FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	134,211	138,094	123,443	123,678	134,228	131,083	140,634

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal 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. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability. This is accomplished by improvements in platform offensive performance, stealth, and self defense. This PE supports the Future Naval Capabilities (FNC) Program in the areas of Sea Shield, Sea Strike, and Cross Pillar Enablers.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	143,652	101,650	130,227
Congressional Action	0	37,900	0
Congressional Undistributed Reductions/Rescissions	-110	-1,534	0
Execution Adjustments	-9,028	0	0
FY 2005 SBIR	-2,303	0	0
GWOT Counter IED Efforts	2,000	0	0
Program Adjustments	0	78	-5,146
Program Realignment	0	0	-1,937
Rate Adjustments	0	0	299
FY 2007 President's Budget Submission	134,211	138,094	123,443

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the

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need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.

Specific examples of metrics under this Program Element include:
- Reduce the weight of current structural protection systems by 30% maintaining current energy absorption capabilities by FY 2007.
- Provide improvements in electrical component and device technology as to allow a 50% reduction in motor propulsion and motor controllers weight and volume by FY 2009.
- Increase the hydrodynamic efficiency of current hull designs by 5% by FY 2010.
- Reduce electromagnetic vulnerability of ship hulls by 50% by FY 2011.
- Torpedo defense thresholds will be validated by modeling and simulation to satisfy the overall system performance specification of a Probability of Survival (PS) of the US Navy platform as specified in the draft Capabilities Development Document (CDD) for Surface Ship Torpedo Defense.
- Additional metrics are included within the Missile Defense Activity description.

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COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	85,095	100,194	123,443	123,678	134,228	131,083	140,634

A. 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. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal 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. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability by virtue of improvements in platform offensive performance, stealth, and self defense. This effort supports the Future Naval Capabilities (FNC) in the areas of Sea Shield and Cross Pillar Enablers.

The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Fortified Position Security, Over-the-Horizon Missile Defense, Two-Torpedo Salvo Defense, Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats, Sea Based Missile Defense of Ships & Littoral Installations, Aircraft Integrated Self-Protection Suites, Hostile Fire Detection and Response Spirals 1 and 2, and Advanced Electronic Sensor Systems for Missile Defense.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
SURFACE SHIP & SUBMARINE HULL MECHANIC & ELECTRICAL (HM&E)	50,334	48,611	69,356

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Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), 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 and maneuvering. Distributed intelligence for automated survivability addresses both the basic technology of automating damage control systems, as well as, distributed control of systems utilizing self-healing capability. Advanced electrical power systems efforts address electrical and auxiliary system and component technology to provide improvement in energy and power density, operating efficiency and recoverability from casualties.

Funding increase in FY 2007 is for PDM Power and Energy Technology.

FY 2005 Accomplishments:

- Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines.
- Continued feasibility study of Distributed Pump-Jet Propulsion (DPJP) system concept for submarines.
- Continued validation of computational tools for ducted propulsor design/analysis.
- Continued development of propeller sub-visual cavitation inception scaling law.
- Continued the validation of circulation control and advanced control surfaces with experiments.
- Continued validation of asymmetric hull forms with experimental data.
- Continued submarine propulsion jet cavitation analysis and experiments.
- Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).
- Continued algorithm/finite element model validation for submarine advanced degaussing/deamping.
- Continued analytical and modeling investigation of cavitation, powering, and acoustic performance of submarine propellers.
- Continued Biofilms on Scaffolds and Characterize Spatial Distribution and Chemistries. (NRL)
- Continued efforts to synthesize new metal sulfides as catalysts for fuel cells and evaluate their electrochemical performance. (NRL)
- Continued additional comparison of DYSMAS analysis with German ship trial data.
- Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-

