Electronic Warfare System (MATES) testbed and investigate use of a compact IR countermeasures system for small shipboard platforms to provide an integrated multi-function, multi-band laser based countermeasures system for ship defense.
 - (U) Design and procure hardware/software for a surrogate command-and-control warfare (C2W) network to provide a self-adapting, spatially distributed command and control warfare and electronic attack (C2W/EA) network capable of electromagnetic battlefield dominance through target denial, obscuration, and signature alteration.
 - (U) Demonstrate high intensity per unit volume in the longwave band to improve the spectral performance of the IR special materials and incorporate with the vehicle autopilot and sensor control for the development of an imaging IR decoy system for ships, to include a new obscurant, longwave material enhancement, and a subscale deployment vehicle.
- (U) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual system/platform through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids that fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, electronic countermeasures and other mission-support aircraft to improve situation awareness, to provide dependable combat identification (ID) and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.
 - (U) Develop the final jamming payload, integrate it with the final Micro Air Vehicle design capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman for discreet Navy missions.
 - (U) Develop digital signal processing (DSP) hardware and algorithms to integrate with receiver/transmitter models for development of building block technologies needed for a small, lightweight, programmable Anti-Ship Missile (ASM) seeker simulator for packaging on a recoverable target drone to perform realistic at-sea threat engagement scenarios.

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- (U) Based on results of the STARCROSS studies, develop and test a high speed analog-to-digital and DSP intercept system to establish jamming requirements against mobile radio communications systems potentially employed by enemy forces.
- (U) Conduct an overall system level design (including Electronic Attack, Information Warfare and Artificial Intelligence) and model a coordinated Force-on-Force level engagement for deployment of distributed EW assets that can be used collaboratively in a synchronized fashion in real time.
- (U) Develop prototype set-up and control software models and establish parallelization efforts to reduce per-run execution time, simulation setup time, and post-run analysis time of the CM high-fidelity EW simulation model.
- (U) Define and fabricate RF Off-board Countermeasure (OCM) devices as part of a controlled network of OCM devices to enable any ship in the OCM network area to engage any anti-ship missile and steer it away from all ships in the OCM network protected area.

(U) FY 2001 PLAN: Work continues on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance will continue. The development of micro and unmanned air vehicle designs for small radar cross section platforms and the IRCM development and stand-off jamming work continue to be of importance.

- (U) THREAT WARNING - The objective is to develop small and inexpensive RF receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying and countering the threat.
 - (U) Develop and demonstrate receiver, direction finding and navigation technology subsystems to provide small, inexpensive integrated sensors to allow micro air vehicles to detect and identify RF emitters, locate and navigate towards these emitters and deliver a sensor or countermeasure micro-payload for battlefield intelligence and situational awareness.
 - (U) Demonstrate and transition an electronic support system capable of being deployed on presently available remotely piloted vehicles to provide high quality threat information for strategic and tactical surveillance and reconnaissance missions.
 - (U) Develop and incorporate adaptive radar and communications models into a littoral capable force-on-force level simulator which establishes a common operating picture for the EW commander.

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- (U) Demonstrate the feasibility of generating a coherent tactical picture of the battle scenario by employing Information Warfare Simulation technologies integrated with hardware sensor information in real-time support of the warfighter.

- (U) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard EW systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and SEW Intelligence. The entire radar frequency band from high frequency to millimeter wave is covered under this project. It also includes the protection of U.S. Naval platforms against EO/IR guided weapons by the development of new intermediate frequency (IF) materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
 - (U) Based on previous Army and Navy evaluation of obscurants, optimize a material to be evaluated along with the modified special material, integrate with the vehicle technology advancements, and evaluate the effectiveness against Imaging IR Anti Ship Cruise Missile (ASCM) seekers.
 - (U) Complete system integration and demonstrate in an over-water scenario the capability of providing an integrated multi-function, multi-band laser based countermeasures system for ship defense.
 - (U) Design and demonstrate high fidelity decoys that replicate detailed temporal, spectral and phase features of platforms, thus presenting a realistic target to the threat weapons system from an expendable vehicle which can be spatially separated from the platform.
 - (U) Fabricate and test the command-and-control warfare network, and initiate integration of the C2W network with the electronic attack (EA) subsystem for a self-adapting, spatially distributed C2W/EA network capable of EM battlefield dominance through target denial, obscuration, and signature alteration.

- (U) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual system/platform through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids that fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, electronic countermeasures and other mission-support aircraft to improve situation awareness, to provide dependable combat ID and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.
 - (U) Demonstrate the effectiveness of the final integrated payload/vehicle design and perform radar jamming tests of a Micro Air Vehicle capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman, for discreet Navy missions.

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- (U) Complete subsystem integration and feasibility demonstration of a small, lightweight, programmable Anti-Ship Missile (ASM) seeker simulator for packaging on a recoverable target drone to perform realistic at-sea threat engagement scenarios.
- (U) Conduct Tri-Service jamming tests to establish jamming requirements of mobile communications systems potentially employed by enemy forces.
- (U) Physically implement a coordinated electronic attack capability using available assets and conduct subsystem demonstrations in the lab to provide the capability for deployment of distributed EW assets that can be used collaboratively in a synchronized fashion in real time.
- (U) Complete parallelized full workload model and demonstrate the capacity of the overall model to reduce per-run execution time, simulation setup time, and post-run analysis time of the CM high-fidelity EW simulation model.
- (U) Design and develop algorithms and modeling concepts which allow for high fidelity user friendly models to be embedded in combat systems aboard land, sea or air platforms to provide training, scenario reconstruction, mission planning, and real time operational control.
- (U) Demonstrate RF offboard countermeasure (OCM) devices and define and fabricate infrared OCM devices as part of a controlled network of OCM devices to enable any ship in the OCM network to engage any anti-ship missile and steer it away from all ships in the OCM network protected area.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1999	FY 2000	FY 2001
FY 2000 President's Budget	22,743	24,659	25,462
Appropriated Value		36,259	
Comparability Adjustment from 0602232N	1,200	1,500	
SBIR/STTR Transfer	-48		
Program Adjustment			1,582
Various Rate Adjustments			-1,001
Inflation Adjustments	-103		
Execution Adjustment	-1,393		
Congressional Rescissions		-200	
Congressional Plus Ups		11,500	
FY 2001 PRESBUDG Submission	22,399	37,459	26,043

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(U) CHANGE SUMMARY EXPLANATION:

(U) Schedule: Not applicable

(U) Technical: The Special Access High Power Microwave (HPM) Program is transferred into this P.E. from P.E. 0602232N in FY2001 at a funding level of \$1.8M per year.

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

(U) RELATED RDT&E PROGRAMS:

This PE adheres to Defense S&T Reliance Agreements on EW with oversight and coordination provided by the DDR&E and is associated with efforts that are being pursued under the following Army and Air Force PEs:

- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0603270F (Advanced Electronic Warfare Technology)
- (U) PE 0602270A (Electronic Warfare Technology)
- (U) PE 0602270F (Electronic Warfare Technology)
- (U) PE 0603270A (Advanced Electronic Warfare Technology)
- (U) PE 0605604A (Survivability and Lethality Analysis)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602234N (Materials, Electronics and Computer Technology)
- (U) PE 0603270N (Advanced Electronic Warfare Technology)
- (U) PE 0603217N (Air Systems and Weapons Advanced Technology)
- (U) PE 0603792N (Advanced Technology Transition)
- (U) PE 0604270N (EW Development)

D. (U) SCHEDULE PROFILE: Not applicable.

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