FY 2003 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2002

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2001 ACTUAL	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Force Protection Applied Research	**	130,870	89,390	80,864	77,540	73,039	75,036	CONT.	CONT.

** The Science and Technology PEs were restructured in FY 2002. FY 2001 efforts were funded in PE(s) 0602121N, 0602122N, 0602232N, 0602270N, 0602633N.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. The goal of this project is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability.

(U) SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E) thrusts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability and advanced electrical power systems. Signature reduction addresses electromagnetic, infrared and acoustic signature tailoring, both topside and underwater. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Hydromechanics addresses hydrodynamic technologies, including the signature aspects of the hull-propulsor interface. Distributed intelligence for automated survivability addressees both the basic technology of automating damage control systems as well as distributed auxiliary control with self-healing capability. Advanced electrical power system addresses electrical and auxiliary system and component technology to provide improvement in energy and power density operating efficiency and recoverability from casualties.

(U) SENSORS & ASSOCIATED (S&A) PROCESSING thrust focuses on applied research for complementary sensor and processing technologies for 21st century warfighting success and platform protection. Current small platforms (both surface and airborne) have little to no situational awareness (S&A) or self-protection against air, surface, and asymmetric threats. The goal of this effort is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual or multispectral (Electro-Optic (EO)), Infrared (IR), Radio Frequency (RF), electromagnetic (EM), visual and acoustic) sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multispectral detection and distribution of specific threat information.

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(U) MISSILE DEFENSE (MD) applied research develops enabling technology for littoral Theater Air and Missile Defense (TAMD) enhancements for transition to acquisition programs. These enhancements will interact efficiently, effectively, and in time to detect, control, and engage projected anti-ship cruise missiles, overland cruise missiles, aircraft and theater ballistic threats. The Missile Defense Science and Technology (S&T) projects directly provide elements of the capability required by the Joint Requirements Oversight Council (JROC) TAMD Capstone Requirements Document (CRD) (2001). This PE includes those MD elements that perform risk reduction for Force Protection Capability. In addition, emerging S&T requirements for Discovery and Invention in the area of Directed Energy and Strike Technology are also included under Missile Defense. In the terminology of the TAMD CRD, Attack Operations (Strike) is a necessary element of Theater Air and Missile Defense in order to attack the air threat before they are launched.

(U) AIRCRAFT TECHNOLOGY thrust develops enabling technology for naval aviation, with emphasis on the demands imposed by aircraft carrier flight operations and Marine Corps amphibious and field operations relating to the Joint Mission Areas of Strike and Littoral Warfare. This program exploits emerging technologies of: (a) structures and flight controls to reduce the total life-cycle-cost and extend the operational life of legacy air vehicles; (b) reduced observables, (c) aerodynamic designs of Navy-unique aircraft components; (d) advanced gas turbine engine component designs and power systems for extended range/endurance; and (e) predicting safer, more reliable at-sea operating envelopes. The program provides mission area analysis and concept definition required for the applied research phase of air vehicle programs.

(U) Applied research efforts address manned and unmanned airborne platform technologies for future joint warfighting capabilities to promptly engage regional forces in decisive combat on a global basis and to employ a range of more suitable actions at the lower end of the full range of military operations, which achieve military objectives with minimum casualties and collateral damage. This thrust adheres to Defense Science and Technology (S&T) Reliance Agreements and supports the Department of Defense Science and Technology Strategy, which coordinates and minimizes duplication of aircraft technology efforts. Individual Navy aircraft technology applied research efforts fill Naval Aviation needs that are not met by Air Force, Army, National Aeronautics and Space Administration (NASA), Defense Advanced Research Projects Agency (DARPA) and industry programs.

(U) Aircraft Technology applied research addresses goals and payoffs set forth in the Air Platforms Defense Technology Area Plan (DTAP). At the Project Reliance Fixed Wing Vehicle taxonomy level, goals include Aerodynamics, Flight Control, Subsystems, Structures and Integration technologies.

(U) UNDERWATER (UW) PLATFORM SELF DEFENSE thrust develops enabling technologies that will increase the survivability of surface ship and submarine platforms against torpedo threats. Proposed technologies focus on defeating high priority threats including torpedoes (i.e. straight running, wake homing, acoustic homing, high speed torpedoes, air dropped torpedoes, and salvoes of torpedoes). The long-term goal of the UW Platform Self Defense effort is to develop

technologies that will ultimately be placed on board ship. Technologies should be developed to minimize shipboard impact, allow automatic employment, and require no organizational maintenance. Specific technology includes two programs. The Next Generation Countermeasure (NGCM): A mobile adaptive acoustic countermeasure with acoustic communication links to enable countermeasure connectivity and group behavior to defeat threat torpedoes. The Anti-Torpedo Torpedo (ATT)/Tripwire Demonstration: Technologies that improved passive shipboard detection, classification, and localization (DCL) of incoming torpedoes and an ATT to engage the threat torpedoes.

