Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	100.864	115.700	104.169						Continuing	Continuing
0000: WARFIGHTER SUSTAINMENT APPLIED RESEARCH	100.864	115.700	104.169						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports the Future Naval Capabilities (FNCs) of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, and Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and seabasing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise." FY 2008 reflects the reinitiation of Human Systems Integration efforts to develop automation, human interface, and decision support technologies (funded in FY 2005 and prior).

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 ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	107.564	93.862	92.068	
Current BES/President's Budget	100.864	115.700	104.169	
Total Adjustments	-6.700	21.838	12.101	
Congressional Program Reductions		-0.335		
Congressional Rescissions				
Total Congressional Increases		22.240		
Total Reprogrammings	-5.665			
SBIR/STTR Transfer	-1.035			
Program Adjustments			12.041	
Rate/Misc Adjustments		-0.067	0.060	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ACOUSTIC RESEARCH DETACHMENT TEST SUPPORT PLATFORM UPGRADE**	0.000	1.496
Project: 9999, **ADVANCED COMPOSITE MARITIME MANFACTURING**	0.000	1.995
Project: 9999, **ADVANCED REINFORCED MATERIALS AND NEW MATERIALS RESEARCH FOR AIRCRAFT TIRES**	0.968	0.000
Project: 9999, **AMELIORATION OF MILITARY HEARING LOSS**	0.772	0.000
Project: 9999, **ASSISTIVE TECHNOLOGIES FOR INJURED SERVICEMEMBERS**	0.000	1.596
Project: 9999, **ATMOSPHERIC WATER HARVESTING**	0.966	0.000
Project: 9999, **BIOSENSORS FOR DEFENSE APPLICATIONS**	1.928	1.994
Project: 9999, **COMPOSITE MATERIALS ENHANCEMENTS THROOUGH POLYMER SCIENCE RESEARCH AND DEVELOPMENT**	0.000	2.235
Project: 9999, **DIGITAL DIRECTED MANUFACTURING PROJECT**	1.240	1.695
Project: 9999, **DURABILITY OF COMPOSITE MATERIALS AND STRUCTURES**	1.544	0.000
Project: 9999, **FRICTION STIR WELDING**	0.000	0.798
Project: 9999, **INTELLIGENT RETRIEVAL OF IMAGERY**	0.000	2.393
Project: 9999, **MAST-MOUNTED IN PORT VIDEO FORCE PROTECTION SURVEILLANCE SYSTEM**	1.547	0.000

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Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **MINIATURIZATION, SYSTEMIZATION OF SEMICONDUCTING METAL OXIDE**	0.773	0.000
Project: 9999, **MISSION DEPLOYABLE SURVEILLANCE BIOMETRICS**	1.545	0.000
Project: 9999, **NANOTECHNOLOGY ENGINEERING & MANUFACTURING OPERATION (NEMO)**	0.776	1.596
Project: 9999, **NANOTECHNOLOGY RESEARCH**	3.858	0.000
Project: 9999, **ON-BOARD VEHICLE POWER SYSTEMS DEVELOPMENT**	0.000	2.393
Project: 9999, **OPTIMIZATION OF NEW MARINE COATINGS**	1.932	1.596
Project: 9999, **PULSE VIRTUAL CLINICAL LEARNING LAB**	2.314	2.393

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: WARFIGHTER SUSTAINMENT APPLIED RESEARCH	100.864	115.700	104.169						Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE supports the FNC's of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; Naval systems training and education; human systems integration; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and Sea Basing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

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

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ADVANCED NAVAL MATERIALS	8.163	13.068	15.132	

Advanced Naval Materials efforts include: developing advanced, high-performance materials; processes to reduce weight and cost; and enhanced sonar transducers.

The increase between FY 2008 and FY 2009 reflects the initiation of new applied research in Naval Structural Health Monitoring and Corrosion Control Prevention Technologies and transition of cost reduction technology efforts to this activity. The increase between FY 2009 and FY 2010 is due to OSD directed funding increase to S&T.

