

UNCLASSIFIED

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

DATE: February 2007

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total PE	34,398	34,888	73,626	79,450	83,083	80,823	84,888	91,542
2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	26,775	29,907	73,626	79,450	83,083	80,823	84,888	91,542
9999 CONGRESSIONAL PLUS-UPS	7,623	4,981	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this Program Element (PE). The related technologies being developed are aimed at enabling Sea Shield, one of the three 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. The focus is on 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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B. PROGRAM CHANGE SUMMARY:

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
FY 2007 President's Budget Submission	35,110	35,055	54,160	54,773
Congressional Action	0	5,000	0	0
Congressional Reduction	0	-5,000	0	0
Congressional Undistributed Reductions/Rescissions	-90	-167	0	0
Execution Adjustments	-366	0	0	0
Non-Pay Inflation Adjustments	0	0	-67	67
Program Adjustments	0	0	597	-615
Program Realignment	0	0	18,895	25,178
Rate Adjustments	0	0	41	47
SBIR Assessment	-256	0	0	0
FY 2008/FY 2009 President's Budget Submission	34,398	34,888	73,626	79,450

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: The following impacts are due to the FY 2007 \$5M Congressional reduction:

- Lightweight Torpedo Technologies (LTT) (-2,412K): Decrease at-sea test and demonstration phase of LTT project from four years to three years.
- Increases risk of being ready to conduct final LTT system demonstration in FY 2010 per approved Technology Transition Agreement.
- Reduces demonstration candidates for adjunct sensing methods thus increasing risk of project failure.
- Terminated test of a directed blast prototype for a new LTT warhead.

The funding increase from FY 2007 to FY 2008 is due to the initiation of Distributed System Processing (DSP), On-Demand Detection Classification and Localization (ODDCL), Innovative Naval Prototype (INP) Persistent Littoral Undersea Surveillance (PLUS) as well as expanded efforts in Deployable Autonomous Distributed System Deployability (DADS-D), Palantir, Submarine Track & Trail (STT), and Deep Water Active Deployable System (DWADS). The further details are described under the FY 2008 plans of the R-2 activity Wide Area ASW Surveillance.

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Schedule: The following are delays caused by the FY 2007 Congressional reduction of \$5M:

- Compact Rapid Attack weapon (CRAW) (-874K): Delay initiation of CRAW demonstrations from FY 2007 to FY 2008.
- STT (-1,714K): Delay integration of the STT sensor with submersible, checkout testing at-sea, and development and evaluation of tracking algorithms.

C. OTHER PROGRAM FUNDING SUMMARY:

Not applicable.

D. ACQUISITION STRATEGY:

Not applicable.

E. PERFORMANCE METRICS:

The overall metrics of advanced research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, and 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, while reducing size and power requirements.

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PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	26,775	29,907	73,626	79,450	83,083	80,823	84,888	91,542

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development 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, one of the three 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 2006	FY 2007	FY 2008	FY 2009
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	12,386	20,115	50,483	56,214

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 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, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities.

The net increase in funding from FY 2006 to FY 2007 is due to the initiation of DADS-D, Palantir, STT, and DWADS. The net increase from FY 2007 to FY 2008 is due to the initiation of DSP, ODDCL, and INP-PLUS and expanded efforts in DADS-D, Palantir, STT, and DWADS. The further expansion of efforts in DADS-D, Palantir,

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STT, DWADS, DSP, ODDCL, and INP-PLUS contributes to the net funding increase from FY 2008 to FY 2009. Additionally, the increase in Wide Area ASW Surveillance supports a basic shift in Naval strategy away from platform-based undersea surveillance systems toward deployable, distributed systems. The initiation of two and ramp-up of five Future Naval Capabilities (FNC) projects directly support the shift in Naval strategy to off-board distributed systems and contribute to fleet operational requirements. These efforts are funded in accordance with the FNC process and are approved by the Technology Oversight Group.