(U) Due to the number of efforts in the PE, the programs described are representative of the work included in the PE.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is funded 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.

B. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 2001 ACCOMPLISHMENTS:

(U) ($32,106) SURFACE SHIP & SUBMARINE HM&E

- (U) Signature Reduction:

Initiated:
(U) For Submarines - Evaluation of control algorithms for advanced degaussing/de-amping of submarine hulls. Feasibility study to develop realizable modular hull/payload modules. For Surface Ships – Assessment of optional degaussing coil arrangements coils arranged internal to hull. Planning of next generation IR scene model. (Funded in PE 0602121N).
Continued:
(U) For Submarines - Evaluation of submarine flanking path acoustic propagation with a multi-component evaluation. Development of advanced numerical acoustic codes and gridding methods with limited benchmarking. For Surface Ships – Development of physics based numerical model for electromagnetic scattering of hydrodynamic disturbances. (Funded in PE 0602121N).
Completed:
(U) For Submarines – Full-scale trial to establish hull response and radiated noise levels with hull treatments applied. For Surface Ships – Electric field measurements made on an existing 1:96 scale model DDG-51 physical model, validating Boundary Element Model (BEM). Evaluated and procured High Frequency (HF) transmit and receive antennas for at-sea measurements. (Funded in PE 0602121N).

- (U) Hull Life Assurance:

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
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Initiated:
(U) Analytical tool development for dynamic magazine protection. (Funded in PE 0602121N)
Continued:
(U) Installation and demonstration of the fiber-optic health monitoring system on the RV-Triton. Extension of numerical models and methods to better predict sub-detonation reactions in propellants and explosives. Design tool for integrated antenna and composite topside. Design guidelines for stainless steel advanced doublehull. Design concepts for hybrid composite/stainless steel joints. (Funded in 0602121N).
Completed:
(U) Concept design and requirements definition for dynamic magazine protection. Characterization of composite hull response to explosive loads. Development of composite hull criteria. Large-scale laboratory demonstration of the hardware and software for a fiber-optic hull monitoring system for ship hulls under cyclic load and high strain conditions. Hybrid hull design concept with reduced signature composite bow and stern, and potentially lower whipping stresses. (Funded in PE 0602121N).

- (U) Hydromechanics:

Initiated:
(U) For Submarines: Explorations of two advanced, multi-shaft (multi-propulsor), water-jet/pump propulsion systems with the goals of significantly reducing low-frequency noise and facilitating ship arrangement improvements. (Funded in PE 0602121N).
Continued:
(U) For Submarines: Improved maneuvering simulation capability. For Surface Ships: Development, validation, and application of numerical methods to integrated propulsor/hull for advanced surface ship configurations. (Funded in PE 0602121N).
Completed:
(U) For Submarines: Concept design of a looped-blade propeller for a full-stern propulsor. For Surface Ships: Developed experimental techniques for acquiring hydro surface data. Study on the variable pitch prop design. (Funded in PE 0602121N).

- (U) Distributed Intelligence for Automated Survivability:

Continued:
(U) Investigation of fire and smoke spread modeling for damage control. (Funded in PE 0602121N).
Completed:
(U) Validation of viability of self-healing control network and Commercial Off the Shelf (COTS) automation by demonstration on YP-679. Completed demonstration of automation technology to provide 85% reduction in damage control manning. (Funded in PE 0602121N).

- (U) Advanced Electrical Power Systems:

Initiated:

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
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(U) Concept studies and validation efforts for a Universal Controller Architecture concept. Design for a Power Quality (PQ) product in the 1-2MVA range and a Distributed Power Generation product in the .1-.5 MVA ranges. Efforts to transfer wafer-bonding technology to commercial production to allow affordability for Navy applications. (Funded in PE 0602121N).
Continued:
(U) Development of solid-state technology for high power distribution systems. (Funded in PE 0602121N).
Completed:
(U) Quiet solid-state circuit breaker operation. Power Electronics Building Block Concept (PEBB) accepted as an Institute of Electrical and Electronic Engineers (IEEE) standard (IEEE, WG 18). Demonstration of the capability of Fast-Turn-Off (FTO) modules. Transition of Power Node Control Center to Navy Sea Systems Command (NAVSEA). ON-Switch (N type Metal Oxide Semiconductor (MOS) Controlled Thyristor, (NMCT) qualified for multiple “smart munitions” systems. (Funded in PE 0602121N).

