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

DATE: Feb 2005

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

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	69,923	84,325	71,362	85,857	72,931	74,098	61,962	60,928

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy applied research in undersea target detection, classification, localization, tracking, and neutralization is funded through this Program Element (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.

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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PROGRAM CHANGE SUMMARY:

	<u>FY 2004</u>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
FY 2005 President's Budget Submission	76,788	64,060	63,244	63,797
Cong Rescissions/Adjustments/Undist. Reductions	0	-917	0	0
Congressional Action	0	21,200	0	0
Execution Adjustments	-4,892	0	0	0
FNC Realignment	0	0	-560	891
Non-Pay Inflation Adjustments	-71	0	0	0
Program Adjustments	0	-18	-67	-71
Program Realignment	0	0	8,727	20,893
Rate Adjustments	0	0	18	347
SBIR Assessment	-1,902	0	0	0
FY 2006/2007 President's Budget Submission	69,923	84,325	71,362	85,857

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: Not applicable.

Schedule: Not applicable.

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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
WIDE AREA ANTI-SUBMARINE (ASW) SURVEILLANCE	14,232	18,494	27,946	41,558

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.

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FY 2004 Accomplishments:

- Continued development of Telesonar technologies to enable deployable system acoustic communications.
- 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.
- Completed feasibility assessment of using Anti-Submarine Warfare (ASW) acoustic intensity sensors as active receivers.
- Completed development/improvement of multistatic signal processing techniques for systems employing explosive sound sources.
- Completed development of ultra-low power electronics to support advanced ASW maritime remote sensing devices.
- Completed development of deployable volumetric arrays capable of tactically significant gains.
- Completed quantification of potential biologic clutter and false targets for active sonar using fish school size and acoustic intensity data. (NRL)
- Completed determination of channel capacity limits versus data rate for Underwater Acoustic Communications (ACOMMS) systems in specific littoral environments. (NRL)
- Completed initial demonstrations of acoustic time-reversal techniques at sea in a shallow water environment. (NRL)
- Completed analysis of acoustic noise data and determined that the contributions of coastal fishing vessels can have a major impact on the total noise field. (NRL)
- Initiated development of an advanced node design for survivable sensors.
- Initiated development of a non-traditional tracking system for deployment on undersea vehicles.
- Initiated development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continued development and testing of a series of incremental software builds for in-buoy signal processing.
- Continued development of smaller, cheaper low-frequency active transducers for multistatic sonar systems.
- Completed development of transducer, power source, and power amplifier components for the Compact Deployable Multistatic Source (CDMS).
- Completed development and at-sea testing of Compact Deployable Multistatic Receiver (CDMR) hardware and

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software.

- Initiated development of "field-level" processing for large numbers of CMDRs.
- Initiated at-sea testing of the multistatic system components (CDMR, signal processing software, and "field-level" processing).

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed.
- Complete analysis of at-sea data to validate signal-processing techniques derived from acoustic time-reversal concepts. (NRL)
- Complete development of high data rate multi-access communications technique in Underwater Acoustic Communications (ACOMMS) and provide a demonstration of its capability. (NRL)
- Initiate integration of a prototype system for undersea persistent surveillance.
- Initiate investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Initiate development and testing of components of a prototype system for undersea persistent surveillance.
- Initiate testing of a non-traditional tracking system.
- Initiate 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)

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2004 efforts less those noted as completed.
- Complete development of "field-level" processing for large numbers of Compact Deployable Multistatic Receivers (CMDRs).
- Complete development and testing of a series of incremental software builds for in-buoy signal processing.
- Complete development of smaller, cheaper low-frequency active transducers for multistatic sonar systems.
- Complete Palantir Project Plan.
- Initiate concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.