FY 2006 Accomplishments:

- Continued at-sea demonstrations and data collections with the Compact Deployable Multistatic Receiver (CDMR) advanced development model.
- Completed development of multistatic sonar signal classification algorithms for coherent sources.
- Completed concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Completed development and testing of DADS technologies in preparation for a barrier demonstration.
- Completed planning for and conducted DADS barrier demonstration.
- Completed writing of the DADS system documentation.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed.
- Continue STT-Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development. This effort transferred to this PE from PE 0603114N due to Enabling Capability realignments.
- Complete at-sea demonstrations and data collections with the CDMR advanced development model.
- Complete integrated at-sea testing of the multistatic system components (CDMR, Compact Deployable Multistatic Source (CDMS), signal processing software, and "field-level" processing). This effort transitioned from PE 0602747N.
- Complete DADS deployability study to investigate various tactical deployment options. This effort transitioned from PE 0602747N.
- Initiate DADS deployability, survivability and classification performance improvement effort.
- Initiate testing of the Palantir (a non-acoustic surveillance system) sensor system. The related test planning is conducted in PE 0602747N.
- Initiate and complete design improvements of the Palantir sensor/data collection system and conduct an

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FY 2007 data collection exercise.

- Initiate tactical test planning for the Palantir sensor.
- Initiate development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas.
- Initiate STT sensor integration with an undersea submersible.
- Initiate development of an experimental design model of a DWADS for surveillance of deep ocean submarine threats.

FY 2008 Plans:

- Continue all FY 2007 efforts less those noted as completed.
- Complete integration of STT sensors with undersea submersibles.
- Complete all Littoral ASW Multistatic Project efforts for CDMR, CDMS, and development of multistatic signal processing algorithms and transition products to PMA-264, Air Anti-Submarine Warfare Assault and Special Missions Program Office, P.E. 0603254N, Project 1292.
- Complete development of and test an experimental design model of a DWADS system for surveillance of deep ocean submarine threats.
- Initiate DADS at-sea classification performance improvement testing.
- Initiate at-sea testing of integrated STT submersibles and evaluate overall system performance.
- Initiate integration and evaluation of STT tracking algorithms and automated processing.
- Initiate and complete design improvements of the Palantir sensor/data collection system and conduct an FY 2008 data collection exercise.
- Initiate development of DSP threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems.
- Initiate the ODDCL effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations.
- Initiate development of an advanced development model of a DWADS System for surveillance of deep ocean submarine threats.
- Initiate development of a tactical area prototype system for PLUS. This effort transferred to this PE from PE 0602747N.

FY 2009 Plans:

- Continue all FY 2008 efforts less those noted as completed.

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- Complete development of and demonstrate an advanced development model of a DWADS System for surveillance of deep ocean submarine threats.
- Complete development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas.
- Complete development of a tactical area prototype system for PLUS.
- Complete integration and evaluation of STT tracking algorithms and automated processing.
- Initiate DADS deployability and survivability testing.
- Initiate system level design and integration for ODDCL.
- Initiate at-sea demonstrations of STT submersible with fully integrated sensor package.
- Initiate test planning of source algorithms to be used to determine the optimal initial placement of uncontrolled drifting distributed systems.

	FY 2006	FY 2007	FY 2008	FY 2009
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	14,389	8,582	2,943	0

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. Battlegroup ASW Defense will enable smaller, lighter, and cheaper arrays, large multi-line arrays, and submarine flank arrays all with environmental adaptation capabilities.

The net decrease in funding from FY 2006 to FY 2007 is due to the decreased efforts in Multi-Mode Magnetic Detection System (MMMDS), Sonar Automation Technology (SAT), and Shallow Water Array Performance (SWAP) and the transition of Counter Torpedo Detection, Classification and Localization (CTDCL) program to PE 0603123N. The net decrease from FY 2007 to FY 2008 is due to planned program completions and transitions in MMMDS, SAT and SWAP efforts. The net decrease in funding from FY 2008 to FY 2009 is due to the end of MMMDS project in FY 2008 and the program transitions to NAVAIR.

FY 2006 Accomplishments:

- Continued development, demonstration and transition of SAT threat submarine detection and classification algorithms.
- Continued development and demonstration of SAT algorithms for transition to the distributed ASW sensors of

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the Integrated Undersea Surveillance System, NAVSEA, PE 0204311N (Maritime Surveillance Program).

