FY 2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2004
Exhibit R-2

BA: 02 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

COST: (Dollars in Thousands)

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Undersea Warfare Applied Research	85,424	76,788	64,060	63,244	63,797	65,054	66,399

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: 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.

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	84,496	62,583	66,353
Cong. Rescissions/Adjustments/Undist.Reductions	0	-944	0
Congressional Actions	0	15,150	0
Execution Adjustments	2,314	0	0
Inflation Savings	0	0	-214
Rate Adjustments	0	-1	-79
SBIR Assessment	-1,386	0	0
Technical Adjustments	0	0	-2,000
FY 2005 President's Budget Submission	85,424	76,788	64,060

BA: 02 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not Applicable.

Schedule: Not Applicable.

FY 2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2004

Exhibit R-2a

BA: 02 PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

PROJECT TITLE: Undersea Warfare Applied Research

COST: (Dollars in Thousands)

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Wide Area Anti-Submarine (ASW) Surveillance	17,359	16,457	18,708

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 ASW 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.

FY 2003 Accomplishments:

- Completed component-level developments that enable deployable, ultra-lightweight, ultra-low power, Matched

Field Tracking arrays for barrier/area surveillance applications.
- Completed development of an enhanced acoustic sparker source for environmental sensing and air-deployed ASW sensor applications.
- Completed acquisition of scale-model threat target scattering databases and assessed robustness of target scattering features to environmental distortion.
- Completed at-sea testing of a low frequency, submarine-deployed autonomous acoustic source.
- Completed analysis of FY 02 multi-static source sea-test data.
- Transitioned the forward scattering echo detection algorithms to Naval Air Systems Command (NAVAIR) Extended Echo Ranging (EER).
- Completed evaluation of a "non-traditional scattering" concept as applied to multi-static sonar.
- Continued feasibility assessment of using ASW acoustic intensity sensors as active receivers.
- 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/explosive sound sources.
- Continued development and at-sea testing of Compact Deployable Multi-static Receiver (CDMR) hardware and software.
- 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 multi-static sonar systems.
- Initiated development of ultra-low power electronics to support ASW advanced remote sensing devices.
- Initiated development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Initiated development of deployable volumetric arrays capable of tactically significant gains.
- Initiated research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.

FY 2004 Plans:

- Complete feasibility assessment of using ASW acoustic intensity sensors as active receivers.
- Complete development/improvement of multi-static signal processing techniques for systems employing explosive sound sources.
- Complete development and at-sea testing of Compact Deployable Multi-static Receiver (CDMR) hardware and software.
- Complete development of ultra-low power electronics to support advanced ASW maritime remote sensing devices.
- Complete development of deployable volumetric arrays capable of tactically significant gains.
- Continue development of Telesonar technologies to enable deployable system acoustic communications.

- Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continue development and testing of a series of incremental software builds for in-buoy signal processing.
- Continue development of smaller, cheaper low-frequency active transducers for multi-static sonar systems.
- Continue development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Continue research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.
- Initiate development of "field-level" processing for large numbers of CMDRs.
- Initiate development of an advanced node design for survivable sensors.
- Initiate development of a non-traditional tracking system for deployment on large-scale Unmanned Undersea Vehicles (UUVs).
- Initiate development of multi-static signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.
- Initiate at-sea testing of the multi-static system components (CDMR, signal processing software, and "field-level" processing).

FY 2005 Plans:

- 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 multi-static sonar systems.
- Complete analysis of FY 2004 multi-static sea test data.
- Continue development of Telesonar technologies to enable deployable system acoustic communications.
- Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continue development of "intelligent" algorithms aimed at optimizing distributed multi-static sources/receivers.
- Continue research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.
- Continue at-sea testing of the multi-static system components (CDMR, signal processing software, and "field-level" processing).
- Continue development of an advanced node design for survivable sensors.
- Continue development of a non-traditional tracking system for deployment on large-scale Unmanned Undersea Vehicles (UUVs).

- Continue development of multi-static signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.