(U) ($6,850) SENSORS & ASSOCIATED PROCESSING:

- (U) Distributed Aperture System:

Continued:
For Surface Ship, the Shipboard Laser Acquisition System (SBLAS), a common laser warning solution for all naval surface vessels that can detect and locate tactical laser threats by indirect scattering as well as direct illumination, successfully demonstrated proof of concept of single sensor laser-threat warning for large ships and wide area protection for amphibious assault vehicles. SBLAS Critical Design Review (CDR) was successfully conducted and long-lead procurement initiated for system fabrication, delivery and testing under the Platform Protection FNC (PPFNC) Electronic Warfare (EW) Integrated Self-Protection for Small Surface Platforms (EWISSP) program commencing in FY02. (Funded in PE 0602270N)
Completed:
(U) For Surface Ships, the Navy studied various concepts and designs for ship based Infrared Search and Track (IRST). The study looked at two technology options for shipboard IRSTs-- full staring and step-staring. The study results recommend the full staring technology, using anemorphic optics and electronic stabilization techniques. This study provides the bases for the Distributed Aperture System (DAS) and the technology to pursue for the DDX, CGX, and CVNX. Also, the Navy has successfully demonstrated the porting of shipboard IRST signal processing algorithms to processor independent Middleware interface software for application in the DAS. (Funded in PE 0602270N and 0602232N).
(U) Supports the EW Electro-Optic/Infra Red (EO/IR) technology development projects within the PPFNC. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against threat missile systems which EW threat warning and self-protection capabilities can provide. The focus of FY01 efforts was to develop EO/IR technologies that could provide these platforms the capability to achieve very accurate hemispheric direction-finding (DF) of radio frequency (RF) signals and deny the enemy their effective use

or exploit their weaknesses. This capability, when integrated with emitter identification and Low Probability of Intercept (LPI) detection systems, will provide netted targeting information and cueing that allows for platform self protection against various threat systems. (Funded in PE 0602270N and 0602232N).
Continued:
(U) For Naval Aircraft, the Electrical IR Decoy Launcher project successfully evaluated alternate decoy launcher concepts including the rail gun and coil gun concepts and successfully conducted a single shot demonstration firing of a full size decoy to deployment velocity. (Funded in PE 0602270N).
Completed:
(U) For Naval Aircraft,the Multicolor Threat Warning project demonstrated the capability to use a charged coupled device to obtain wide-angle search to detect narrow atomic line emissions in missile plumes using a very narrow bandpass spectral filter to remove clutter. This capability will aid in the detection of threat non-radio frequency (RF) missiles in order to effectively deploy countermeasures improving aircraft survivability. (Funded in PE 0602270N).

(U) ($13,564) AIRCRAFT TECHNOLOGY:

- (U) Integrated Avionics:

Continued:
(U) Overall multi-mode visually-coupled display system technology integration enhancement between visor optics, three dimensional (3-D) audio, precision head tracking and selected threat protection technology. (Funded in PE 0602122N).
Completed:
(U) Field demonstration of the baseline Navy Crusader flightworthy day/night helmet-mounted display system including night cameras and baseline image fusion module operations. (Funded in PE 0602122N).
(U) Advanced digital magnetic head tracker acceptance and performance validation testing. (Funded in PE 0602122N).

- (U) Naval Air Vehicle Technology:

Continued:
(U) Development of prediction of corrosion-assisted fatigue degradation within a scatter factor of four to development engineering guidelines for maintenance practices. (Funded in PE 0602122N).
(U) Development of analysis of dynamic load effect on fatigue life. (Funded in PE 0602122N).
(U) Development and simulation of automated maneuvering algorithms to improve lethality, safety, and survivability for Naval Mission tasks. (Funded in PE 0602122N).
(U) Development, integration, and testing of intelligent flight control prognostics and reconfiguration to improve safety, survivability, and maintainability. (Funded in PE 0602122N).

(U) Flight-testing with DARPA and Boeing of a Unmanned Air Vehicle (UAV) to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept. (Funded in PE 0602122N).
Completed:
(U) Implementation and simulation testing of seven different non-linear, intelligent, and adaptive guidance and control laws for the Intelligent and Adaptive Guidance and Control Law Study. (Funded in PE 0602122N).
(U) Initial non-real-time high-fidelity simulation testing of system level fault diagnostics including system failure identification and reconfiguration. (Funded in PE 0602122N).
(U) Initial development testing of flight control hardware prognostics algorithms using data sets. (Funded in PE 0602122N).
(U) Initial simulation of advanced carrier landing algorithms using both an F/A-18 and an unconventional aircraft. (Funded in PE 0602122N).
(U) Medium fidelity Uninhabited Combat Air Vehicle (UCAV) simulation with no distribution limitations for university participants. (Funded in PE 0602122N).
(U) Two high-speed wind tunnel tests of the F/A-18E in the NASA-LaRC 16-ft Transonic Tunnel (TT). The first test used highly instrumented wings to measure both steady and unsteady pressure coefficients as well as root mean square (RMS) data of the forces and moments. This pressure data was then used to validate several structured and unstructured computational fluid dynamics (CFD) codes. (Funded in PE 0602122N).

- (U) Classified program. (Funded in PE 0602122N).