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based, zonal-electrical power system that reconfigures within 10 milliseconds.
- Continued designing software for the system manager for the Universal Control Architecture (UCA).
- Continued development of analytical models to further define submarine modular hull concepts.
- Continued development of Bacterial Mixture to Optimize Charge Generating Capacity. (NRL)
- Continued development of global surface wave measurement capability for ship models.
- Continued development of new Explosion Resistant Coatings against underwater explosion and ballistic threats in support of JEERCE ACTD.
- Continued development of reliability based design and structural analysis code development.
- Continued development of signature tools for design of distributed pump-jet propulsion system (DPJP) concept for submarines.
- Continued development of surface ship acoustic flow noise model (joint effort with Dutch Navy).
- Continued development of technologies for future Marine Corps Battlefield Power System.
- Continued development of thermal management technology for shipboard power distribution.
- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).
- Continued High Surface Area Conducting Electrodes for use as Biofilm Scaffolds. (NRL)
- Continued investigation of hybrid composite to steel joints for hybrid surface ship hulls, contributing to agreement with Japan.
- Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.
- Continued investigation of superconducting degaussing techniques for surface ships.
- Continued mmWave Signatures Analysis.
- Continued modeling of electric warship components and system electromagnetic signatures.
- Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation.
- Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems.
- Continued next generation IR scene model and next generation IR code.
- Continued preparation for shock testing of composite hull section in cooperation with Germany.
- Continued ship service fuel cell development.
- Continued development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Continued technology development for alternate approaches to high voltage fast turn off switches. (NRL)
- Continued technology development for wafer bonded high voltage power switches. (NRL)
- Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by

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development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques.
- Continued to develop design tool for integrated antenna and composite topside.
- Continued to investigate improved maneuvering simulation capability for submarines.
- Continued validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions.
- Transitioned preliminary testing data of Explosion Resistant Coating (ERC) against underwater explosion and ballistic threats to FY05 Joint Enhanced Explosion Resistant Coatings Exploitation (JEERCE) Advanced Concept Technology Demonstration (ACTD).
- Completed study of flow noise over submarine control surfaces.
- Completed documenting the historical use of circulation control technology in the Navy.
- Completed 9MVA (megavolt asynchronous) Power Electric Building Block (PEBB) developmental demonstrations.
- Completed an intermediate-scale experiment to establish proof of the blast mitigation concept.
- Completed analysis of forward-scatter experiments (ship-sea interaction).
- Completed analysis of the interaction of water-mist with Class A fuel.
- Completed characterization of the 5MW High Temperature Superconducting Motor for Electric Ship Research and Development Consortium (ESRDC).
- Completed demonstration of tolerance of NRL-patented fuel cell catalysts to sulfur dioxide in air, showing a significant improvement over state of the art platinum catalysts. (NRL)
- Completed development of a cross-polarizer Silicon Carbide (SiC) characterization method and transitioned it to industry. (NRL)
- Completed development of high frequency ship measurement capability.
- Completed development of modeling and simulation tools for submarine coating concept.
- Completed evaluation of prediction methods which relate ship hydrodynamics and ship signatures.
- Completed Evaluation of the 44 MVA Power System Emulator which is based on the 9 MVA PEBB.
- Completed numerical model for electromagnetic scattering.
- Initiated and completed validation of asymmetric threat on hull forms with experimental data.
- Initiated AC propagation experiments.
- Initiated Advanced Capability Electric Systems (ACES) applied research for on-board vehicle power system with trade studies and system design (transition to advanced technology effort in PE 0603123N in FY 2006).
- Initiated aperstructure technology demonstration.
- Initiated biofilm growth studies on high surface area electrodes and tested electrodes in a miniature prototype microbial fuel cell. (NRL)

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- Initiated development of a low-cost submarine distributed propulsor concept.
- Initiated development of flexible composite propeller concept.
- Initiated development of pulsed power technology, to include pulsed alternators and capacitors.
- Initiated circulation control analysis for three-dimensional flow effects.
- Initiated development of quiet control surface design tool based on control surface flow noise studies.
- Initiated development of structural analysis codes describing failure mechanisms of sandwich composites.
- Initiated development of test vessel and technology to evaluate performance and signature associated with electrically driven waterjets (AWJ-21) and Rim-drive motor (Advanced Hull-form Inshore Demonstrator - AHFID).
- Initiated flow noise evaluations of surface ships with Advanced Electric Ship Demonstrator (AESD).
- Initiated hull machinery noise measurements.
- Initiated IR and radar detectability prediction capability.
- Initiated IR validation experiment planning.
- Initiated land-based test site (Purdue, NSWCCD) that will evaluate Integrated Engineering Plant (IEP) conceptual architectures to provide improved survivability of auxiliary systems that support combat systems.
- Initiated multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship.
- Initiated validation of acoustics performance prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Initiated validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Initiated work to assess cavitation performance of loop-bladed propulsor concept.
- Initiated development of a low-cost submarine distributed propulsor concept (RED-I).