FY 2008 Accomplishments:
- Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.
- Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of advanced composites and polymers with fire resistance for ship structures. - Continued development of nanotube reinforced composite materials for next generation air and naval platforms. - Continued development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials and definition of standardized materials properties and composition ranges. - Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Continued development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study. - Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications. - Continued development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms. - Continued stainless steel carburization study to enhance corrosion performance. - Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials. - Continued evaluation of low temperature carburized materials for marine application. - Continued development of coating performance and knowledge database for Naval use. - Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB). - Continued friction stir welding development for control of residual stresses and elimination of distortion in naval steels. – Continued development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals. - Continued development of solid-state growth methods for making high-strain, high-coupling piezoelectric single crystals. – Continued development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.				

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements. - Completed evaluation of corrosion performance on the family of conjugated poly (phenylenevinylene) polymers. - Completed development of techniques and procedures to enhance hot corrosion and oxidation resistance. - Completed development of Microbiologically Influenced Corrosion (MIC) resistant passive alloys for sea basing. - Completed development of multifunctional transducer material, high-force high-strain actuators; and evaluation of advanced transducer single crystal high-strain materials. - Completed development of welding processes and consumables for high-nickel containing naval steels. - Completed development of phthalonitrile based organic resin material and hybrid composite development with improved fire resistance; and process development of fiber reinforced foam material. - Completed catalyst development and grow vertically aligned carbon nanotubes in existing gated silicon post structures in a DC plasma CVD reactor, obtaining stable field emission and 1 ampere/cm2 current densities. - Initiated development of materials processing methods for single crystal piezoelectrics to make strong, robust sonar transducers. - Initiated modeling and process development of single-melt cold hearth casting of naval titanium alloys including Ti 5-1-1-1 for enhanced mechanical properties and formability. - Initiated development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials. - Initiated ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Initiate acoustic damping coatings for ship tank application. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above.				

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Initiate development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems. – Initiate development of new 3D mechanical characterization technique for polymer composites based on dissipative energy density principles. – Initiate development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis. – Initiate development and application of distributed fiber optic Bragg gratings for structural health monitoring of ships and aircrafts. - Initiate assessment of the degree of sensitization potential of marine grade Al alloys. - Initiate investigation of criteria for stable pitting of stainless steel. - Initiate development of surface assessment technologies to measure surface profile and chlorine. - Initiate evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges. The following efforts transition from Cost Reduction Technologies in this PE in FY 2009: - Continue development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. - Continue development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. - Continue development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Initiate development of seamless joining technologies for large, complex shaped conventional ceramic windows from small, inexpensive components using electorphoretic deposition of ceramic nanoparticles.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of intelligent corrosion sensor systems for intergranular corrosion cracking. - Initiate studies on fuel cell corrosion. - Initiate development of superhydrophobic surface modification technology. - Initiate studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys.					
BIOCENTRIC TECHNOLOGIES Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; microbial or plant engineering to produce high-value naval materials such as energetic compounds or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems. The increase from FY 2008 to FY 2009 is due to the initiation of new efforts for advanced biometric sensing for autonomous systems, chemical sensing, and micro-bio-fuel cells for autonomous vehicles. *FY 2008 Accomplishments:* - Continued engineered microbial synthesis and processing of energetic materials. - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology (i.e., engineered plants for explosives detection, study of human stress biomarkers and bioinspired panoramic imaging systems). - Continued efforts on naval biosensor to detect brain structures and blood vessels through skull bones. - Continued efforts on innovative marine mammal diagnostics to detect viruses, bacteria, fungi and immunomarkers. - Continued, developed and demonstrated methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms.		5.640	5.786	5.491	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection methods. - Continued a program to develop a microfabricated analytical system for trace detection of illicit materials including explosives, and other hazardous chemicals. - Continued biomimetic signal processing efforts, such as temporal and temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks. - Initiated effort to power AUV recharging station using (sediment) microbial fuel cell. - Initiated effort to develop single domain antibodies for the recognition of explosives and small toxins. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Continue marine mammal immunomarker efforts, including the characterization of the dolphin fore-stomach microbial community, identification of probiotic immunostimulating species and immunobioassays for stress and infection detection. - Complete biomimetic temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Complete development of an initial set of molecular diagnostic tests for bacterial, fungal and viral pathogens of marine mammals. - Complete program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection methods. - Initiate efforts on advanced biomimetic sensing and neural control for human-robot interaction to enable effective collaboration of warfighters and autonomous systems.					

