FY 2009 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2008
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	92,455	71,764	58,658	60,792	63,916	70,730	80,440

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.

All Navy applied research in undersea target detection, classification, localization, tracking, and neutralization is funded through this PE. Technologies being developed within this PE are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country’s current capital investment in surveillance, submarine, surface ship, and air ASW assets. Research focused on understanding the impacts on marine mammals of manmade underwater sound is also conducted in the Program Element.

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 2007	FY 2008	FY 2009
FY 2008/FY 2009 President's Budget Submission	93,224	68,455	65,254
Congressional Action	0	4,400	0
Congressional Undistributed Reductions/Rescissions	0	-491	0
Execution Adjustments	1,309	0	0
Program Adjustments	-287	0	-6,386
Rate Adjustments	0	0	-210
SBIR Assessment	-1,791	-600	0
FY 2009 President's Budget Submission	92,455	71,764	58,658

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:
The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

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A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy applied research in undersea target detection, classification, localization, tracking, and neutralization is funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield which is one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2007	FY 2008	FY 2009
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	43,279	30,292	25,642

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high bandwidth communications links. The cornerstone of Wide Area Surveillance is the ability to rapidly distribute acoustic and non-acoustic sensors from air, surface, and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked-components, multi-static operation, and supported by passive/active signal processing all with the objective of increased detection capabilities.

The decrease from FY 2007 to FY 2008 is associated with the transition of the Innovative Naval Prototype (INP) Persistent Littoral Undersea Surveillance (PLUS) to PE 0603747N. The decrease from FY 2008 to FY 2009 is due

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to zero-sum realignment within the Future Naval Capability program of record to fund Technology Oversight Group approved Enabling Capabilities. Additionally, FY 2009 funds were moved to the newly established Marine Mammals Activity ($1.2M)

FY 2007 Accomplishments:

- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continued development of "intelligent" algorithms aimed at optimizing distributed multistatic sources/receivers.
- Continued development of a non-traditional tracking system for deployment on undersea vehicles.
- Continued testing of a non-traditional tracking system.
- Continued development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.
- Continued development of tracking and classification algorithms for broadband Doppler sensitive waveforms for wide area surveillance.
- Continued an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications.
- Continued an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications.
- Continued an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications.
- Continued an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems.
- Continued an effort to develop optical signal processing technology appropriate for Undersea Warfare and underwater communications systems.
- Continued and completed third geomagnetic noise coherence investigation from cooperating airborne measurement platforms.
- Continued magnetic mapping and localization study and component development for small-diameter Autonomous Undersea Vehicles.
- Completed development of Telesonar technologies to enable deployable system acoustic communications.
- Completed testing of advanced node design and associated technologies.
- Completed development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.

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- Completed integration of a prototype system for undersea persistent surveillance.
- Completed investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Completed development and testing of components of a prototype system for undersea persistent surveillance.
- Completed evaluation of undersea persistent surveillance system performance and trade-offs.
- Completed demonstration of a prototype system for undersea persistent surveillance.
- Completed development of a prototype system for PLUS. PLUS transitions to PE 0603747N (Undersea Warfare Advanced Technology) for advanced technology development beginning in FY 2008.
- Completed efforts to develop an underwater intruder defense system, including comprehensive active and passive signatures from swimmers, harbor environment noise characteristics, and fiber optic array technology. (NRL)
- Completed analysis and modeling of high frequency underwater acoustic communications techniques between Unmanned Undersea Vehicles (UUVs) and demonstrated its capability. (NRL)
- Completed development of a Helium-3 scalar magnetometer for stationary magnetic arrays.
- Completed Next Generation Autonomous Sensor (NGAS) Joint Research Project (JRP) collaboration and related Overhauser scalar magnetometer investigations.
- Completed efforts to measure, quantify, and model reverberation and clutter from biologics and the seafloor and provide a prediction tool for multistatic active sonars. (NRL)
- Initiated the development of technologies for a low source-level, light-weight ship-protection system against underwater intruders, including vessels with explosives. (NRL)
- Initiated development of signal processing algorithms for operational and pipeline ASW active sonar systems by extending NRL’s broadband, beam-based theory for the Time Reversal Operator. (NRL)

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continued experimental test planning for Palantir sensor.
- Continued Submarine Track and Trail applied research efforts for UUV technology in the areas of advanced undersea sensors, communications, and autonomy. This effort transferred from PE 0602114N due to Enabling Capability (EC) realignments.
- Initiated an applied research effort to improve distributed system processing techniques and capabilities.
- Initiated development of automatic signal processing algorithms for use with a Deep Water Active Deployable System (DWADS) for surveillance of deep ocean submarine threats.
- Initiated development of a transmit/receive array for use with a DWADS for surveillance of deep ocean submarine threats.