FY 2006 Plans:

- Continue all efforts of FY 2005, except those noted as completed above.
- Continue ERC effort in core S&T and ACTD support. These efforts will provide US input to trilateral agreement with UK and Australia.
- Complete shock testing of composite hull section in cooperation with Germany.
- Complete development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Complete development of flexible composite propeller concept.
- Complete development of propeller sub-visual cavitation inception scaling law.
- Complete the validation of circulation control and advanced control surfaces with experiments.

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- Complete submarine propulsion jet cavitation analysis and experiments.
- Complete development of a low-cost submarine distributed propulsor concept (RED-I).
- Complete validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Complete investigation of distributed pump-jet propulsion acoustic performance.
- Complete and deliver next generation IR scene model and next generation IR code.
- Complete comparison of DYSMAS analysis with German ship trial data.
- Complete biofilm growth studies on high surface area electrodes and characterization of miniature prototype microbial fuel cell. (NRL)
- Initiate prediction of constrained (heave and roll) capsize motions using advanced codes.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Transfer development of technologies for future Marine Corps Battlefield Power System to PE 0602236N in FY 2007.
- Complete evaluation of an Integrated Engineering Plant (IEP) concept to provide improved survivability.
- Complete Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).
- Complete modeling of electric warship components and system electromagnetic signatures.
- Complete ACTD support for ERC application to surface ships.
- Complete development of global surface wave measurement capability for ship models.
- Complete validation of computational tools for ducted propulsor design/analysis.
- Complete experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).
- Continue investigations of propulsor cavitation including mitigation concepts (passive and active)
- Continue composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures.
- Continue development and demonstration of distributed power generation and rapid power transfer within the context of zonal electric power systems and advanced electric architectures.
- Initiate large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion.
- Initiate testing of 10X smaller microbial fuel cell and test membraneless designs in simulated environmental (marine, etc.) conditions. (NRL)

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	FY 2005	FY 2006	FY 2007
ADVANCED ENERGETICS	9,376	14,745	15,837

Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems for both defensive and offensive applications. Efforts include: development of new fuels, oxidizers, explosive ingredients and formulations; and reliable simulation tools and diagnostics to develop and design superior-performance, and/or reduced-vulnerability systems tailored to specific warfighter missions.

FY 2005 Accomplishments:

- Initiated PDM II Advanced Energetics research in technology development for the next generation reactive material warhead concepts (formulations, material properties, target interaction, lethality models, and experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials. Explosive testing occurred in fourth quarter of FY.
- Initiated PDM II Advanced Energetics research in development and evaluation of advanced explosive/propellant/reactive ingredients and formulations for next generation higher performing systems. Explosive testing occurred in fourth quarter of FY.
- Initiated PDM II Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. Explosive testing occurred in fourth quarter of FY.
- Initiated proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Initiate PDM II Advanced Energetics research in advanced multiphase blast concepts employing dense

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metalized explosives to enhance performance of air and underwater blast warheads.
• Initiate PDM II Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application.

FY 2007 Plans:

• Continue all efforts of FY 2006.

	FY 2005	FY 2006	FY 2007
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	9,789	17,828	12,438

Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats and to develop the capability to interdict underwater asymmetric threats to ships and infrastructure in harbors. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. (Asymmetric threat efforts are co-funded by PE 0602131M.) A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF), electromagnetic (EM), visual, and acoustic), or chemical sensors/biosensors 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.

Another goal of this effort is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Two Torpedo Salvo Defense. This provides a capability to prevent any of the torpedoes, in up to two-torpedo salvos fired at high value units, from hitting those units. Specific technology includes two efforts. The first is Next Generation Countermeasure (NGCM), a mobile adaptive acoustic countermeasure with acoustic communication links among countermeasures. The second is Anti-Torpedo Torpedo (ATT)/Tripwire Demonstration, of an ATT to engage the detected threat torpedoes.

This activity supports the Fleet and Force Protection Future Naval Capabilities (FNC). This effort includes

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support to Sea Shield and Sea Strike Pillars and FNC Enabling Capabilities for Aircraft Integrated Self-protection Suite, Fortified Position Security, Advanced Electronic Sensor Systems for Missile Defense, and Hostile Fire Detection and Response Spirals 1 and 2. Budget Activity 2 sensor efforts are co-funded by PEs 0602235N and 0602271N.

An increase in funding in FY 2006 is due to new initiatives in NRL efforts, biomimetic technologies and Shipboard EO/IR Closed Loop Self Protection. Funding decreases in FY 2007 are due to a decrease in NRL activities, transferring the completion of the Shipboard EO/IR Closed Loop Self-Protection effort to PE 0602271N, and the transition of the Asymmetric Threat Weapon Program to PE 0602131M.