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of underwater chemical sensors powered by sediment fuel cell. - Initiate research for detection or mitigation of microbes or compounds of naval relevance in various settings. - Initiate micro-bio-fuel cell efforts for implanted or micro-autonomous vehicles. - Initiate integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control. - Initiate effort to develop living fluidic networks. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research on microbial synthesis of phloroglucinol, an energetic material precursor. - Complete effort to develop and demonstrate methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms. - Complete development of a microfabricated analytical system for trace detection of illicite materials including explosives, and other hazardous chemicals. - Initiate development of a second set of molecular diagnostic tests for recently discovered viral, bacterial, and fungal pathogens of marine mammals.					
COST REDUCTION TECHNOLOGIES Cost Reduction Technology efforts include: developing ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; and airframe and ship corrosion efforts for advanced cost effective prevention and life cycle management technologies. This activity includes the Navy's share of the Versatile, Affordable, Advanced Turbine Engine (VAATE) program for materials. Investments under this activity were previously reported under Advanced Naval Materials and were broken out to provide improved clarification of the overall investment scope. The decrease from FY 2008 through FY 2010 is due to FNC EPE-FY10-03 being pushed out and a decrease for Accounting Management Reduction.		11.516	9.340	8.264	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued development of ceramic matrix composite turbine blades for gas turbine engines. - Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Continued development of cavitation resistant ship rudder coatings. - Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Continued development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Initiated development of durable alloys and materials for shipboard and aircraft gas turbine engines and spallation-resistant thermal barrier coatings for shipboard/aircraft marine gas turbine hot sections. - Initiated development of advanced materials and processes for high temperature marine turbine disks and combustors. - Initiated development of oxidation and vanadium/sulfate-resistant high temperature coatings for shipboard/aircraft gas turbine engines. - Initiated development of calcium magnesium aluminum-silicate (CMAS)-resistant coatings for ceramic matrix composites. - Initiated development of high temperature foil bearing coatings for aircraft engine weight reduction. - Initiated development of high temperature organic matrix composites. - Initiated development of low-platinum and platinum-free aluminide coatings that are phase compatible with turbine blade alloys and exhibit low oxidation rates. - Initiated efforts to assess manufacturing issues and reliability of ceramic matrix composites for turbine engines. - Initiated integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Initiated development of materials processing for future gas turbine molybdenum-based alloys. - Initiated efforts to conduct warfighter sustainment applied research, including technology management of investments supporting the naval enterprise and naval capability pillars.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Initiated efforts to assess technology options for the development of applied FNC technologies packaged into deliverable science and technology products. - Initiated applied research and development of improved coatings for (1) non-skid surfaces, (2) ship rudders, (3) high performance ship topsides, and (4) high performance airfield pavements. - Initiated efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions to Sea Basing Technologies activity in this PE in FY 2009) - Initiated analytical model and reduced scale component development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers, focusing on closing technology gaps associated with Alternative Integrated Power System Architectures. (This effort transfers to PE 0602123N in FY 2009) *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate applied research in determining lifting of hot section materials exposed to alternative synthetic fuels and petroleum-synthetic fuel blends. - Initiate applied research development of Calcium Magnesium Aluminum-Silicate (CMAS)-resistant coatings for molybdenum-base alloys. - Initiate life prediction research for modeling of hot section gas turbine materials, including blades, in mixed naval environments. - Initiate development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly detection and corroboration. *FY 2010 Plans:* - Continue all efforts from FY 2009. - Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Initiate durable environmental barrier coatings for 2700F ceramic-matrix composites.					