(U) ($2,138) UNDERWATER PLATFORM SELF DEFENSE

- (U) Underwater Platform Self Defense:

(U) Initiated: None
Continued:
(U) Development of ATT and Tripwire Torpedo Defense System (TDS) technology. (Funded in PE 0602633N).

- (U) Classified program. (U) Classified program. (Funded in PE 0602633N).

(U) FY 2001 Congressional Plus-Ups:

- (U) ($4,839) Three Dimensional Printing (3DP) Metal Working Technology: Demonstrate an electronic-based manufacturing capability that would incorporate a Three Dimensional Printing (3DP) machine and supporting process equipment. Three Dimensional Printing is a rapid solid freeform process for metal and metal composite parts and tooling equipment. (Funded in PE 0602121N)
- (U) ($1,931) Electromagnetic Propulsion Systems: Develop new high-energy technologies for electric power storage, distribution, and electric propulsion systems on Navy ships. (Funded in PE 0603508N)

• (U) ($7,726) Advanced Hull Form In-Shore Demonstrator (AHFID): Complete preliminary design of complete subscale AHFID Rim Driven Propulsor (RDP) electric drive system installation on Hybird Small Waterplane Area Craft (HYSWAC) vehicle, preliminary design of all components and some long lead procurements. Complete redesign and model tests of RDP for improved efficiency is underway. (Funded in PE 0603792N)

2. (U) FY 2002 PLANS:

(U) ($55,638) SURFACE SHIP & SUBMARINE HM&E

• (U) Signature Reduction:

Initiate:

(U) For Submarines: Development of analytical models to further define modular submarine hull concepts. For Surface Ships - Planning of tow tank acoustic tests and numerical model of uncoated surface combatant hull for surface ship acoustic program. Antenna isolation measurement for both high band and low arrays integrated into topside structures. Assessment of technology options for electromagnetic, thermal, electro-optical and visual signature reduction of Low-Observable Integrated Deckhouse (LID). Assessment of susceptibility of surface ships electrical fields causing mines to trigger for Near Field Deamping program. Development of a measurement system to evaluate scaling relationships for hydrodynamic disturbances.

Continue:

(U) For Submarines - Evaluation of control algorithms for advanced degaussing/de-amping of submarine hulls. Development of advanced numerical acoustic codes and gridding methods. For Surface Ships - Development of technology options for electromagnetic, thermal, electro-optical and visual signature reduction of LID. Assessment of susceptibility of surface ships electrical fields causing mines to trigger for Near Field Deamping program. Development of physics based numerical model for electromagnetic scattering of hydrodynamic disturbances.

Complete:

(U) For Submarines – Feasibility study to develop realizable modular hull/payload modules. Analyze full-scale trial data to establish hull response and radiated noise levels with hull treatments applied. For Surface Ships – Validate numerical model to predict the eddy current contribution to magnetic signatures. Assessment of both internal and external degaussing coil arrangements. Recommendations for physics and software architecture for the next-generation infrared scene model.

• (U) Hull Life Assurance:

Initiate:

(U) Component design for dynamic magazine protection. Study of Advanced Design Hardening Methods for hull structure design for Stainless Steel Advanced Double Hull (SSADH), Composite Hybrid Hull and other hull forms. Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy. Develop tools to describe failure mechanisms of sandwich composites.

Continue:

(U) Characterization of composite hull shock response with shock table tests on topside joints. Design tool for integrated antenna and composite topside. Analysis of results for composite hull shock tests performed in the Baltic Sea (joint effort with Germany).
Complete:
(U) Complete analytical tool development for dynamic magazine protection. Demonstrate the fiber-optic health monitoring system on the RV-Triton during rough weather trials.

- (U) Hydromechanics:

Initiate:
(U) For Submarines: Maneuvering experiments using existing/modified propulsor hardware from the VIRGINIA and Office of Naval Research (ONR) Advanced Stern Programs. For Surface Ships: Identification and quantification of bubble sources around surface ships, including wave-breaking and turbulence effects.
Continue:
(U) For Submarines: Improved maneuvering simulation capability. For Surface Ships: Numerical prediction of hydrodynamic disturbances generated by surface ships. Development, validation, and application of numerical codes to integrated propulsor/hull for advanced surface ship configurations. Numerical prediction of radar returns from nearby waves to surface waves at ship position and the resulting motion response prediction.
Complete:
(U) For Submarines: Comparison of computational and experimental results for a looped-blade propulsor concept and design a looped-blade propeller for a full-stern propulsor. For Surface Ships: Demonstration and evaluation of the variable pitch prop design.

- (U) Distributed Intelligence for Automated Survivability:

Initiate:
(U) Assessment of explosion mitigation through preemptive use of water mist for advanced damage countermeasures.
Continue:
(U) Investigation of fire and smoke spread modeling for damage control
Complete:
(U) Automated damage control effort to provide design criteria for automated systems.