- Continued integration of CTDCI processing with advanced sensors for outyear transition to the AN/WSQ-11 Torpedo Defense System program via the Block II and III upgrades. This effort transfers to PE 0603123N in FY 2007.
- Continued MMMDS development of magnetometer sensor technologies.
- Continued the integration of MMMDS sensor hardware/software into towed vehicles and fixed-wing Unmanned Air Vehicles (UAV).
- Completed performance evaluation of a CTDCI prototype torpedo protection system capable of countering two torpedoes launched in rapid succession. All CTDCI efforts transfer to and are reported under PE 0603123N in FY 2007.
- Completed collection and analysis of MMMDS performance data.
- Completed evaluation of proposed MMMDS processing approaches and down-select to one approach.
- Completed planning for MMMDS tests that utilize fixed wing aircraft, helicopter, and UAV platforms.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed.
- Complete development and demonstration of SAT threat submarine detection and classification algorithms; transition to NAVSEA under PE 0603561N (Advanced Submarine System Development), Project 0223 (Submarine Combat Systems Improvements) and PE 0204311N (Maritime Surveillance Program).
- Complete MMMDS development of magnetometer sensor technologies.
- Initiate/complete test flights to collect relevant MMMDS data.

FY 2008 Plans:

- Complete the integration of MMMDS sensor hardware/software into towed vehicles flown by vertical takeoff unmanned aerial vehicle surrogates.
- Complete MMMDS final reporting; transition to NAVAIR.
- Initiate/complete MMMDS planning and execution of final over water demonstration with realistic target.

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	FY 2006	FY 2007	FY 2008	FY 2009
NEUTRALIZATION	0	1,210	20,200	23,236

Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). Weapon technology areas include: Torpedo Bridging Technologies which address development of technologies to enable a heavyweight torpedo and a shooting platform to be effectively employed as a fully-linked weapon system utilizing a fiber optic link, broadband signal processing, and behavior based control. The ultimate goals of Neutralization efforts are to develop reduced size advanced undersea weapons with revolutionary capabilities and to fill Sea Shield mission capability gaps and demonstrate transformational capabilities for ASW weapons.

The increase in funding from FY 2007 through FY 2009 is due to the LTT, which provides a tactically revolutionary PK against quiet diesel-electric submarines operating in harsh shallow water environments, and CRAW which is capable of deployment from an air-vehicle at low altitude to neutralize undersea threat targets from the stand-off ranges of US Naval vessels. These research efforts initiate in FY 2007 and continue for five years and are targeted for transition in FY 2010 and FY 2011 respectively. This project is funded in accordance with the FNC process and is approved by the Technology Oversight Group.

FY 2007 Plans:

- Initiate LTT integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system for at-sea testing.

FY 2008 Plans:

- Continue all FY 2007 efforts.
- Continue 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. (Transitioned from PE 0602747N)
- Continue LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 LWT. (Transitioned from PE 0602747N)
- Continue 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

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demonstration). (Transitioned from PE 0602747N)

- Continue 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. (Transitioned from PE 0602747N)
- Continue LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT. (Transitioned from PE 0602747N)
- Continue LTT advanced counter-countermeasure algorithm and tactics development for LWT. (Transitioned from PE 0602747N)
- Continue feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range. (Transitioned from PE 0602747N)
- Continue 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. (Transitioned from PE 0602747N)
- Continue a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement. (Transitioned from PE 0602747N)
- Complete LTT feasibility investigations addressing adjunct sensor configurations, stealth and propulsion technologies, and geo-coordinate based navigation systems. (Transitioned from PE 0602747N)
- Initiate in-water data collection for development of advanced counter countermeasure processing, weapon-to-weapon acoustic communication and a salvo vehicle intelligent controller.
- Initiate development of a high channel count LTT broadband transmitter.
- Initiate development and integration of a total LTT system prototype in the Mk 54 torpedo form factor for at sea demonstrations.
- 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.
- Initiate CRAW in water data collection to support development of guidance and control algorithms enabling an ASW offensive capability in the Common Very Lightweight Torpedo.
- Initiate tests to support the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal.