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research on Nb-Cr-Si alloys for improved corrosion resistance at high temperatures. - Initiate, develop and apply emerging technologies that support delivery of Navy. approved FNC enabling capabilities structured to close operational capability gaps in warfighter sustainment. - Initiate package emerging warfighter sustainment technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. - Initiate and develop mature warfighter sustainment technologies that support naval requirements identified within the Naval Power 21 capability pillars.					
ENVIRONMENTAL QUALITY Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness. *FY 2008 Accomplishments:* - Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) coating systems for Navy platforms, far-term noise and air pollution emissions abatement technology for unrestricted operations, and multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). – Continued initial development of robotic Hull Biomimetic Underwater Grooming (BUG) and associated grooming approaches. - Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Continued pilot scale system development of miniature gasification process for treatment of shipboard solid waste.		2.284	3.141	3.109	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued and completed initial decision report on impact of synthetic lubricants on shipboard oily waste treatment systems. – Completed alternate torch technologies for shipboard plasma waste treatment. - Completed report on cost benefit analysis of improved hull coatings and technologies for prevention of marine fouling. – Initiated development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants. *FY 2009 Plans:* – Continue all efforts of FY 2008 less those noted as completed above. – Complete development of the Mobile Cleaning Recovery and Recycling System (MCRRS) vehicle for cleaning of aircraft non-skid decks as a part of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. – Complete initial development of robotic Hull BUG and associated grooming approaches. – Initiate field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete pilot scale system development of miniature gasification process for treatment of shipboard solid waste. - Complete far-term noise and air pollution emissions abatement technology for unrestricted operations. - Complete multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). - Initiate efforts on ballast tank and system design optimization that minimize fuel discharges from compensated systems, minimize sedimentation in clean ballast and compensated ballast tanks, and maximize exchange of organisms during ballast tank exchanges. - Initiate efforts on solids separation/removal from shipboard liquid waste streams.					
HUMAN SYSTEMS INTEGRATION		2.912	2.362	2.681	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity supports the warfighter by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. FY 2008 reflects a reinitiation of work in this field of research, which is paramount to the reduction in complex naval systems design, acquisition, operation, and maintenance costs and improvements in the effectiveness of operations. This effort was funded from FY 2002 through FY 2005 under this PE within the Manpower and Personnel activity; budget priorities led to the gap in funding in FY 2006 and FY 2007. Congressional, DoD, and Navy policies and instructions require the Navy and Marine Corps to have a comprehensive plan for Human Systems Integration (HSI) in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems. *FY 2008 Accomplishments:* - Initiated research to develop automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Initiated research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Initiated HSI tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels. *FY 2009 Plans:* - Continue all efforts of FY 2008. *FY 2010 Plans:* - Continue all efforts of FY 2009.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. - Initiate research into enhancing the ability to identify and fuse relevant multi-sensor data and then effectively presenting this information to the decision making team in order to gain tactical knowledge and improve their operational performances.					
LITTORAL COMBAT / POWER PROJECTION This activity provides for technologies that enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the Littorals. The FNC Program considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; strike; maneuver; sustainment; and fleet/force protection. This activity includes technical assessments and trade studies for FNC Enabling Capabilities that transition high priority technologies to the Navy and Marine Corps in support of the Sea Strike, Sea Shield, Sea Basing, and ForceNet Naval Power 21 pillars as well as Enterprise and Platform Enabling Science and Technology requirements. The decrease from FY 2008 to FY 2009 reflects the completion of the Battlefield Power Generation Technology FNC effort in FY 2008. The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to reduce the load of dismounted combatants and to improve SSN/SSGN next generation photonics mast capabilities. *FY 2008 Accomplishments:* - Completed development of battlefield power generation technologies. - Initiated efforts to conduct FNC warfighter sustainment applied research, including technology management of FNC investments supporting the naval enterprise and naval capability pillars.		8.047	6.271	14.632	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Initiated efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate development of technologies to reduce the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification. (Concurrent funding provided by PE 0603236N) - Initiate efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products.					
MANPOWER/PERSONNEL These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning. This activity further supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest		2.999	2.718	2.827	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. *FY 2008 Accomplishments:* - Continued low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. - Initiated development of a virtual, experimental-based software environment to test and evaluate the effect of various incentive structures on resource allocation decision making. - Initiated development of artificial intelligence and optimization techniques to create simulation based decision support tools for resource allocations across units and battle groups. - Initiated development of Unit-level tools to enable commanders to analyze the cost implications of their actions and weigh tradeoffs between readiness, cost, and risk. - Initiated development of intelligent agents to empower total force members to make training and assignment choices that enhance their careers and meet personal goals. - Initiated research to provide results for guiding the development on an interface allowing experts in HSI to work with subject matter experts to define and refine critical intra-domain concepts while capturing information for future use. - Initiated a continuous engineering process evaluation and adaptation to show that the developing process is executable and effective. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. *FY 2010 Plans:* - Continue all efforts of FY 2009.					
MEDICAL TECHNOLOGIES		14.821	12.134	18.378	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This program supports the development of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not applied research related to development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee, and Joint Technical Coordinating Group (JTCG) process, to prevent duplication of effort. This project funds the Force Health Protection FNC that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike". The decrease from FY 2008 to FY 2009 is due to the completion of several traumatic brain injury (TBI) efforts and a transition of investments to advanced technology. The increase from FY 2009 to FY 2010 reflects the initiation of Naval Noise-Induced Hearing Loss (NIHL) efforts to reduce the incidence of NIHL. *FY 2008 Accomplishments:* - Continued studies on decompression sickness (DCS) and arterial gas embolism (AGE), to include novel approaches to the prevention, detection and treatment of DCS/AGE, particularly by non-recompressive methods. - Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes. - Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness. - Continued studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued studies related to optimization of submariner health and performance. Submarine crewmembers are exposed to a variety of unique stressors including prolonged deployments, effects of altered diurnal rhythms, non-standard breathing gases, lack of sunlight, etc that can impact health and performance. - Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields. - Continued efforts for “stress inoculation” to mitigate the impact of exposure to stressful combat environments prior to deployment. - Completed study to evaluate endomorphin-based product to treat traumatic brain injury (TBI). - Completed research to treat and prevent attrition due to combat related psychological stress and acute Post Traumatic Stress Disorder (PTSD), a significant problem for retention of personnel. - Initiated program to develop enhanced First Responder capabilities. - Initiated program to develop enhanced Forward Resuscitative Surgical capabilities. - Initiated program to develop enhanced En Route Care capabilities. - Initiated efforts to mitigate the effects of environmental and other threats to health. - Initiated program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)). - Initiated efforts to reduce operational injuries. - Initiated efforts to reverse NIHL. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Initiate research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies. - Initiate research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Initiate research to improve personal protective equipment technology.					