- (U) Advanced Electrical Power Systems:

Initiate:
(U) Support of power & energy research infrastructure, including major test and instrumentation needs, for such things as advanced prototype testing, Superconducting Magnetic Energy Storage (SMES), and other applications of superconductivity, as well as, power and control systems.
(U) Studies to define advanced system state estimation concepts for controls and sensors. Development of technology basis for a family of electromechanical actuators. Advanced thermal management concepts and components.

Continue:
(U) Evaluation of the potential of impact wafer bonded FTOs for future Navy systems. Evaluate potential applications of silicon-carbide in future high voltage and high power applications. Power electronics technology to reduce the size, weight and cost of Electromagnetic Aircraft Launch and Recovery System.
Complete:
(U) Demonstration of advanced passive components for high voltage application.

(U) ($14,136) SENSORS & ASSOCIATED PROCESSING:

- (U) Distributive Aperture System:

(U) Initiated:
For Surface Ships, the Navy intends on beginning advanced research for the development of a ship based Distributed Aperture System (DAS) Infrared Search and Track (IRST) for DDX, CGX, and CVNX platforms. The DAS will address future surface combatant needs to win or avoid engagements by weapons and platforms, and asymmetric threats faced in the littorals. The DAS program will investigate, examine and evaluate new technologies and techniques for focal plane arrays, anemographic optics, stabilization techniques, modularized replaceable packaging, and high-speed processors and algorithms. The DAS sensor, consisting of eight modules for surface ships will vary based on the size of ship. It will provide surface ships with a 360-dgree panoramic staring view on the horizon to line of sight, and will detect, declare, and track air contacts and surface contacts within 2-3 seconds. The sensor modules can pan downward to view the surface from near the ship to line of sight for in port counter terrorism awareness. DAS will address the surface naval ships needs for a passive fighting ability and in-port security capability. Two International FY02 Project Agreements (United Kingdom and Australia) will assist the DAS program in the development of sensor, signal processing algorithms, and high-speed technologies.
(U) For Naval Aircraft, As anti-air threat missile systems increase in both number and technical sophistication, the Navy is developing a Missile Warning System (MWS) project that uses a solid-state two color staring sensor and tracking system to provide aircraft systems with the detection, location and identification of sophisticated threat missiles with the fidelity required to queue laser-based directional infrared countermeasures (DIRCM) systems and launch off-board decoys. The MWS system will demonstrate a time-to-go accuracy of +/- 15% for missile ranges greater than 1.5 kilometers and a 75% increase in the minimum detection range for Man Portable Air Defense Systems (MANPADs) with no increase in the false alarm rate.
(U) For Naval Aircraft, the EO/IR Laser Jammer for Tactical Aircraft (TACAIR) project will focus on components related to the jamming portion of the DIRCM system that also includes the MWS project. These components include technology enhancements to the power and beam characteristics of the laser-based countermeasure and demonstrating effective jam codes for all Tier 1 and Tier 2 threat missiles and a common jam code with 95% effectiveness for all Tier 1 and Tier 2 threat missiles. These capabilities will enable tactical aircraft to

operate routinely in airspace below 20,000 feet by providing self-protection against current and advanced IR guided missile threats.

(U) For Surface Ships A Shipboard EO/IR Closed Loop Self Protection project will be developed to demonstrate an integrated threat detection, classification, and closed loop laser jamming system to counter EO/IR/Laser guided anti-ship missiles. This will be done by using a multi-line high power laser system operating in the visible to longwave IR spectral band; a rangefinder that will range passive targets out to 20km; and a transceiver and signal processor that will classify a target in less than 3 seconds.

(U) For Small Platforms, EO/IR self-protection for Small Surface Vehicles, part of the Electronic Warfare Integrated System for Small Platforms (EWISSP) project, was initiated to provide a small platform with automatic response self and local area protection against IR guided and laser designated missiles and munitions. This will be accomplished with an integrated system capable of detecting and localizing laser designators and providing missile launch indication at a range of 4 km. The EWISSP effort will be continued under PE0602235N in FY03.

(U) For Marine Corps, the End User Terminal (EUT) project, structured to develop improved personal communications, situational awareness and sniper detection for ground troops that use less power, provide greater range and ease of use, was initiated and will use a central processing unit that delivers the performance similar to the 550 MHz Pentium III but at ¼ the power level. The daylight readable low power display will provide a minimum of 256 colors and an 80% power reduction over existing units.

Completed:

(U) For Surface Ships, the Shipboard Laser Acquisition System (SBLAS) project will complete fabrication and characterization of an off-axis laser detection system and a decoy subsystem that will become part of the EWISSP project.

(U) For Naval Aircraft, the Electrical IR Decoy Launcher is developing the capability for multiple decoy shots and investigating components and designs for a non- foreign object damage (FOD) less cartridge.