FY 2005 Accomplishments:

Sensors & Associated Processing –
• Continued the Shipboard EO/IR Closed Loop Self-Protection System effort by initial laboratory testing of the Mid-wave Infrared and Visible Laser System (MIRVLS) generating 15W in the 3-5um region.
• Continued the End User Terminal (EUT) effort by developing a prototype 2-way amplifier for the Secure Net (SECNET) 11 card that will increase by a factor of 9 the secure transmit/receive range between Dismounted-Digital Automated Computing Terminals (D-DACT) in an urban environment.
• Continued work on anti-tampering antenna isolation panels for NULKA decoys: fabricate hydrogen-bonded polymers and test for sensitivity to water degradation. Test isolation performance of new microwave absorbing composites. (NRL)
• Continued development of compact sensor systems in support of responsive Intelligence, Surveillance, and Reconnaissance (ISR). (NRL)
• Continued efforts on Antibodies for biowarfare agents to be synthetically modified with enzymes and studied via surface plasmon resonance to gain a better understanding of the impact tagging these recognition sites have on molecular recognition (kinetics and selectivity) for sensor applications. (NRL)
• Transferred development of a small aperture biomimetic bidirectional acoustic sensor to PE 0602236N and quantum dot reagents for real time chemical sensing to PE 0602435N in FY 2005. Quantum dot reagents for real time chemical sensing will move back to PE 0602123N in FY 2006.
• Completed the Applied Research Phase (6.2) of the EO/IR Laser Jammer for Tactical Aircraft (TACAIR) effort by performing baseline laboratory testing of surface-to-air missile (SAM) jam codes for all Tier 1 and 2 threat missiles. Effort continues under PE 0603123N.
• Completed the Applied Research Phase (6.2) of the Integrated Defensive Electronic Countermeasures Pre-Planned Product Improvement (IDECM P3I) effort by fabricating flexible .009 inch diameter conductors capable

of sustained operation at 5 kilovolts and >1750 degrees Fahrenheit. Effort continues under PE 0603123N.
• Completed development of a variable geometry mirror for the aircraft in conjunction with the ground based laser optics. (NRL)
• Completed the field tests to assess system performance and quantify influences on detection range with respect to signal detection and jamming of threats to low altitude platforms. (NRL)
• Completed the integration of all functions (detection, identification, and jamming) into a field testable Low Altitude Threat Detection and Jamming prototype and perform final concept test. (NRL)
• Completed development of user interface for low-cost compact adaptive optics system. (NRL)
• Initiated the design and development of integrated laser ground based, aircraft protection design to protect large aircraft from Infrared Surface to Air Missiles (SAMs) upon ingress and egress to an airport. (NRL)
• Initiated development of solid projectile coilgun design, consumable casing material and improved railgun efficiency and developed method of reducing muzzle flash and surface wear of the rails. (NRL)
• Initiated design and fabrication of microfluidic nucleic acid extraction and enrichment methods and obtained funding for technology transfer. (NRL)
• Initiated design and development of large (1.5m dia.) telescopes with associated adaptive optics for the Naval Prototype Optical Interferometer (NPOI). (NRL)

Underwater Platform Self-Defense -
• Completed development of NGCM test-bed power amplifier design for single crystal transducer. Transition to PMS415 PE 0101226N.
• Continued developing the mobile NGCM interface between guidance and control and signal generation electronics.
• Continued merging the Smart Adaptive Countermeasure (SACM) Smart Adaptive Processor and a generic signal generator board into a single module suitable for both Acoustic Device, Countermeasure (ADC) MK2 and NGCM.
• Initiated analysis of capability to enable limited acoustic communications among NGCM units.
• Initiated incorporation of ATT warhead acoustic model into TRM.

FY 2006 Plans:

Sensors & Associated Processing -
• Continue all efforts of FY 2005, less those noted as completed above.
• Continue development of reagentless sensors for weapons of mass destruction/explosives, including