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- Complete development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.
- Complete efforts to measure, quantify, and model reverberation and clutter from biologics and the seafloor and provide a prediction tool for multistatic active sonars. (NRL)
- Initiate planning for testing of advanced node designs and associated technologies.
- Initiate development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2005 efforts less those noted as completed.
- Complete integrated at-sea testing of the multistatic system components (CDMR, signal processing software, and "field-level" processing).
- Complete concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).
- Initiate design and development of Palantir sensor and data collection system and conduct a FY 2006 data collection exercise.
- Initiate experimental test planning for Palantir sensor.
- Initiate Deployable Autonomous Distributed System (DADS) study of component feasibility to enable effective deployment, survival, and cost options. This effort transitions to Program Element 0603747N in FY 2007.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed or transitioned.
- Complete development of Telesonar technologies to enable deployable system acoustic communications.
- Complete testing of advanced node design and associated technologies.
- Complete evaluation of undersea persistent surveillance system performance and trade-offs.
- Complete integration of a prototype system for undersea persistent surveillance.
- Complete demonstration of a prototype system for undersea persistent surveillance.
- Complete investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Complete development and testing of components of a prototype system for undersea persistent surveillance.
- Complete initial development of an underwater intruder defense system and provide a demonstration of a viable overall system concept. (NRL)
- Complete analysis and modeling of high frequency underwater acoustic communications techniques between Unmanned Undersea Vehicles (UUVs) and demonstrate its capability. (NRL)

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The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2006 efforts less those noted as completed.
- Initiate an applied research effort to improve distributed system processing techniques and capabilities.
- Initiate the On-Demand Detection Classification and Localization (DCL) effort focusing on the development of sensor and platform designs compatible with notional Concept of Operations (CONOPS).
- Initiate an effort to develop automation techniques for transition to various Littoral ASW distributed sensor systems.

	FY 2004	FY 2005	FY 2006	FY 2007
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	25,125	28,282	23,902	16,872

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 nm. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. 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).

FY 2004 Accomplishments:

- Continued development of Reduced Diameter fiber optic sensors to improve towed array reliability.
- Continued development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns.
- Continued development of structural magnetostrictive materials to enable more rugged transducer designs.
- 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 investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continued investigations into time-reversal techniques to improve the performance of active sonar systems.
- Continued development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continued development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continued design and development of underwater projectors using structural magnetostrictive materials.

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- Continued development of baffled ring transducer technology.
- Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Completed development and evaluation of advanced sonar signal classification algorithms, using "support vector machines", which enable improved sonar operator performance.
- Completed development and testing of a low-cost fishline fiber optic array for platform-based deployment.
- Completed development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the High Frequency sail array designs for 688- and Virginia-class submarines--transitioned to the Advanced Systems Technology Office, SEA-93, and Program Element 0603561N. (Transduction)
- Completed development of very thin, compact High Frequency cymbal transducers for conformal arrays.
- Completed demonstration showing that geo-acoustic inversion using a towed array is insensitive to the source-receiver range. (NRL)
- Initiated development of an acoustic/magnetic hybrid sensor.
- Initiated the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification, and tracking process.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continued development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines. This work transitioned to Program Element 0603747N in FY 2005.
- Continued characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems. This work transitioned to Program Element 0603747N in FY 2005.
- Continued passive acoustic array testbed design and hardware component procurement to support future passive sonar system designs.
- 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 system requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Completed hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.
- Completed development of Lead Zirconate Titanate (PZT) materials for High-Frequency Broadband Transducers &

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Arrays for submarines.

- Initiated preliminary Multi-Mode Magnetic Detection System design and component-level development of air deployed magnetometer sensor technologies.
- Initiated Multi-Mode Magnetic Detection System development and installation of real-time noise reduction, detection, and tracking algorithms on a simulator to enable data collection and performance evaluation.

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed.
- Complete evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability and transition to the NAVSEA Advanced Systems Technology Office, Program Element 0603561N.
- Complete development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns. Transition to the NAVSEA Advanced Systems Technology Office, Program Element 0603561N.
- Complete investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Complete investigations into time-reversal techniques to improve the performance of active sonar systems.
- Complete design and development of underwater projectors using structural magnetostrictive materials.
- Complete the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification, and tracking process.
- Complete investigations of the feasibility of geo-acoustic parameter inversion and demonstrate using an operational Navy asset. (NRL)
- Initiate development of low cost, compact, combined acoustic sensor. This effort will contribute to applied research for undersea persistent surveillance.
- Initiate development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2004 efforts less those noted as completed or transitioned.
- Complete hardware component integration, testing, and installation of an acoustic array test bed in support of future passive sonar system designs.
- Complete preliminary Multi-Mode Magnetic Detection System (MMMDS) design and component-level development of air deployed magnetometer sensor technologies.
- Complete MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms to enable data collection and performance evaluation.