(U) ($33,467) MISSILE DEFENSE

Initiate:

(U) As part of the Missile Defense Future Naval Capability: The Infrared Sensors project will initiate requirements analysis and technical assessment of alternatives for advanced IRST for airborne detection of Theater Ballistic Missile (TBM) events. The Littoral Affordability project will develop affordable elements of multi-spectral sensor and combat systems for the purpose of early detect-through-engage functions over-the-horizon from firing ships.

(U) The following Discovery and Invention will commence: The Directed Energy project will build upon free electron laser technology to conduct design studies and component development for a 100kw Free Electron Laser for potential naval use. The Advanced Energetics project will be the Navy component of the Defense Threat Reduction Agency led Thermobaric Warhead Explosive Fill ACTD. This work will include composition synthesis and process development for

this explosive fill. Using as a basis the Army Developed Tactical Cruise Missile System (TACMS), feasibility and design efforts will be conducted for adaptation of this system to a submarine launched TACMS, TACMS-P, for a wide range of precision strike targets.
Continue:
(U) As part of the Missile Defense Future Naval Capability: The Distributed Weapons Coordination (DWC) project, an evolution from Composite Threat Evaluation / Weapon Assignment (TEWA), will develop algorithms (compatible with an open-architecture combat system) for the purpose of collating theater-wide sensor use and weapons status for common threat evaluation (CTE) and Preferred Shooter Recommendation (PSR) functions. The DWC project will develop and demonstrate Navy Area TBM Defense CTE and PSR functionality at a laboratory simulation facility.

(U) ($10,185) AIRCRAFT TECHNOLOGY
(U) Naval Air Vehicle Technology (includes Integrated Avionics):
Initiate
(U) Technology demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
(U) Technology demonstration of an innovative composite structural configuration of dynamically loaded rotary components.
(U) Real-time CFD modeling of ship airwake flows to provide higher fidelity simulations, enhancing safety.
(U) Laboratory validation of a new, innovative design concept for dynamically loaded rotary components for the Maximizing Usable Service Times (MUST) Program.
(U) Development of two full-scale demonstrations of the innovative design concept for dynamically loaded rotary components for the MUST Program.
Continued:
(U) Abrupt Wing Stall) figures of merit development and verification, CFD validation, and wind tunnel test techniques to mitigate/eliminate AWS on current/future fighter/aircraft aircraft.
(U) Development and simulation of advanced control laws for ship-board auto-land of unconventional vehicles.
(U) Development and simulation of automated maneuvering algorithms to improve lethality, safety, and survivability for Naval Mission tasks.
(U) Development of Advanced optics and head tracker of a multi-mode helmet vision system.
Complete:
(U) Flight-testing with DARPA and Boeing of a UAV to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept.
(U) Piloted simulation of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.

(U) Classified program.

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(U) ($2,612) UNDERWATER PLATFORM SELF DEFENSE

- (U) Underwater Platform Self Defense:

Initiate:
(U) Development of technology for a Next Generation Countermeasure (NGCM)
Continue
(U) Development of ATT component technology in propulsion, MicroElectroMechanical Systems (MEMS), and Guidance and Control (G&C)

(U) FY 2002 Congressional Plus-Ups:

- (U) ($991) American Underpressure System (AUPS): Complete the test program of the AUPS including the control system design. The project will develop control simulation data to verify performance and safety of the system in order to fully respond to the United States Coast Guard stated requirements and permit rulemaking changes.
- (U) ($857)Battery Charging Technology: Provide applied research efforts to the development of improved battery charging technology.
- (U) ($3,568) Center for Advanced Transportation Technology: Provide applied research support to the Center for Advanced Power Systems (CAPS).
- (U) ($991) Endeavor: Develop a software environment for advanced marine vehicles and operations research, with an emphasis on physics based modeling.
- (U) ($4,460) Fusion of Hyperspectral and Panchromatic Data: Research to develop a real-time airborne fusion processor and algorithms for the Navy Hyperspectral/Imaging for Surveillance and Targeting (HISTAR) program. Establish proposal for HISTAR. Research to support development of a hyperspectral sensor and signal processing for the Shared Reconnaissance Pod (SHARP) on the F/A-18 aircraft for real-time detection and classification of threat targets.
- (U) ($1,487) Modular Advanced Hull Form: Research structural issues associated joining steel and composite materials, as well as investigating concepts of generic hybrid composite Naval ship hull construction.
- (U) ($2,478) Three Dimensional Printing (3DP) Metal Working Technology: … Provide applied research to the technique of three dimensional printing (3DP) metal working.