	FY 2003	FY 2004	FY 2005
Battlegroup Anti-Submarine Warfare (ASW) Defense	27,291	27,672	28,610

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 2003 Accomplishments:

- Completed performance/sea testing of optical standoff sensor systems.
- Completed development of signal processing techniques that combine multiple waveforms from echo returns before tracks are formed to improve sonar system detection performance and holding times.
- Completed fabrication and field-testing of the performance of a complete polymer coated fiber array.
- Completed development of in-situ calibration techniques to monitor large conformal arrays.
- Completed the writing of the Sonar Automation technology development plan.
- Completed development of technical approaches for automatically configuring the AN/SQS-53C sonar systems based on environmental conditions.
- Completed testing of environmentally adaptive signal processing techniques as applied to the AN/SQS-53C sonar.
- Completed development of EA AN/SQQ-89 signal processing techniques.
- Completed development of High Frequency Broadband (HFBB) outboard power electronics and controls for conformal arrays.
- Completed testing of prototype candidate transducer arrays for down-select to a prototype array contract. The HFBB effort was terminated in FY03 due to budget reductions.
- Initiated development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Initiated development and testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Initiated design and development of underwater projectors utilizing structural magnetostrictive material.
- Initiated development of baffled ring transducer technology.
- Initiated development of improved techniques to distinguish submarine echoes from those produced by ocean

bottom features.
- Initiated development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that enable improved sonar operator performance.
- Initiated development of a geo-acoustic inversion capability for submarines utilizing the submarine's passive towed array data.
- Initiated development of signal processing and system control algorithms for the AN/WSQ-11 "Tripwire" torpedo protection system.
- Initiated development of an AN/WSQ-11 "Tripwire" test-bed for algorithm testing.
- 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 and testing of a low-cost Fishline fiber optic array for platform-based deployment.
- Continued development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the High Frequency (HF) sail array designs for 688- and Virginia-class submarines.
- Continued development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continued development of very thin, compact HF cymbal transducers for conformal arrays.
- Continued development of PZT (Lead Zirconate Titanate) materials for High-Frequency Broadband Transducers & Arrays for submarines.
- Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification and Localization (D/C/L)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 assembly and laboratory measurements of a large aperture virtual sonar array.
- Continued fabrication and calibration of HF fiber optic sensors as well as in-lab testing and a field demonstration of the HF acoustic array.
- Continued development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continued characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- Continued system requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Continued hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.
- Continued passive acoustic array test-bed design and hardware component procurement to support future

passive sonar system designs.

FY 2004 Plans:

- Conduct Multi-Mode Magnetic Detection System (MMMDS) effort under Littoral ASW Future Naval Capability (FNC).
- Complete development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that enable improved sonar operator performance.
- Complete development and testing of a low-cost Fishline fiber optic array for platform-based deployment.
- Complete development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the High Frequency (HF) sail array designs for 688- and Virginia-class submarines--transition to the Advanced Systems Technology Office (ASTO), SEA-93, and Program Element 0603561N. (Transduction)
- Complete development of very thin, compact HF cymbal transducers for conformal arrays.
- Terminate development of PZT (Lead Zirconate Titanate) materials for High-Frequency Broadband Transducers & Arrays for submarines.
- Complete assembly and laboratory measurements of a large aperture virtual sonar array.
- Complete fabrication and calibration of HF fiber optic sensors as well as in-lab testing and a field demonstration of the HF acoustic array.
- Complete system requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Complete hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.
- Continue development of Reduced Diameter fiber optic sensors to improve towed array reliability.
- Continue development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns.
- Continue development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continue development of signal processing improvements for coherent tactical active sonar systems aimed at improving D/C/L of small, slow moving submarines in shallow water.
- Continue investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continue investigations into time-reversal techniques to improve the performance of active sonar systems.
- Continue development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continue characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.

- Continue passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.
- Continue development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continue development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continue design and development of underwater projectors using structural magnetostrictive materials.
- Continue development of baffled ring transducer technology.
- Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continue development of a geo-acoustic inversion capability for submarines utilizing the submarine's passive towed array data.
- Continue development of signal processing and system control algorithms for the AN/WSQ-11 "Tripwire" torpedo protection system.
- Continue development of an AN/WSQ-11 "Tripwire" test-bed for the testing of algorithms.
- Initiate development of an acoustic/magnetic hybrid sensor.
- Initiate development of surface ship active sonar signal processing techniques to enable Detection/Classification/Localization of torpedoes and autonomous underwater vehicles (AUVs).
- Initiate the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification and tracking process.
- Initiate preliminary MMMDS design and component-level development of AUV-based magnetometer sensor technologies.
- Initiate MMMDS 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:

- Complete evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability. Transition to the NAVSEA Advanced Systems Technology Office (ASTO), 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 (ASTO), 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 passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.