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luminescent quantum dot-based biosensors and engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX). (transferred from PE 0602435N in FY 2006)
• Complete the EUT effort by developing low cost, lightweight gunfire detection architecture with a production goal of less than $10,000 and weight of less than four pounds.
• Complete development of anti-tampering antenna isolation panels for NULKA decoys: demonstrate isolation performance and water degradability of microwave absorptive composite. (NRL)
• Initiate the Integrated EO/IR Self-protection Suite for Rotary Wing Aircraft effort by performing a platform integration analysis and design review.
• Initiate testing of the Mid-wave Infrared (MWIR) gunfire detection system with the D-DACT network for EUT.
• Initiate investigation of improved jam codes and closed-loop countermeasure techniques to integrate with the Shipboard Integrated Electro-Optic Defense Systems (SHIELDS) hardware for Shipboard EO/IR Closed Loop Self-protection.
• Initiate data collection for a database of chemical signatures from actual naval assets (land and water-based).
• Initiate efforts in nanoscale biosensor/bioprocessing components for platform protection.
• Initiate efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms.
• Initiate the development of low-cost, lightweight radar absorbing material (RAM) based on metallized cellulose in the form of fibers, fabric and paper. (NRL)
• Initiate design and testing of on-chip nucleic acid amplification and transfer technology. (NRL)
• Initiate studies to develop catalytic activity profile of bioactive coatings against chemical agents. Design and initiate fabrication of coatings to degrade both, chemical and biological agents. (NRL)
• Initiate development of a portable detection system for defense against small arms fire and rocket propelled grenades (RPG) using Field Programmable Gate Arrays (FPGAs), infrared focal plane arrays (IRFPA), and filtering algorithms. (NRL)

Underwater Platform Self-Defense –
• Continue all efforts of FY 2005.
• Complete merging the Smart Adaptive Countermeasure (SACM) Smart Adaptive Processor and a generic signal generator board into a single module suitable for both Acoustic Device, Countermeasure (ADC) MK2 and NGCM.

FY 2007 Plans:

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- Continue all efforts of FY 2006, less those noted as complete above.
- Continue biocentric sensor for detection efforts including panoramic periscope and temporal pattern recognition for explosive noise location.
- Continue advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Intelligent Video Surveillance FNC product (transferred from PE 0602131M).
- First demonstration of high resolution imaging of faint sources using the combined adaptive optics and optical interferometry at NPOI. (NRL)
- Transfer completion of the Shipboard EO/IR Closed Loop Self-Protection effort to PE 0602271N. Activities consist of developing additional jam codes and tracking algorithms and demonstrating their effectiveness during final at-sea testing of the Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware including the at-sea turret with a field of regard of +/- 20 degrees in elevation and 360 degrees in azimuth.
- Complete development of quantum dot reagents for real time chemical sensing.
- Complete development of reagentless sensors for weapons of mass destruction/explosives, including luminescent quantum dot-based biosensors and engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX).
- Complete synthesis and acquisition of all the components needed for the fabrication of durable multifunctional coatings. (NRL)
- Initiate integration of DNA and antibody array analysis and demonstrate capability for rapid screening and pathogen species confirmation. (NRL)
- Initiate design and fabrication of self-reporting coatings for system failure detection. (NRL)

Underwater Platform Self-Defense –
- Continue all efforts of FY 2006, less those noted as complete above.
- Continue advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Underwater Threat Neutralization FNC product (transferred from PE 0602131M).
- Continue advanced concept development of a scalable low frequency continuous wave acoustic weapon for use against underwater asymmetric threats (transferred from PE 0602131M).
- Complete processing algorithms for communications among NGCM units.

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	FY 2005	FY 2006	FY 2007
AIRCRAFT TECHNOLOGY	8,695	12,865	14,296

The Aircraft Technology activity develops high impact, scaleable naval air vehicle technologies, such as structures and flight controls for future and legacy air vehicles, integrated avionics, advanced electrical power systems, and aerodynamics, which significantly increase the naval warfighter's capabilities, effectiveness, readiness, and safety, while reducing life cycle cost. This activity directly supports the naval aviation vision, providing a robust and credible forward presence through flexible response and dominant power projection from the sea.

Increase in funding in FY 2006 is due to the addition of new projects in Ship-To-Objective Maneuver (STOM) and Heavy Lift System Concept efforts.