3. (U) FY 2003 PLANS:

(U) ($45,990) SURFACE SHIP & SUBMARINE HM&E

- (U) Signature Reduction:

Initiate:

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(U) For Surface Ships – Initiate surface ship acoustic hull radiation model development. Initiate flow noise model development for surface ships. Development of next generation IR scene model.
Continue:
(U) For Submarines - Algorithm/finite element model validation for submarine advanced degaussing/deamping. Development of advanced numerical acoustic codes and gridding methods. Continue development of analytical models to further define modular submarine hull concepts. For Surface Ships - Antenna isolation measurement for both high band and low arrays integrated into topside structures. Demonstration of technology options for electromagnetic, thermal, electro-optical and visual signature reduction of Low-Observable Integrated Deckhouse (LID). Development of physics based numerical model for electromagnetic scattering of hydrodynamic disturbances.
Complete:
(U) For Submarines- Assessment of internal foundation structure impact to hull response to excitation/propulsion drive types. For Surface Ships – Tank test for surface ship acoustic behavior validation. Assessment of susceptibility of surface ships electrical fields causing mines to trigger for Near Field Deamping program. Experimental and analytical assessment EM scattering from droplets and sprays and the preliminary version of Next Generation IR Code for Verification and Validation.

- (U) Hull Life Assurance:

Continue:
(U) Definition of composite hull structural failure modes and mechanisms, development of design concepts and design guidance for composite structural details. Design tool for integrated antenna and composite topside.
Complete:
(U) Component design for dynamic magazine protection. Study on Advanced Design Hardening Methods for hull structure design for SSADH, Composite Hybrid Hull and other hull forms.

- (U) Hydromechanics:

Initiate:
(U) For Submarines: Model testing of a looped-blade propeller with a full stern to characterize powering, cavitation, acoustic, and maneuvering performance.
Continue:
(U) For Submarines: Improved maneuvering simulation capability. Investigation of flow conditions and hull propeller interaction of fine and full sterns during maneuvering. Develop experimental methods to control/eliminate the cavitation and apply to model-scale propellers. For Surface Ships: Development, validation, and application of numerical codes to integrated propulsor/hull for advanced surface ship configurations.
Complete:
(U) For Surface Ships: Numerical prediction of hydrodynamic disturbances generated by surface ships. Cavitation prediction of variable pitch propeller by numerical methods.

- (U) Distributed Intelligence for Automated Survivability:

Continue:
(U) Assessment of explosion mitigation through preemptive use of water mist for advanced damage countermeasures. Investigation of fire and smoke spread modeling for damage control.

- (U) Advanced Electrical Power Systems:

Continue:
(U) Development of technology basis for a family of electromechanical actuators. Advanced thermal management concepts and components. Development of compact high-powered solid state switching technology for the Electromagnetic Aircraft Launch System (EMALS) and other pulsed and steady state applications. Development of advanced power system and control architectures for operation and reconfiguration of future all-electric ships. Support of power & energy research infrastructure, including major test and instrumentation needs, for such things as advanced prototype testing, Superconducting Magnetic Energy Storage (SMES), and other applications of superconductivity, as well as, power and control systems.
Complete:
(U) Transition of demonstration Hardware, Application, and System Managers to advanced EMALS program Commercial PEBB-based utility products available for Navy application.

(U) ($10,400) SENSOR & ASSOCIATED PROCESSING:

- (U) Distributive Aperture System:

Initiated:
(U) For the Naval Aircraft, the Integrated Defensive Electronic Countermeasures (IDECM) project will add additional capability to the radio frequency countermeasures (RFCM) system for F/A-18 E/F self-protection. This consists of developing a RF decoy towline capable of operating intermittently for 30 seconds at 650 degrees centigrade for 3 minutes total exposure time and applying Gallium Arsenide technology to design a prototype solid-state transmitter for the fiber optic towed decoy.
Continued:
(U) For Surface Ships, the Navy will continue developing DAS technologies and associated processing with the International Partners. Work schedule for FY03, 04 and 05 will seek to examine and integrate the sensor modules into a single system design to support shipboard combat operations. A high-speed processor and associated algorithms, ported to middleware, will be examined for real-time application. Technologies will be tested and verified in laboratories prior to shipboard DAS demonstration. The DAS program will deliver a three-sensor package with associated processing and high-speed central processor for integration into surface combatants. International partners will mirror the U.S. effort and help to explore, examine, and evaluate the DAS sensor, signal processing algorithms, and high-speed processor technologies to support a FY05/06 demonstration.
(U)For Marine Corps, the EUT project will examine techniques to inject advanced-scope information into its network and commence integration of the RF module and the vest/garment. Enhanced RF transmitters will be

developed using Gallium Nitride on Silicon Carbide transistor technology. The goal is a factor of 3 improvement in efficiency vs. current man wearable transmitters being used by the Marine Corps Warfighting Laboratory.
(U) For Naval Aircraft, the EO/IR laser jammer for Tactical Air (TACAIR) project continues to examine two-color (low operating temperature) Focal Plane Arrays for common optics.
(U) For Naval Aircraft, the MWS project will undertake improved time-to-go (TTG) accuracy testing, attend live fire demonstrations and tests as well as continue to test high temperature focal plane arrays.
(U) For Surface Ships The Shipboard EO/IR closed loop self-protection project will complete the development of the optical train design and continue development of the data processor and optical augmentation software algorithms for threat classification. The repackaging of the mid-wave IR laser will be completed in preparation for a future functional field demonstration.