- Complete development of a hybrid sensor to detect both acoustic and magnetic signatures.
- Complete development of surface ship active sonar signal processing techniques to enable detection, classification, and localization of torpedoes and autonomous underwater vehicles (AUVs).
- Complete the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification and tracking process.
- Complete design and development of underwater projectors using structural magnetostrictive materials.
- Continue development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continue development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continue development of baffled ring transducer technology.
- Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continue development of a geo-acoustic inversion capability for submarines utilizing the submarine’s passive towed array data.
- Continue development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system.
- Continue development of an AN/WSQ-11 “Tripwire” test-bed for the testing of algorithms.
- Continue development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continue development of signal processing improvements for coherent tactical active sonar systems aimed at improving D/C/L of small, slow moving submarines in shallow water.
- Continue development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines.
- Continue characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- Continue preliminary MMMDS design and component-level development of AUV-based magnetometer sensor technologies.
- Continue MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms on a simulator to enable data collection and performance evaluation.
- Initiate development of an integrated solution to environmentally adaptive signal processing, incorporating environmental sensing, adaptive transmit waveforms, and receive signal processing.
- Initiate development of low cost, compact, combined acoustic sensor.
- Initiate focused research program to establish fundamental limits of passive sonar performance in shallow water using the passive acoustic array test-bed.
- Initiate collection and analysis of MMMDS performance data.
- Initiate evaluation of proposed MMMDS processing approaches and down-select to one approach.

	FY 2003	FY 2004	FY 2005
Cooperative Anti-Submarine Warfare (ASW)	0	1,250	1,250

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 LASW FNC under the heading of Integrated Anti-Submarine Warfare (IASW) in Program Element (PE) 0603235N. Those IASW efforts have been terminated due to budget reductions. A portion of those efforts will continue in this PE as Cooperative ASW starting in FY 2004. 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.

FY 2003 Accomplishments:

Not Applicable

FY 2004 Plans:

- Initiate investigation into a flexible information/knowledge management architecture that can support several sonar systems including land/air-based sensors.
- Initiate 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 2003	FY 2004	FY 2005
Neutralization	23,457	16,428	15,492

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, and Supercavitation. Demonstration projects include Anti-Torpedo Torpedo (ATT), Adaptable High-Speed Underwater Munitions (ASHUM), Next Generation Countermeasures (NGCM) and Torpedo Bridging Technologies (TBT) for torpedo defense. The ultimate goal is to develop reduced sized advanced undersea weapons with revolutionary capabilities and fill Sea Shield mission capability gaps.

FY 2003 Accomplishments:

- Completed a series of three elastic tests to determine Containerized Countermeasure Anti-torpedo Torpedo (CCAT) system CW/CM vulnerability and ATT hard-kill lethality.
- Completed nearly 150 simulated ASHUM terminal defense engagements between a single wake homing torpedo and a straight running ship. The average number of shots taken, hits achieved and penetrations of the warhead were computed for these simulated engagements.
- Completed analysis of Undersea Warhead directed blast cavity. Single stage test showed desired performance, and dual stage test showed cavity pinch-off limits enhancement.
- Completed transition of Explosive and Undersea Warheads effort Enhanced Ship Survivability Modeling Codes (using DYSMAS Hydro-Code) to Naval Shipyards.
- Completed development of Weapon Silencing active-passive mounts for reducing weapon machinery noise and implementation of Weapon Silencing active controller hardware into Active Fiber Composites effort.
- Completed Computational Fluid Dynamics (CFD) codes for Supercavitation vehicle simulation.
- Completed Undersea Warhead and G&C sections design using MSDO tools.
- Completed Weapon/Platform Connectivity dual band frequency agile signal processor development to improve torpedo single-ping detection, classification and homing performance. Transitioned algorithms to acquisition via the Advanced Processor Build for Torpedoes (APB-T) process.
- Continued development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continued development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continued optimization of undersea weapons system design using MSDO with respect to construction and performance.