FY 2005 Accomplishments:

- Continued development of survivability/reduced observables technology (classified).
- Continued Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity.
- Completed design for demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
- Completed Persistent Intelligence, Surveillance, and Reconnaissance (ISR) Unmanned Air Vehicle (UAV) technologies effort.
- Completed Joint Transformational Strike (JTS) technology addressing Automatic Target Recognition (ATR) and Combat Identification (CID).
- Initiated development of a new class of practical CFD-based engineering analysis and design tools to facilitate design of advanced high performance rotors.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete CFD modeling of ship airwake flows to provide higher fidelity.
- Initiate demonstration of system integration of a shaped memory alloy into a Reconfigurable Rotor Blade system for improved range and lifting capacity in a tilt rotor aircraft.
- Initiate development of STOM Heavy Lift System Concept.
- Initiate development of flight control, intelligent autonomy, command & control, and multi-vehicle

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cooperation technologies for unmanned air vehicles.
• Initiate development of a CFD based integration system to maximize operational capability of autonomous aircraft by choosing optional flight pattern for any environmental condition.
• Develop a new class of practical CFD-based engineering analysis and design tools for advanced high performance rotors.
• Initiate design concepts for an experimental vertical lift utility UAV.

FY 2007 Plans:

• Continue all efforts of FY 2006, less those noted as completed above.
• Initiate development effort to control flow and thermal dynamics in particle coating process and densification dynamics of large windows. (NRL)
• Refine/Evaluate/Validate CFD-based engineering analysis and design tools for advanced high performance rotors.
• Complete design and initiate technology development of an experimental vertical lift UAV.

	FY 2005	FY 2006	FY 2007
MISSILE DEFENSE (MD)	6,901	6,145	11,516

This activity describes Missile Defense S&T projects of the Sea Shield Future Naval Capability (FNC):
• Distributed Weapons Coordination (DWC) open architecture combat system algorithms for automated battle management aids (ABMA), including common threat evaluation (CTE) and preferred shot recommendation (PSR) functions that will enable fleet units to defend against air and missile attacks with increased effectiveness and efficiency. Metrics for DWC include (a) increased effectiveness of combat resources through a theater-wide threat evaluation process; (b) increased efficiency of weapons resources through weapon assignment and preferred shot recommendations considering Theater Ballistic Missile Defense (TBMD) and Area/Ship Defense capability operating simultaneously; and (c) reduced “free riders” (threats not fired at) due to ineffective use of resources (unengaged targets) by 50% (threshold) 80% (objective).
• Littoral Affordability (classified program). Metrics for this project are classified.
• Advanced Area Defense Interceptor (AADI) S&T planning effort for Navy - Marine Corps Air Directed Surface to Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in FY 2008. The metric for AADI is execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability.
• Distributed Sensor Coordination (DSC) algorithms for airborne sensor management in ADSAM and multi-

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threat air defense engagements. The metric for DSC is effective coordination of airborne sensor resources to support NIFC-CA capability, evaluated using laboratory Monte Carlo simulations within simulated stressing air defense environments.

- Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile 6 (SM-6) Block II future fleet air defense missile. The metrics for this new project will be defined in a transition agreement to be signed with the Navy acquisition customer upon project initiation in 2007 for an enhanced performance envelope for engaging advanced theater missiles in terminal phase while meeting or exceeding required performance against modern air threats.

Funding increase in FY 2007 is caused by addition of new NII project and introduction of NRL effort.

FY 2005 Accomplishments:

- Continued development of DWC and DSC algorithms for use in air and missile defense ABMA.
- Continued Littoral Affordability effort (classified program).
- Initiated and completed AADI experimental planning for the Navy ADSAM demonstration taking place under PE 0603123N in FY 2008.

FY 2006 Plans:

- Continue efforts of FY 2005.
- Complete Littoral Affordability effort (classified program).

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as complete above.
- Perform additional AADI S&T planning and coordination for the FY 2008 Navy ADSAM live-fire demonstration taking place under PE 0603123N.
- Complete development and documentation of DWC and DSC algorithms.
- Initiate NII project.
- Initiate program to investigate effects of charged particle layers on UHF to S-Band radars used to track space vehicles (NRL).

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CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADPICAS	1,446	0

Initiated development of intelligent composite active structures and systems to provide precision position control and vibration suppression for military and space structures to enhance their structural performance and reduce their fuel consumption. Applications include fighter jets, helicopters, smart rockets, satellites, and space stations.

	FY 2005	FY 2006
ADVANCED FUSION PROCESSOR	0	2,600

This effort supports advanced fusion processor research.

	FY 2005	FY 2006
BATTERY CHARGING TECHNOLOGY	2,037	0

Continued research efforts funded in FY 2003 and FY 2004. Initiated development and validation of a charging algorithm for lithium-ion batteries. Initiated development of a DC-DC converter hardware design and engineering model.