FY 2009 Plans:

- Continue all FY 2008 efforts less those noted as completed.
- Complete LTT development, scale up and testing prototype components.
- Complete LTT advanced counter-countermeasure algorithm and tactics development for LWT.
- Initiate development of an integrated LWT set-to-hit simulation capability including robust representations

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of the technologies developed and demonstrated under LTT FNC project to evaluate end-to-end weapon performance.

- Initiate design and development of LTT platform integration hardware and software for final demonstration sea test in FY 2010.
- Initiate in-water data collection on CRAW homing in presence of countermeasures.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

- PE 0204311N (Integrated Surveillance System)
- PE 0205620N (Surface ASW Combat System Integration)
- PE 0601153N (Defense Research Sciences)
- PE 0602235N (Common Picture Applied Research)
- PE 0602435N (Ocean Warfighting Environment Applied Research)
- PE 0602747N (Undersea Warfare Applied Research)
- PE 0602782N (Mine and Expeditionary Warfare Applied Research)
- PE 0603235N (Common Picture Advanced Technology)
- PE 0603254N (ASW Systems Development)
- PE 0603506N (Surface Ship Torpedo Defense)
- PE 0603513N (Shipboard System Component Development)
- PE 0603553N (Surface ASW)
- PE 0603734N (CHALK CORAL)
- PE 0603782N (Mine & Expeditionary Warfare Advanced Technology)
- PE 0604221N (P-3 Modernization Program)
- PE 0604261N (Acoustic Search Sensors)
- PE 0604503N (SSN-688 and Trident Modernization)
- PE 0604784N (Distributed Surveillance System)

NON-NAVY RELATED RDT&E:

- PE 0603175C (Ballistic Missile Defense Technology)
- PE 0602702E (Tactical Technology)
- PE 0603739E (Advanced Electronics Technologies)

D. ACQUISITION STRATEGY:

Not applicable.

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 PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2006	FY 2007
DEMONSTRATION WAVE POWER BUOY FOR ADVANCED DEPLOYABLE SYSTEM	0	1,793

This effort supports wave power buoy for advanced deployable systems research.

	FY 2006	FY 2007
HAWAII UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	1,628	0

Developed and tested advanced technologies to meet operational requirements related to the Advanced Swimmer Delivery Vehicle.

	FY 2006	FY 2007
MPP/APB TORPEDO IMPROVEMENT PROGRAM	3,837	0

Initiated development of signal processing algorithms for torpedo applications and conducted in-water data collection to assess the performance of these algorithms. The specific focus for this effort was to: (1) develop software to implement enhanced torpedo signal processing functions for the demonstration and evaluation of the processing improvements provided by the modified algorithms; (2) research and develop open and common architecture characteristics, and develop an initial architecture design to be used across Torpedo platforms; (3) expand the behavior-based Torpedo Intelligent Controller capabilities by developing and testing both salvo and anti-surface warfare capabilities within the behavior-based architecture; (4) develop, implement and evaluate algorithm modifications to the Technology Requirements Model to correct verification and validation deficiencies; and (5) conduct data collection and analysis of land-based and in-water testing.

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PROJECT TITLE: Congressional Plus-Ups

	FY 2006	FY 2007
SAUVIM	958	0

This effort funded continued development of the Semi-Autonomous Underwater Vehicle for Intervention Missions (SAUVIM). Development included an underwater sensor system for precise position feedback, investigation of the performance of the robotic arm and sensor system in virtual and real-world environments, upgraded high-level vehicle control systems and seafloor mapping algorithms, implementation of object detection using cameras and sonar and an upgraded agent-based communication system. The technology being developed and demonstrated in this program will provide the US Navy the capability to safely deploy and maintain undersea equipment and munitions using stable, semi-autonomous, underwater vehicles.

	FY 2006	FY 2007
UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	0	3,188

Conduct analysis, development and testing of advanced technologies in support of naval special warfare undersea vehicle requirements.

	FY 2006	FY 2007
VALIDATION AND IMPLEMENTATION OF SENSOR SWEET SPOT SELECTION ALGORITHMS	1,200	0

This effort utilized existing data sets for analysis and further development of algorithm products that aid in optimizing training and enhancing sensor operations, effectiveness and tactics.