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FY 2008 Plans:

- Continue all FY 2007 efforts less those noted as completed above.
- Complete development of tracking and classification algorithms for broadband Doppler sensitive waveforms for wide area surveillance.
- Complete magnetic mapping and localization study and component development for small-diameter Autonomous Undersea Vehicles.
- Initiate design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications.
- Initiate development of spin-dependent tunneling and coupled magnetostrictive/piezoelctric passive magnetometer device technologies.
-Initiate development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales. (NRL)
-Initiate development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies. (NRL)
-Initiate fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components. (NRL)

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continue all FY 2007 efforts.
- Complete Submarine Track and Trail applied research efforts for UUV technology in the areas of advanced undersea sensors, communications, and autonomy.
- Complete experimental test planning for Palantir sensor.
- Initiate incorporation and enhancement of technology from real-time data fusion technologies into Distributed System Processing (DSP).
- Initiate and complete a FY 2008 Palantir data collection exercise. All Palantir system related products developed in this PE transition to PE 0603747N where Palantir system development continue.
- Initiate development of algorithms to optimize the placement of uncontrolled drifting systems.
- Initiate development of a simulator for placement of uncontrolled drifting systems.
- Initiate development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL).

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FY 2009 Plans:

- Continue all FY 2008 efforts less those noted as completed above.
- Complete development of technologies for a low source-level, light-weight ship-protection system against underwater intruders, including vessels with explosives. (NRL)
- Complete development of signal processing algorithms for operational and pipeline ASW active sonar systems by extending NRL's broadband, beam-based theory for the Time Reversal Operator. (NRL)
- Initiate a research effort to accomplish array shape estimation using fiber-optic interferometric methods.
- Initiate a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS).

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continue all FY 2008 efforts less those noted as completed above.
- Complete incorporation and enhancement of technology from real-time data fusion technologies into Distributed System Processing (DSP).
- Complete development of automatic signal processing algorithms for use with a DWADS for surveillance of deep ocean submarine threats.
- Complete development of a transmit/receive array for use with DWADS for surveillance of deep ocean submarine threats.
- Initiate algorithm testing of uncontrolled drifting systems using a simulator.
- Initiate research effort aimed at the ideal placement and control of acoustic sources and drifting sensor systems.
- Initiate a research effort focusing on distributed system in-situational environmental characterization and system monitoring.
- Initiate a research effort to determine the placement of and follow-on control and pattern keeping of acoustic sources and distributed sensor systems.

	FY 2007	FY 2008	FY 2009
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	15,491	15,110	10,294

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with detections inside 10 nautical miles. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally

adaptive processing techniques. Research aimed at understanding and predicting the impacts of manmade underwater sound on marine mammals is also conducted in this activity. Battlegroup ASW Defense will enable smaller, lighter, and cheaper acoustic/non-acoustic arrays, large multi-line arrays, and submarine flank arrays (all with environmental adaptation capabilities).

The FY 2008 to FY 2009 decrease is associated with the movement of funds to establish the new Marine Mammals Activity ($4.3M)

FY 2007 Accomplishments:

- Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification, and Localization of small, slow moving submarines in shallow water.
- Continued design and development of underwater projectors using structural magnetostrictive materials.
- Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continued development of an acoustic/magnetic hybrid sensor.
- Continued development of low cost, compact, combined acoustic sensor.
- Continued development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing.
- Continued electroactive polymer smart sensor development.
- Continued dipole projector array design and development.
- Completed investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Completed development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Completed development of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Initiated compact low frequency projector developments.

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continued development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system.
- Continued development of an AN/WSQ-11 “Tripwire” testbed for the testing of algorithms.
- Completed hardware component integration, testing and installation of the acoustic array test bed.

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- Initiated a focused research study to evaluate sonar performance using the acoustic array testbed.

FY 2008 Plans:

- Continue all FY 2007 efforts less those noted as completed above.
- Complete development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing.
- Initiate development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability.
- Initiate development of environmentally adaptive target detection and classification algorithms for deep water operating environments.
- Initiate an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and demonstrations when sound is transmitted underwater. This effort transfers to the newly established Marine Mammals Activity in FY 2009.

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continue all FY 2007 efforts less those noted as completed above.
- Complete a focused research study to evaluate sonar performance using the acoustic array testbed.