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research to develop a Human Injury and Treatment (HIT) model for predicting outcomes of personnel exposure to shipboard damage. - Initiate and develop mature force health protection technologies that support naval requirements identified within the Navy and Marine Corps.					
SEA BASING TECHNOLOGIES		14.529	28.001	23.327	
This activity includes development and advancement of technologies to support Seabasing. Areas include: advanced hull forms, propulsion, and materials to support high speed, shallow draft, and beachable connectors; innovative connector interface and transfer technologies; advanced wave and position sensors and autonomous controls to support vessel to vessel interfaces; and autonomous conveyance systems to support automated and integrated warehousing. The increase from FY 2008 to FY 2009 represents changes in the complexity and cost for expanded efforts under the Sea Base to “Over-the-Shore” Connector Prototype (T-CRAFT Innovative Naval Prototype (INP) program model design and fabrication). This change is also due to continuation of the Sense and Respond Logistics(S&RL) program, and movement of Automated-semi-automated Weapons Breakout and Build-up System funding from Cost Reduction Technologies into this R-2 Activity where the effort is correctly identified in the FY 2008 Plans. The decrease in funding from FY 2009 to FY 2010 is due to the beginning of technical evaluation and down-selection for the T-CRAFT as well as the beginning of prototype and component development for the T-Craft. *FY 2008 Accomplishments:* - Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform. - Continued the down-selection of T-CRAFT designs for further development and model construction and testing. - Continued T-CRAFT model construction and testing. - Continued the construction of a scaled model of a Rapidly Deployable Stable Transfer Platform demonstrator. - Continued a second evaluation of potential Seabasing INP efforts.					