(U) ($21,500) MISSILE DEFENSE

Continue:
(U) As part of the Missile Defense Future Naval Capability: The Infrared Sensors project will validate sensor design for E-2C aircraft-compatible IRST sensor, capable of detecting TBM events and cueing radio frequency (RF) sensors at meaningful ranges as well as conduct critical component tests. The Distributed Weapons Coordination (DWC) project will continue development of algorithms for the AEGIS Combat System, CTE and PSR functions. It will also demonstrate Navy Anti-Air Warfare (AAW) combined with terminal TBM defense functionality in a laboratory simulation facility. The Littoral Affordability effort will develop affordable elements of multi-spectral sensor and combat systems for the purpose of early detect-through-engage functions over-the-horizon from firing ships.
(U) As part of Discovery and Invention: The advanced energetics project which includes composition synthesis and process development for the Thermobaric Warhead Explosive Fill ACTD will continue.

(U) ($10,000) AIRCRAFT TECHNOLOGY

- (U) Naval Air Vehicle Technology (includes Integrated Avionics):

Initiate:
(U) Technology demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
(U) Technology demonstration of an innovative composite structural configuration of dynamically loaded rotary components.
(U) Real-time CFD modeling of ship airwake flows to provide higher fidelity simulations, enhancing safety.
(U) Laboratory validation of a new, innovative design concept for dynamically loaded rotary components for the MUST Program.
(U) Development of two full-scale demonstrations of the innovative design concept for dynamically loaded rotary components for the MUST Program.

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

Continue:
(U) Abrupt Wing Stall figures of merit development and verification, CFD validation, and wind tunnel test techniques to mitigate/eliminate AWS on current/future fighter/aircraft aircraft.
(U) Development and simulation of advanced control laws for shipboard auto-land of unconventional vehicles.
(U) Development and simulation of automated maneuvering algorithms to improve lethality, safety, and survivability for Naval Mission tasks.
(U) Development of Advanced optics and head tracker of a multi-mode helmet vision system.
Commplete:
(U) Piloted simulation of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.
(U) Flight-testing with DARPA and Boeing of a UAV to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept.

(U) Classified program.

(U) ($1500K) UNDERWATER PLATFORM SELF DEFENSE
- (U) Underwater Platform Self Defense:

Continue:
(U) Development of technology for a NGCM. Continue development of ATT component technology in propulsion, MEMS, and G&C.

C. (U) PROGRAM CHANGE SUMMARY:

	FY 2001	FY 2002	FY 2003
FY 2002 President's Budget	**	117,072	
Adjustments from FY 2002 President's Budget:			
Section 8123 Mgmt Reform Initiative		-1,167	
Congressional Plus-Ups		14,965	
FY 2003 President’s Budget Submission	**	130,870	89,390

** The Science and Technology PEs were restructured in FY 2002. FY 2001 efforts were funded in PE(s) 0602121N, 0602122N. 0602232N, 0602270N, 0602633N.

FY 2003 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2002

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

(U) CHANGE SUMMARY EXPLANATION:

Schedule: Not Applicable.
Technical: Not Applicable.

D. (U) OTHER PROGRAM FUNDING SUMMARY:

(U) RELATED RDT&E: The aircraft technology program adheres to Defense S&T Reliance Agreements on Air Platforms (Fixed Wing, Rotary Wing, Integrated High Performance Turbine Engine Technology (IHPTET), and Aircraft Power), Sensors, Electronics & Electronic Warfare (Integrated Platform Electronics), Human Systems, and Materials/Processes.

(U) NAVY RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602271N (RF Systems Applied Research)
(U) PE 0602235N (Common Picture Applied Research)
(U) PE 0603235N (Common Picture Advanced Technology)
(U) PE 0603271N (RF Systems Advanced Technology)
(U) PE 0603123N (Force Protection Advanced Technology)
(U) PE 0603502N (Surface and Shallow Water Mine Countermeasures (MCM))
(U) PE 0603513N (Shipboard System Component Development)
(U) PE 0603553N (Surface Anti-Submarine Warfare)
(U) PE 0603561N (Advanced Submarine Systems Development)
(U) PE 0603573N (Advanced Surface Machinery Systems)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0604307N (Surface Combatant Combat System Engineering)
(U) PE 0604558N (New Design SSN Development)
(U) PE 0604561N (SSN-21 Development Program)
(U) PE 0204152N (E-2 Squadrons)
(U) PE 0205601N (HARM Improvement)
(U) PE 0602131M (Marine Corps Landing Force Technology)
(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations)

(U) NON NAVY RELATED RDT&E:
(U) PE 0602270A (Electronic Warfare Technology)
(U) PE 0602204F (Aerospace Sensors)

FY 2003 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2002

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

E. (U) SCHEDULE PROFILE: Not applicable.