FY 2009 Plans:

- Continue all FY 2008 efforts less those noted as completed above.
- Initiate single crystal and hybrid projector design and development.
- Initiate research to improve detection of quiet diesel-electric submarines using passive sonar arrays in deep ocean environments.

The following efforts contribute to the Littoral Anti-Submarine Warfare FNC:

- Continue all FY 2008 efforts.

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	FY 2007	FY 2008	FY 2009
COOPERATIVE ASW	728	0	0

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify, and localize very quiet undersea targets. Many of the tools required to achieve this objective were being developed as components of the Littoral Anti-Submarine Warfare FNC under the heading of Integrated Anti-Submarine Warfare (IASW) in PEs 0602235N and 0603235N. The focus of this effort is to leverage those concepts and technologies previously investigated under IASW in order to develop technologies that enable the exchange and fusion of ASW sensor data among the technologies developed under Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas.

The funding profile from FY 2007 to FY 2008 reflects the completion of the real-time data fusion effort.

FY 2007 Accomplishments:

- Completed the incorporation of estimates of environmental uncertainty into the fusion of sensor information.
- Completed planning for and conducted at-sea technology demonstration of real-time data fusion technologies and analyzed results. Real-time data fusion technologies transition to the Distributed System Processing effort described under the Wide Area ASW Surveillance activity in this Program Element.

	FY 2007	FY 2008	FY 2009
MARINE MAMMALS	0	0	5,500

This activity consolidates and expands research associated with marine mammals and conducted in FY 2008 in the Battlegroup Anti-Submarine Warfare Activity. The sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. This program is to assure that Navy decisions can be based on scientifically defensible positions.

The goal of this activity is to support: (1) marine mammal research related to understanding impacts of underwater sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine

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organisms; and (4)research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing of bioluminescence sensors).

The marine mammals research conducted in this Program Element (P.E.) represents part of a total effort executed in coordination with complementary research performed in P.E. 0602435N.

This Activity has been created to specifically address the work associated with determining and mitigating the effects on the behavior of marine mammals of manmade sound transmitted underwater. The FY 2009 funding associated with this newly created Activity came from the Battlegroup Anti-Submarine Warfare Activity ($4.3M) and the Wide Area Anti-Submarine Warfare Surveillance Activity ($1.2M).

FY 2009 Plans:

- Complete an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet Anti-Submarine Warfare experimentation exercises and demonstrations when sound is transmitted underwater. This effort transferred to this newly established Activity from the Battlegroup Anti-Submarine Warfare Defense Activity.
- Initiate multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures.
- Initiate development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery.
- Initiate research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).
- Initiate research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters.
- Initiate development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise.
- Initiate development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish.
- Initiate research to examine sensitivity of fish to anthropogenic sound.
- Initiate research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.

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	FY 2007	FY 2008	FY 2009
NEUTRALIZATION	22,845	21,990	17,222

Neutralization focuses on the development of enabling technologies for undersea weapons to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing, and Propulsion), Power Sources, Supercavitation, and Torpedo Defense (TD).

The following demonstration FNC projects are included in this activity: 1) the Lightweight Torpedo Technology (LTT) project (begins transition to PE 0603747N in FY 2008), and 2) the Compact Rapid Attack Weapon (CRAW) project.

The ultimate goal of this activity is to develop modular and reduced sized undersea weapons based on common technology enablers (where possible), to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, and enable new undersea weapon concepts of operations to rapidly transition to submarine neutralization/engagement in deep and shallow water under unique payload limitations posed by unmanned platforms, external stowage, and future Naval platforms.

The funding decrease from FY 2008 to FY 2009 represents the phased movement of technologies from Applied (6.2) to Advanced (6.3) Research as the technologies mature in the areas of Wide Area Surveillance and Neutralization.

FY 2007 Accomplishments:

- Continued development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons (examine experimentally, in water, the physics of interactions among multiple supercavitating projectiles in a projectile burst).
- Continued optimization of undersea weapons system design using MSDO with respect to constraints in cost and performance.
- Continued development of enhanced performance for torpedo warheads through the use of focused energy technologies for Light Weight Torpedo (LWT) Improvement and CRAW applications.