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated planning of T-CRAFT prototype and component development. - Initiated Sense and Respond Logistics (S&RL) research in: battlefield fuel management; decision support systems for S&RL; emergent intelligence/intelligent agents for S&RL; and advanced sensors/ processes for S&RL. *FY 2009 Plans:* - Continue all efforts of FY 2008 and expand efforts under the Sea Base to “Over-the-Shore” Connector Prototype (T-CRAFT Innovative Naval Prototype (INP) program model design and fabrication). - Continue efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions from Cost Reduction Technologies activity in this PE in FY 2009.) - Initiate the down-selection of Sense and Respond Logistics Information Architecture prototype development. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete the down-selection of T-CRAFT designs for prototype and component development. - Complete T-CRAFT model testing and evaluation. - Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate procurement of components and material to support T-CRAFT prototype construction. - Initiate development of agent based decision support and logistics planning algorithms.					
TRAINING TECHNOLOGIES Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, while deployed, and to operate effectively in the complex, high-stress, information-rich and ambiguous environments of modern warfare such as asymmetric warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance. Improved training efficiency and cost-effectiveness is		9.790	10.699	10.328	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training. *FY 2008 Accomplishments:* - Continued program on intelligent agents for objective-based training. - Continued Computer Generated Forces (CGF) task aimed at improved techniques for human cognitive and behavioral modeling. - Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks. - Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring. - Continued work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring. - Continued task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence. - Continued task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates. - Continued field studies and user tests evaluating new features and job aiding tools. - Initiated development of optimized strategies for performance aiding and training. - Initiated development of virtual technologies for warfare training application. - Initiated development of technologies to support human performance in networked warfighting environments. - Initiated development of training technologies for culture, values, and language training and opponent simulation for training systems. *FY 2009 Plans:* - Continue all efforts of FY 2008.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research to create computational models of human behavior in selected non-Western environments that reflect the dominant cultural, social, ethnic, and economic determinants of behaviors, attitudes, and beliefs of individuals, groups, and organizations operating in these environments, and exploit these models to forecast responses to our actions and those of others attempting to exert influence in these environments. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research into computational neuron-models in the design of training systems - Initiate the integration of cognitive and neuron-computational models of human learning. - Initiate research into intelligent tutoring systems for adaptive competency in submarine bridge team and surface ship combat information center trainers.					

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0308601N/Modeling and Simulation Support									Continuing	Continuing
PE 0601102A/Defense Research Sciences									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601103N/University Research Initiatives									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602102F/Materials									Continuing	Continuing
PE 0602105A/Materials Technology									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602202F/Human Effectiveness Applied Research									Continuing	Continuing
PE 0602203F/Aerospace Propulsion									Continuing	Continuing
PE 0602204F/Aerospace Sensors									Continuing	Continuing
PE 0602211A/Aviation Technology									Continuing	Continuing

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PE 0602303A/Missile Technology		Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research		Continuing	Continuing
PE 0602601A/Combat Vehicle and Automotive Technology		Continuing	Continuing
PE 0602702F/ Command Control and Communications		Continuing	Continuing
PE 0602705A/Electronics and Electronic Devices		Continuing	Continuing
PE 0602709A/Night Vision Technology		Continuing	Continuing
PE 0602716A/Human Factors Engineering Technology		Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research		Continuing	Continuing
PE 0602785A/Manpower/ Personnel/Training Technology		Continuing	Continuing
PE 0602786A/Warfighter Technology		Continuing	Continuing
PE 0602787A/Medical Technology		Continuing	Continuing
PE 0603002A/Medical Advanced Technology		Continuing	Continuing
PE 0603003A/Aviation Advanced Technology		Continuing	Continuing
		Continuing	Continuing

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PE 0603216F/Aerospace Propulsion and Power Technology			
PE 0603236N/Warfighter Sustainment Advanced Technology		Continuing	Continuing
PE 0603512N/Carrier Systems Development		Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)		Continuing	Continuing
PE 0603716D8Z/Strategic Environmental Research Program		Continuing	Continuing
PE 0603721N/ Environmental Protection		Continuing	Continuing
PE 0603724N/Navy Energy Program		Continuing	Continuing
PE 0603729N/Warfighter Protection Advanced Technology		Continuing	Continuing
PE 0603851D8Z/ Environmental Security Technical Certification Program		Continuing	Continuing
PE 0604561N/SSN-21 Developments		Continuing	Continuing
PE 0604703N/Personnel, Training, Simulation, and Human Factors		Continuing	Continuing
PE 0604771N/Medical Development		Continuing	Continuing

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PE 0605152N/Studies and Analysis Support - Navy	Continuing	Continuing
PE 0708011N/Industrial Preparedness	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

As discussed in Section A, there are a significant number of varied efforts within this PE. For the most part these efforts support the FNC program. As such, each is monitored at two levels. At the lowest level each is measured against both technical and financial milestones on a monthly basis. Annually each FNC and its projects are reviewed in depth for technical and transition performance by the Chief of Naval Research against goals which have been approved by the Navy.

The FNC managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or bi-annual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.