- Continued development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPrEy) undersea vehicle to further enhance Torpedo Stealth efforts.
- 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 to capitalize on connectivity between a HWT and submarine platform combat control including sensors.
- Initiated development of improved modeling and simulation capabilities, including improved threat models, torpedo system models and acoustic environment simulation using Torpedo Enterprise Advanced Modeling and Simulation (TEAMS).

FY 2004 Plans:

- Continue development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continue development of improved threat and torpedo system modeling and simulation capabilities (TEAMS).
- Continue development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continue optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continue development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPrEy) undersea vehicle to further enhance Torpedo Stealth efforts.
- Continue development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continue development of TBT to capitalize on connectivity between a HWT and submarine platform combat control including sensors.
- Initiate effort to conduct full ship validation effort for Explosion Response simulation code (using DYSMAS Hydro-Code).
- Initiate development of Explosive and Undersea Warheads Microelectromechanical Systems (MEMS) Inertial Measuring Unit (IMU) into the warhead Safety & Arming (S&A) sub-system.
- Initiate implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
- Initiate application of MSDO tools probabilistic methods and uncertainty analysis for Light-Weight Torpedo (LWT) design.
- Initiate development of supercavitation controller and autopilot, and integration with control surfaces and devices.
- Initiate supercavitation homing sensor development using single crystal and piezoelectric and piezoceramic materials.

- Initiate TBT high fidelity simulation based evaluation of weapon signal processing and Heavy-Weight Torpedo (HWT) tactical control technologies.

FY 2005 Plans:

- 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 technologies to enable a HWT and a shooting platform to be effectively employed as a fully linked weapon system.
- Continue development of CW/CM (ATT, NGCM, ASHUM) technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- Continue development of improved threat and torpedo system modeling and simulation capabilities (TEAMS).
- Continue full ship validation effort for Explosion Response simulation code (using DYSMAS Hydro-Code).
- Continue development of Explosive and Undersea Warheads MEMS IMU into the warhead Safety & Arming (S&A) sub-system.
- Continue development of Weapon Silencing affordable noise control concepts for machinery and propulsor radiated noise.
- Continue optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continue development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization.
- Continue implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
- Continue application of MSDO tools probabilistic methods and uncertainty analysis for Light-Weight Torpedo (LWT) design.
- Continue development of supercavitation controller and autopilot, and integration with control surfaces and devices.
- Continue supercavitation homing sensor development using single crystal and piezoelectric and piezoceramic materials.
- Initiate development of a Supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors.

	FY 2003	FY 2004	FY 2005
Project Morgan	2,865	0	0

Classified Program. FY04 efforts are funded in PE 0603747N and FY05 efforts are funded in PE 0603734N (BA4).

FY 2004 Plans:

Not Applicable

FY 2005 Plans:

Not Applicable

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ACOUSTIC TEMPERATURE PROFILER	2,436	0

Improved the Acoustic Temperature Profiler (ATP) measurement sensitivity across a wider range of depths, thereby increasing the accuracy of the Sound Velocity profile. The ATP is a technique that allows the temperature profile of the ocean to be measured nearly continuously. The Sound Velocity Profile (SVP) is a critical environmental parameter used for estimating and predicting sonar system performance. Phase III improved ATP measurement sensitivity across a wider range of depths, thereby increasing the accuracy of the SVP.

	FY 2003	FY 2004
AN/SQS-53C MINE DETECTION AND CLASSIFICATION ENHANCEMENTS	0	1,682

Initiate 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 2003	FY 2004
ATT (6.75-inch dia) Multi-Mission Undersea Weapon	1,142	2,521

FY03 (previously titled Undersea Defensive Warfare Systems (6.25” ATT Technology)): Developed additional ATT guidance sonar channels, which will enable the 6.25” Anti-Torpedo Torpedo (ATT) to operate with increased effectiveness in intercepting threat torpedoes at shallow depths and in the wake of a surface ship. Design

and development of the hardware to support the in-water evaluation of this technology was completed. Engine subsystems for the advanced, extended range ATT engine were integrated into the engine architecture. FY04 new title: ATT Multi-Mission Undersea Weapon. Optimize signal processing and tactics used in ATT for offensive applications; update the multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept; and collect in-water data to evaluate proposed multi-mission guidance and control technologies.