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- Continued validation of computational models for torpedo lethality.
- Continued effort to conduct full ship validation effort for Explosion Response simulation code, using Dynamic System Mechanics Advanced Simulation (DYSMAS) Hydrocode (test plan developed, finite element ship model was completed, pretest simulations were conducted).
- Continued implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
- Continued development of high-speed supercavitating torpedo vehicle control and homing sensor.
- Continued to conduct experiments and tests on vehicle control concepts and homing sensors.
- Continued fourth quarter (of the fiscal year) explosive testing for warhead projects.
- Continued conduct of computer code refinements and investigation of supercavitating vehicle dynamics and instability.
- Continued development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors.
- Continued feasibility investigations (including acoustic element construction) to test the ability of single crystal to operate at high field, high drive, and high duty cycle for both torpedo Tonpiltz transducer and broadband cylindrical projector applications.
- Continued fin and cavitator control, and integrate with controller for the supercavitating 6.75-inch vehicle.
- Continued torpedo design and optimization to support the external weapon stowage effort in DARPA Tango Bravo Program.
- Continued data collection on a technology test-bed for surface ship close in torpedo defensive system using supercavitating projectiles.
- Completed Low Acoustic Motor Propulsor (LAMPrEy) technology transition to DARPA Tango Bravo Program. Transition to DARPA PE 0603766E, Project NET-02.
- Completed development of improved threat models and torpedo system simulation capabilities under the Torpedo Enterprise Advanced Modeling and Simulation initiative.
- Completed transition of appropriate supercavitating vehicle control technology and control devices to DARPA Underwater Express program.
- Initiated efforts in electric propulsion for the Next Generation Torpedo.
- Initiated signal processing and homing algorithms for supercavitating vehicle.
- Initiated efforts that enhance undersea weapons G&C capabilities in autonomy, sensors, sensor processing, communication and networking by leveraging current, or contribute to developing, technologies for UUVs.

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The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:

- Continued application of MSDO tools probabilistic methods and uncertainty analysis for LWT design.
- Continued feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications. (Transitions to PE 0603747N in FY 2008)
- Continued LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 LWT. (Transitions to PE 0603747N in FY 2008)
- Continued LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for LWT demonstration). (Transitions to PE 0603747N in FY 2008)
- Continued data collection for LWT broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array. (Transitions to PE 0603747N in FY 2008)
- Continued LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT. (Transitions to PE 0603747N in FY 2008)
- Continued LTT advanced counter-countermeasure algorithm and tactics development for LWT. (Transitions to PE 0603747N in FY 2008)
- Continued feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range. (Transitions to PE 0603747N in FY 2008)
- Continued development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density. (Transitions to PE 0603747N in FY 2008)
- Continued a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement. (Transitions to PE 0603747N in FY 2008)
- Initiated development of a reduced size/weight CRAW for air deployment. This effort included sensor, guidance and control, warhead, propulsion, and air frame integration tasks.
- Initiated an iterative algorithm development to enable the CRAW to search, home, and terminally home against targets in deep and shallow water both without and with countermeasures.
- Initiated technology to enable a CRAW warhead to achieve required lethality against submarine targets.
- Initiated use of design techniques for LWT using undersea weapons system design tools transitioned from Discovery and Innovation to FNC.

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FY 2008 Plans:

- Continue all efforts of FY 2007 less those noted as completed above.
- Continue weaponization study for unmanned undersea vehicle initiated in FY 2007.
- Complete validation of computational models for torpedo lethality and transition to PMS415.
- Initiate weaponization study for unmanned surface vehicle.
- Initiate test and evaluation of signal processing and homing algorithms for supercavitating vehicle.
- Initiate integration of hydroreactive shaped charge technology into CRAW warhead development. (Technology transitioning from PE 0602123N)
- Initiate long pulse concept to exploit explosion bubble technology to enhance undersea warhead performance with smaller volumetric requirements.
- Initiate efforts to develop air and underwater delivered kinetic energy enhanced lethality warhead concepts.
- Initiate hybrid propulsion for Heavyweight Torpedo.

The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:

- Continue all efforts of FY 2007 less those noted as completed above.
- Continue development of a shaped charge liner for CRAW warhead initiated in FY 2007.
- Complete an iterative algorithm development to enable the CRAW to search, home, and terminally home against targets in deep and shallow water both without and with countermeasures.
- Initiate LTT development of an underwater acoustics communications capability to enable coordinated attack and net-centric connectivity. (Transitions to PE 0603747N in FY 2009)
- Initiate LTT development of salvo weapons tactics utilizing behavior-based control. (Transitions to PE 0603747N in FY 2009)

FY 2009 Plans:

- Continue all efforts of FY 2008 less those noted as completed above.
- Complete transition of appropriate supercavitating vehicle control technology and devices to DARPA Underwater Express Program.
- Complete efforts in electric propulsion for LWT.
- Complete signal processing and homing algorithms for supercavitating vehicle.
- Complete the evaluation of the integration of hydroreactive shaped charge technology into CRAW warhead

development.
- Initiate development of advanced undersea warhead fuzing concepts.
- Initiate development of enhanced yield explosive concepts for undersea warhead applications.
- Initiate quiet propulsion systems development for torpedoes.