	FY 2005	FY 2006
BLAST RESISTANT ANECHOIC SPRAYABLE ELASTOMERIC COATINGS FOR NAVY SHIPS	966	0

Initiated development, testing, and evaluation of a new coating system that can be applied to metal ship bulkheads and armored vehicles providing blast protection to the occupants. The end of the first year of development will result in one or more fire retardant coating systems that can be applied to metal structures and provide blast protection.

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	FY 2005	FY 2006
CENTER FOR CRITICAL INFRASTUCTURE PROTECTION	6,558	0

Initiated development of innovative technology solutions for use in the protection of critical infrastructure. Technologies developed will increase protection for ports and the merchant shipping system, maintaining port operations, and the surrounding infrastructure.

	FY 2005	FY 2006
COMPOSITE REPAIR OF METAL STRUCTURES	972	0

Initiated development of low cost, sonic resistant composite repairs for metal airframe structures. This new concept for the repair of the Navy’s aging fleet of both fixed wing and rotary wing aircraft offers the promise to extend the airframe life at a significantly lower cost and with greater reliability and safety than methods currently in use.

	FY 2005	FY 2006
COMPOSITES DEVELOPMENT FOR NAVY LOW RISE CONSTRUCTION	1,452	0

Initiated development and demonstration of prototype wood plastic composite (WPC) structural components for military housing. These structural components provide the following advantages relative to conventional wood products; (1) resist moisture penetration into the building structure, (2) resist high lateral loads from seismic and wind events, and (3) facilitate proper construction techniques.

	FY 2005	FY 2006
CORROSION MODELING SOFTWARE PROJECT - NAVAIR	4,088	0

Continued development and validation testing of workable corrosion maintenance guidelines and criteria for high strength steel components. Airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

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	FY 2005	FY 2006
FACIAL RECOGNITION TECHNOLOGY	0	1,400

This effort supports facial recognition technology research.

	FY 2005	FY 2006
HIGH EFFICIENCY QUIET ELECTRIC DRIVE	966	1,500

FY 2005 - Initiated modification of the single-phase model to a three-phase model, test and evaluate.

FY 2006 - This effort supports high efficiency quiet electric drive research.

	FY 2005	FY 2006
HIGH FREQUENCY ACOUSTIC SIGNAL PROCESSOR SYSTEM	0	3,000

This effort supports high frequency acoustic signal processor system research.

	FY 2005	FY 2006
HYPERSPECTRAL DATA FUSION	3,278	0

Initiated demonstration of a hyperspectral/imager for surveillance and tracking in the airborne realtime processing on the NRL P-3 test aircraft.

	FY 2005	FY 2006
INTEGRATED FUEL PROCESSOR–FUEL CELL SYSTEM	1,933	0

Completed for demonstration a prototype integrated fuel processor/fuel cell system to operate on JP-5 fuel. If successful, the system may provide payoffs of increased efficiency and lower emissions of auxiliary power units used onboard aircraft and ocean-going vessels.

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	FY 2005	FY 2006
LIGHTWEIGHT SHIP STRUCTURES (LSS)	963	500

FY 2005 - Initiated research to explore, develop and optimize alloys based on Al-Zn-Mg-Sc-Zr. Efforts include alloy fabrication, microstructural and mechanical characterization, stress corrosion cracking studies, and development of a cost-benefit analysis, demonstrating the feasibility of implementing the alloy and providing the foundation for subsequent certification.

FY 2006 - This effort supports Lightweight Ship Structures.

	FY 2005	FY 2006
LITHIUM ION BATTERY FOR MULTIPLE NAVY AIRCRAFT (J-UCAS & T-45 TRAINER)	0	1,500

This effort supports lithium ion battery for multiple Navy aircraft (J-UCAS & T-45 Trainer) research.

	FY 2005	FY 2006
LOW-COST RAPID PROTOTYPE/PRODUCTION TECHNOLOGY FOR POLYMERIC AIRCRAFT COMPONENTS INITIATIVE	2,225	1,000

FY 2005 - Continued, from FY04, the development and qualification of a rapid prototyping and production technology based on Selective Laser Sintering (SLS) which will be used for the design, development, and qualification of advanced polymeric aircraft components. Focused on material and process optimization with emphasis on meeting aerospace application requirements.

FY 2006 - This effort supports the low-cost rapid prototype/production technology for polymeric aircraft components intiative.

	FY 2005	FY 2006
MAGNETIC REFRIGERATION TECHNOLOGY FOR NAVAL APPLICATIONS	0	1,900

This effort supports magnetic refrigeration technology for naval applications research.