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- Initiate a focused research study to evaluate sonar performance using the acoustic array testbed.
- Initiate collection and analysis of MMMDS performance data. This effort transitions to Program Element 0603747N in FY 2006.
- Initiate evaluation of proposed MMMDS processing approaches and down-select to one approach. This effort transitions to Program Element 0603747N in FY 2006.

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.
- Complete development of structural magnetostrictive materials to enable more rugged acoustic transducer designs.
- Complete development of baffled ring transducer technology.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2005 efforts less those noted as completed or transitioned.
- Complete Adaptive Beamforming processing development.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed.
- Complete development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Complete development of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all FY 2006 efforts less those noted as completed.
- Complete a focused research study to evaluate sonar array performance using the acoustic array testbed and provide a Transition Report to the Chief of Naval Operations, Director Submarine Warfare Division, Code N77.

	FY 2004	FY 2005	FY 2006	FY 2007
COOPERATIVE ASW	1,149	1,236	749	752

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

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developed as components of the Littoral Anti-Submarine Warfare (LASW) Future Naval Capability under the heading of Integrated Anti-Submarine Warfare (IASW) in Program Elements (PEs) 0602235N and 0603235N. A portion of those efforts continued in this PE (0602747N) as Cooperative ASW in FY 2004. The focus of this effort was to leverage those concepts and technologies previously investigated under IASW in order to develop technologies that enabled the exchange and fusion of ASW sensor data among the technologies developed under Battlgroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas.

FY 2004 Accomplishments:

- Initiated investigation into a flexible information/knowledge management architecture that can support several sonar systems including land/air-based sensors.
- Initiated investigation into technologies to automatically fuse tactical sensor information to form and maintain an improved ASW portion of the Common Tactical Undersea Picture.

FY 2005 Plans:

- Complete investigation into a flexible information/knowledge management architecture that can support several sonar systems and include land/air-based sensors.
- Complete investigation into technologies to automatically fuse tactical sensor information to form and maintain an improved ASW portion of the Common Tactical Undersea Picture.
- Initiate development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

FY 2006 Plans:

- Continue development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

FY 2007 Plans:

- Complete development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

	FY 2004	FY 2005	FY 2006	FY 2007
NEUTRALIZATION	14,807	15,314	18,765	26,675

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Neutralization focuses on technologies for undersea weapons to counter threat submarines by increasing the Probability of Kill (Pk). Weapon technology focus areas include: Counterweapons/Countermeasures (CW/CM), Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing and Propulsion), Power Sources, Supercavitation, and Demonstration of Torpedo Bridging Technologies (TBT). The ultimate goal is to develop reduced sized advanced undersea weapons with revolutionary capabilities to fill Sea Shield Warfighter Capability Gap/Enabling Capability: Rapid Submarine Cueing, Detection, Localization, and Neutralization in Shallow and Deep Water/LASW Gap 1: Provide improved submarine cueing/wide area search in deep and shallow water ocean areas. Capability must include ability to rapidly transition to submarine neutralization/engagement.

FY 2004 Accomplishments:

- Continued development of improved threat models and torpedo system simulation capabilities under the Torpedo Enterprise Advanced Modeling and Simulation (TEAMS) initiative.
- 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 development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPRey) undersea vehicle to further enhance Torpedo Stealth efforts.
- Continued optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continued to develop enhanced performance directed energy torpedo warhead technologies for Light-Weight Torpedo (LWT) Improvement and Compact Rapid Attack Weapon (CRAW) applications.
- Continued validation of computational models for torpedo lethality.
- Completed development of weapon noise models and control concepts for propulsor radiated noise.
- Completed fabrication and tested supercavitation homing sensor using single crystal and piezoelectric and piezoceramic materials.
- Completed transition of Integrated Simulation Based Design Environment (ISBDE) to Canistered Countermeasure Anti-Torpedo (CCAT) vehicle.
- Initiated application of MSDO tools probabilistic methods and uncertainty analysis for LWT design.
- Initiated development of algorithms for coordinated behavior of groups of torpedo defense vehicles.
- Initiated development of supercavitation controller and autopilot, and integration with control surfaces and devices.