The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area:

- Continue all efforts of FY 2008 less those noted as completed above.
- Complete the development of algorithms for CRAW to search, home and terminally home in deep and shallow water against targets both without and with countermeasures.

CONGRESSIONAL PLUS-UPS:

	FY 2007	FY 2008
ACOUSTIC LITTORAL GLIDER	4,782	0

Continued at-sea testing of prototype acoustic undersea gliders and began integration of undersea warfare payloads into twenty-five gliders. Conducted operational testing of the gliders to demonstrate the ability to carry and/or deploy undersea acoustic sensors.

	FY 2007	FY 2008
ADVANCED ACOUSTIC TRANSDUCER CONCEPTS	1,943	0

Continued development of materials and processing techniques for Galfenol. Investigated texture and chemistry, grain growth inhibitors, and other alloying additions that can result in texture enhancements. Also, studied new insulating coating practices to prevent electrical shorts between laminates. Undertook a cost reduction program to reduce the cost of the Terfenol-D/magnet active element in the HUNTER transducer. Developed a fully coupled, nonlinear, dynamic model to enable understanding of the behavior of Magnetostrictive Materials. Developed a test bed to characterize new concepts and designs. Investigated Magnetostrictive sensors to determine their viability as underwater acoustic pressure sensors.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

	FY 2007	FY 2008
ANTI-TORPEDO TORPEDO (6.75 INCH DIAMETER) MULTI-MISSION WEAPON	1,444	0

Continued research to support optimization of signal processing and 6.75" weapon tactics used in ATT for offensive applications. Continued collection of in-water data to evaluate proposed multi-mission guidance and control technologies. Initiated research on extending multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept.

	FY 2007	FY 2008
AUTONOMOUS UNMANNED UNDERSEA VEHICLE (UUV) DELIVERY & COMMUNICATIONS DEMONSTRATION	0	1,988

This effort will focus on feasibility studies and the design of a payload module for a large unmanned undersea vehicle (UUV) to deliver and communicate with smaller UUVs for anti-submarine warfare and mine countermeasures.

	FY 2007	FY 2008
GALFENOL ENERGY HARVESTING	0	1,589

Initiate research to develop Galfenol (Iron Gallium) alloys for use in energy harvesting devices. Develop processing techniques for texture development in rolled sheet, improvements in directional solidification practices and welding/joining studies.

	FY 2007	FY 2008
HIGH POWER LITHIUM BATTERY	0	795

This effort is a follow-on to an FY 2006 Congressionally directed program. This year's effort will incorporate the capabilities developed in FY 2006 into a D-cell form factor.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

	FY 2007	FY 2008
MICRO ELECTRO MECHANICAL SYSTEMS-INERTIAL MEASUREMENTS UNITS (MEMS-IMU)	1,943	0

Continued research and design of Micro Electro Mechanical Systems (MEMS) sensors for various applications including weapons safety and health monitoring. Continued development of advanced manufacturing processes for MEMS and demonstrated their reliability and application in system prototyping and low volume output for these applications. Initiated research into application of MEMS based projectile control devices.

C. OTHER PROGRAM FUNDING SUMMARY - NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences
PE 0602114N Power Projection Applied Research
PE 0602123N Force Protection Applied Research
PE 0602435N Ocean Warfighting Environment Applied Research
PE 0602782N Mine and Expeditionary Warfare Applied Research
PE 0603114N Power Projection Advanced Technology
PE 0603123N Force Protection Advanced Technology
PE 0603506N Surface Ship Torpedo Defense
PE 0603553N Surface ASW
PE 0603561N Advanced Submarine System Development
PE 0603747N Undersea Warfare Advanced Technology
PE 0603758N Navy Warfighting Experiments and Demonstrations
PE 0604221N P-3 Modernization Program
PE 0604261N Acoustic Search Sensors
PE 0604784N Distributed Surveillance System

OTHER PROGRAM FUNDING SUMMARY - NON-NAVY RELATED RDT&E:
PE 0602702E Tactical Technology
PE 0603739E Advanced Electronics Technologies

D. ACQUISITION STRATEGY:
N/A