	FY 2003	FY 2004
HIGH POWERED ULTRASONICS SHIPBORNE WASTE TREATMENT SYSTEM	0	1,483

Perform feasibility and efficacy studies using terfenol magnetostrictive materials for several Navy environmental waste treatment applications.

	FY 2003	FY 2004
LITHIUM CARBON MONOFLUORIDE BATTERY	954	989

FY03: Completed delivery of fifteen AA size wound cells; Improved cell performance through optimization of the cathode and electrolyte formulations, and the use of new grommets and separator materials; and Evaluated carbon precursors based on structural parameters and correlated to performance. FY04: Deliver fifteen proof-of-concept AA wound cells with thin electrodes. Define the optimal cell design to be incorporated into future D and DD size cells for Navy buoy applications. Conduct investigation of density, pellet thickness, electrolyte absorption, and cathode swelling properties as related to discharge performance. Initiate development of a model to predict cathode behavior during discharge; Initiate a feasibility study of various cathode technologies.

	FY 2003	FY 2004
LOW ACOUSTIC SIGNATURE MOTORS	2,001	1,730

FY03: Provided applied research to Low Acoustic Signature Motor/Propulsor for Electrically Powered Undersea Vehicles (LAMPREY) technology development. Manufactured modified propulsor/control surfaces/after body component hardware for LAMPREY water tunnel test vehicle and at-sea test vehicle. Bench-scale motor component test data were collected and analyzed to ascertain noise sources and noise levels for comparison to planned water tunnel measurements and performance predictions. FY04: Complete fabrication and integration of modified component hardware into water tunnel test vehicle. Instrument water tunnel test vehicle to measure

propulsor shaft speed, motor operating conditions, and vibration of the propulsor and vehicle hull. Collect and analyze water tunnel test data on motor performance and acoustics. Complete integration of modified hardware into at-sea test vehicle and perform Tow Tank and At-Sea vehicle runs.

	FY 2003	FY 2004
MAGNETORESTRICTIVE TRANSDUCTION	5,158	3,115

Initiated: the following in FY03: Investigation and development of iron gallium alloys to determine their magnetostriction and mechanical strength; Investigation of three cost reduction methods for the production of TERFENOL-D magnetostrictive alloys; and Development of transducer design incorporating iron gallium alloys. FY04: Complete investigation of three cost reduction methods for the production of TERFENOL-D. Continue investigation and development of iron gallium alloys; Continue development of transducer design incorporating iron gallium alloys.

	FY 2003	FY 2004
MEMS-IMU TORPEDO DEFENSE APPLICATIONS	0	3,461

Develop advanced manufacturing processes for the Microelectromechanical System (MEMS) based Safe and Arm (S&A) Inertial Measurement Unit (IMU) and to integrate it into the MEMS S&A system intended for use in the Navy's Containerized Countermeasure Anti-torpedo Torpedo (CCAT) defensive weapon.

	FY 2003	FY 2004
Semi-Autonomous Underwater Vehicle for Intervention Missions (SAUVIM)	1,619	0

The objective of this project was to develop and demonstrate the control methodologies and algorithms necessary to perform complex tasks using a robotic arm attached to an underwater vehicle. The problem was enhanced by strong underwater currents, force feedback, object recognition, and object dimensioning.

	FY 2003	FY 2004
UNDERSEA DEFENSIVE WARFARE SYSTEMS (RAPID RESPONSE ATT WEAPON)	1,142	0

Expanded the capabilities of the 6.25" Anti-Torpedo Torpedo (ATT) technology, enabling a submarine-launched quick reaction response weapon for use against torpedoes and other close aboard targets.

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 (ENG))
PE 0604784N (Distributed Surveillance Systems)

NON-NAVY RELATED RDT&E:
PE 0603763E (Marine Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0602702E (Tactical Technology)
PE 0602173C (Support Technologies - Applied Research)

D. ACQUISITION STRATEGY:
Not Applicable