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- Initiated 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).
- Initiated implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continued development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continued development of TBT for weapons and combat systems to capitalize on connectivity between a Heavy-Weight Torpedo (HWT) and submarine platform combat control including sensors.
- Completed collection and transition of in-water broadband weapon sonar data sets to the Mk48 and Mk54 programs.
- Completed and transitioned Narrow Band Intelligent Controller technology source code, development tools, documentation, and performance assessments to the Mk 48 Common Broadband Advanced Sonar System (CBASS) program via the torpedo Advanced Processor Build (APB) process.
- Completed and transitioned Frequency Agile Adaptive Beamforming algorithms to the Mk 48 program via the torpedo APB process.
- Initiated and completed studies to determine specifications for new, broadband sonar for the MK54 lightweight torpedo.
- Initiated TBT high fidelity simulation based evaluation of weapon signal processing and HWT tactical control technologies.
- Initiated planning of a joint project agreement between the US and UK titled "Torpedo Guidance and Control (G&C): False Targets" and delivered a summary statement of intent (SSOI) to the Navy International Project Office (NIPO).

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed.
- Complete development and in-water testing of the Weapon Silencing integrated motor/propulsor - LAMPRey.
- Complete development of a high fidelity Simulation Based Design (SBD) evaluation of weapon signal processing and HWT tactical control technologies.
- Complete development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification, and localization.
- Initiate development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and

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homing sensors.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all efforts of FY2004 less those noted as completed.
- Complete development and in-water demonstration of technologies to enable a HWT and a shooting platform to be effectively employed as a fully linked broadband weapon system.
- Complete validation of a high fidelity weapon simulation false alarm bottom model.
- Initiate TBT LWT broadband data collection.
- Initiate feasibility assessment and investigation of TBT including coherent broadband sonar design, novel adjunct sensors, warhead advancements, and distributed sensor interoperability for LWT.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed.
- Complete transition of undersea weapons system design tools techniques to LWT, Anti-Torpedo Torpedo (ATT), and Next Generation Countermeasure (NGCM).
- Complete full ship validation effort for Explosion Response simulation code, conduct analysis of test data, and continue upgrades to DYSMAS Hydrocode including technologies to increase computational speed.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all efforts of FY2005 less those noted as completed.
- Initiate TBT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT.
- Initiate TBT development of an advanced LWT directed charge warhead, multi-mode fusing, and sub-scale detonation testing.
- Initiate TBT advanced counter-countermeasure algorithm and tactics development for LWT.
- Initiate feasibility assessment of TBT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed.
- Complete development of torpedo system simulation capabilities under TEAMS.

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The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:

- Continue all efforts of FY2006 less those noted as completed.
- Complete the joint project agreement between the US and UK titled "Torpedo Guidance & Control (G&C): False Targets" and investigate options for continued collaboration.
- Initiate development of a reduced size/weight CRAW) for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ACOUSTIC GLIDER	0	4,259

Design, build, and test a prototype acoustic glider capable of operation in harsh littoral environments.

	FY 2004	FY 2005
AN/SQS-53C MINE DETECTION AND CLASSIFICATION ENHANCEMENTS	1,636	0

Initiated development and testing of signal processing algorithms to classify small objects as mine-like/non-mine-like with a false alarm rate lower than that of legacy systems.

	FY 2004	FY 2005
ANTI-TORPEDO TORPEDO (6.75-INCH DIAMETER) MULTI-MISSION UNDERSEA WEAPON	2,450	5,052

FY 2004: Initiated optimization of signal processing and 6.75" weapon tactics used in Anti-Torpedo Torpedo (ATT) for offensive applications; updated the multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept; and collected in-water data to evaluate proposed multi-mission guidance and control technologies. Demonstrated, using simulation and in-water investigation, the ability of the 6.75" sensor to accomplish directed charge placement normal to a submarine target.