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	FY 2005	FY 2006
MINIATURE AUTONOMOUS VEHICLES (MAVS)	1,737	0

Continued in-water demonstrations of distributed communications and control architecture. Expanded multi-vehicle fleet to include underwater crawlers.

	FY 2005	FY 2006
MK V PATROL BOAT REPLACEMENT CRAFT PROTOTYPE	1,448	2,500

FY 2005 - Initiated construction of the new composite MKV.I prototype craft.

FY 2006 - This effort supports the MKV patrol boat replacement craft prototype.

	FY 2005	FY 2006
NANO-MAGNETIC MATERIALS FOR FUTURE MILITARY PROPULSION AND ENERGY SYSTEMS	0	1,400

This effort supports nano-magnetic materials for future military propulsion and energy systems research.

	FY 2005	FY 2006
NAVAIR CORROSION MODELING SOFTWARE PROJECT	0	2,100

Develope workable corrosion maintenance guidelines and criteria for high strength steel components, in particular arrestment gear of carrier aircraft. Present airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort will enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

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PEM FUEL CELL FOR VEHICLE SENSORS	0	1,000

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This effort supports PEM fuel cell for vehicle sensors research.

	FY 2005	FY 2006
PMRF FORCE PROTECTION LAB	7,714	3,400

FY 2005 - Initiated development of force protection and security technologies by integrating, evaluating and demonstrating enabling technologies, tools, and processes. Approaches include integration of advanced sensor systems, novel sensor and data fusion processes, behavior modeling and analysis, and data mining and knowledge extraction techniques.

FY 2006 - This effort supports the PMRF Force Protection Lab.

	FY 2005	FY 2006
POLYMERIC AIRCRAFT COMPONENTS	0	1,000

This effort support polymeric aircraft components research.

	FY 2005	FY 2006
PROJECT ENDEAVOR	1,641	0

Completed production of a software system that integrates the design process for advanced marine vehicles with mission and environmental (wind, wave, etc.) requirements, will begin to produce some stand-alone modules dealing with mission planning, wave forecasting and hindcasting as well as completing the integration process. The major focus was technology transfer of system components.

	FY 2005	FY 2006
SECURE INFRASTRUCTURE TECHNOLOGY LABORATORY	0	6,800

This effort supports the Secure Infrastructure Technology Laboratory.

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	FY 2005	FY 2006
SMALL WATERCRAFT PROPULSION DEMONSTRATOR	1,447	1,500

FY 2005 - Initiated development of an advanced internal combustion engine and associated electrical generator.

FY 2006 - This effort supports small watercraft propulsion demonstrator research.

	FY 2005	FY 2006
STRUCTURAL RELIABILITY OF FRP COMPOSITE IN SHIP ASSEMBLIES	968	0

Completed analysis of mechanical property variability for composite laminates and the associated effect on structural reliability as it relates to design guidelines and analysis methods.

	FY 2005	FY 2006
THEATER SUPPORT VESSEL HULL MATERIAL DEVELOPMENT	1,928	0

Initiated the design and development of technologies including an alternative hull and air cushion for advanced littoral combat ships. These technologies allow improved delivery of firepower and information, as well as, increased hydrodynamic, aerodynamic, stealth, and survivability traits.

	FY 2005	FY 2006
THIN FILM BATTERY	1,941	1,400

FY 2005 - Initiated development and optimization of chemical vapor deposition and plasma thin film deposition techniques for thermal, lithium, and lithium ion battery materials and cells. The goal is to prove the feasibility of manufacturing these types of batteries, which will provide improved energy and power densities, safety and reliability over current technologies.

FY 2006 - This effort supports thin film battery research.

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	FY 2005	FY 2006
UNDERSEA PERIMETER SECURITY TECHNOLOGY	0	1,200

This effort supports the undersea perimeter security technology research.

	FY 2005	FY 2006
UNMANNED SEA SURFACE VEHICLES FOR MARITIME MISSIONS	3,408	2,200

FY 2005 - Completed and delivered two prototype vehicles. Initiated operational testing to determine at-sea performance. Completed development of techniques for deploying and retrieving vehicles from host platform. Incorporated advanced power and autonomy technologies.

FY 2006 - This effort supports research of unmanned sea surface vehicles for maritime missions.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603513N (Shipboard System Component Development)
PE 0603553N (Surface ASW)
PE 0603561N (Advanced Submarine System Development)
PE 0603573N (Advanced Surface Machinery Systems)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))

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PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Developments)

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

D. ACQUISITION STRATEGY:
Not applicable.