FY 2005: Continue most promising efforts of FY 2004. Expand the optimization and demonstration of the effectiveness of a 6.75" sensor to effectively place a directed charge on a submarine target.

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BUDGET ACTIVITY: 02

PROGRAM ELEMENT: 0602747N

PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

	FY 2004	FY 2005
GALFENOL ALLOYS	0	1,188

Initiate development of metallurgical techniques to inexpensively manufacture Galfenol and other compositions of that general class of magnetostrictive materials. Galfenol is ductile (i.e., not brittle) and as such can be utilized in numerous applications that normal magnetostrictive and piezoelectric materials cannot be used.

	FY 2004	FY 2005
HIGH POWERED ULTRASONICS/ SHIP WASTE TREATMENT	1,443	990

FY 2004: Initiated feasibility and efficacy studies using terfenol magnetostrictive materials for several Navy environmental waste treatment applications. Initiate examination of a variety of shipboard wastes and waste treatment processes to determine the potential for developing new approaches to Navy waste treatment or improvements in performance of existing waste treatment systems using high-powered sonication technologies.

FY 2005: Continue most promising efforts of FY04. Initiate development of a small-scale prototype system for treating shipboard waste using high-powered ultrasonic technology.

	FY 2004	FY 2005
LITHIUM CARBON MONOFLUORIDE BATTERY	962	0

Developed proof-of-concept AA wound cells with thin electrodes. Defined the optimal cell design to be incorporated into future D and DD size cells for Navy buoy applications. Conducted investigation of density, pellet thickness, electrolyte absorption, and cathode swelling properties as related to discharge performance. Developed model to predict cathode behavior during discharge. Conducted feasibility study of various cathode technologies.

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	FY 2004	FY 2005
LOW ACOUSTIC SIGNATURE MOTOR/PROPULSOR	1,698	0

Fabricated and integrated modified component hardware into water tunnel test vehicle. Instrumented water tunnel test vehicle to measure propulsor shaft speed, motor operating conditions, and vibration of the propulsor and vehicle hull. Collected and analyzed water tunnel test data on motor performance and acoustics. Completed integration of modified hardware into at-sea test vehicle and perform Tow Tank testing and At-Sea vehicle runs.

	FY 2004	FY 2005
MAGNETORESTRICTIVE TRANSDUCTION RESEARCH	3,031	3,962

FY 2004: This effort included the investigation and development of iron gallium alloys to determine their magnetostriction and mechanical strength, investigation of cost reduction methods for the production of TERFENOL-D magnetostrictive alloys, and development of transducer design incorporating iron gallium alloys.

FY 2005: Continue the development and transition of Terfenol-D as an active magnetostrictive material for use in advanced underwater sonar transducer arrays. This effort will be expanded to include improvements to the corrosion resistance of the material.

	FY 2004	FY 2005
MEMS-IMU	3,390	2,774

FY 2004 and FY 2005: Initiate development of advanced manufacturing processes for Microelectromechanical Systems (MEMS) and demonstrate their reliability and application in system prototyping and low volume output for various applications. The initial demonstration was focused on the Navy's Containerized Countermeasure Anti-torpedo Torpedo (CCAT) Inertial Measurement Unit (IMU) integrated into the MEMS safe and arm system. Enabling packaging technologies developed in this project will also support future miniature fuze devices. Various sensor sub-containers and integration issues were evaluated for potential applications in remote sensing, munitions health monitoring, and inventory tracking.

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	FY 2004	FY 2005
MICRO-DETONICS FOR MINIATURE WEAPONS	0	2,774

Initiate development of the technology to enable fabrication of integrated Microelectromechanical Systems (MEMS) fuzing and micro-explosive initiators. Base materials and processes for in-situ fabrication of the micro-explosive material will be investigated and developed. Micro-explosive materials resulting from candidate processing methods will be analyzed and tested. The best processes will be adopted and integrated into the MEMS fabrication sequence. The fabrication process, including the incorporation of micro-explosive material into a MEMS Fuzing/Safe & Arming chip, will be demonstrated.

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 Systems)

NON-NAVY RELATED RDT&E:

PE 0603763E (Marine Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0602702E (Tactical Technology)

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D. ACQUISITION STRATEGY:

Not applicable.