RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development					R-1 ITEM NOMENCLATURE Marine Technology PE 0603763E, R-1 #51					
COST *(In Millions)*	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Cost To Complete	Total Cost
Total Program Element (PE) Cost	19.597	23.659	22.538	21.964	48.396	55.896	57.696	60.496	Continuing	Continuing
Advanced Ship-Sensor Systems MRN-02	19.597	23.659	22.538	21.964	48.396	55.896	57.696	60.496	Continuing	Continuing

(U) Mission Description:

(U) The objective of the Marine Technology Program is to identify, develop, and rapidly mature critical advanced technologies and system concepts for maritime applications that support the following goals: 1) enhancement of the ability of US naval forces to dominate the maritime battlespace, particularly in the littoral arena; 2) improved power projection capabilities of US naval forces, particularly with respect to their ability to influence the land battle; and 3) ability to counter the threat to US personnel and platforms created by the worldwide spread of increasingly sophisticated naval technology. In particular, the growing threat of quiet diesel/electric (DE) submarines, the continuing worldwide proliferation of advanced submarine and weapons capabilities, and the easy availability of modern underwater mines all represent unique warfighting challenges encountered in the maritime arena. These threats pose the greatest challenges for operations in the restricted water, near-shore regimes that are of growing importance to US strategic considerations, and necessitate the continued development of increasingly affordable far-term solutions for enhancing the operating capability and survivability margins of US naval forces in the littoral.

(U) The purpose of the Advanced Ship-Sensor Systems project is to develop innovative sensing and communication technologies that allow US naval forces to maintain and improve their effectiveness in operating forward from the sea in the ever more dangerous conditions of future tactical environments. This project has three principal thrusts: 1) generation of improved maritime battlespace awareness through the development of advanced sensors capable of more completely and robustly interrogating the surrounding environment; 2) development of advanced communications capabilities to enable expanded maritime information networking; and 3) exploration of platform system approaches for increased survivability in light of these and other advanced sensor and communications capabilities, including integrated sensor/stealth solutions.

(U) The Undersea Littoral Warfare (ULW) program is developing the Netted Search, Acquisition, and Targeting (NetSAT) System, a networked approach for improved attack performance that exploits the use of a sonobouy field during the weapon run to identify, locate, and mitigate the impact of countermeasures and target evasion tactics on torpedo operation. A bi-directional fiber optic link enables return of torpedo

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information to a processor servicing the other sensors on the network in addition to providing a command link for the weapon. The ability to rapidly discern the geographic picture from multiple viewpoints is expected to provide major (10x) torpedo performance improvements in strong countermeasure environments while requiring only modest modification of existing torpedo inventories. This development will be seamlessly coupled to the active acoustic search system development completed in FY98 (Distant Thunder), providing system significant enhancements in Anti-Submarine Warfare (ASW) performance at all points in the attack chain. In addition, the Undersea Littoral Warfare (ULW) program is conducting three other extended feasibility assessments: the ability of innovative, multi-dimensional receiver arrays, when coupled with optimal processing approaches, to provide robust passive sonar solutions in shallow water; the ability to detect non-acoustic submarine signatures from an unmanned aerial vehicle based system; and the ability of advanced synthetic aperture sonar processing techniques to revolutionize our ability to classify and identify underwater mines at much greater search rates than possible with current systems.

(U) The Water Hammer program is conducting concept development for a standoff mine neutralization system consisting of a phased array of shock tubes to generate, focus, and transport to militarily important distances (tens of meters) a pressure pulse of sufficient energy to neutralize the threat (>1000 psi-msec; >2000 psi). Water Hammer has the potential for rapid, precision, in-stride lane clearance in deep or shallow water, reducing the need for high fidelity detection and classification. While the initial program focuses on mine/obstacle clearance, Water Hammer also has general utility as a close-in defense system for ships against multiple classes of subsurface threats.

(U) The Buoyant Cable Array Antenna (BCAA) program is investigating a full duplex link (transmit and receive) for data transfer and communications to/from submarines while operating at speed and depth. Technologies that may be employed to achieve high data transfer rates from a submerged condition include photonic signal and power links, enhanced antenna loading materials, adaptive array calibration, and enhanced communications protocols.

(U) Program Accomplishments and Plans:

(U) FY 1998 Accomplishments:

- Continued development, planning, and testing of the proof-of-concept Anti-Submarine Warfare (ASW) Netted Search, Acquisition and Targeting (NetSAT) system at sea, incorporating a wide frequency band, autonomous, long duration, leave behind acoustic source; signal processing for enhanced detection and attack performance (Distant Thunder); and acoustic space-time adaptive processing. ($ 10.628 Million)

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- Conducted development of multi-frequency Interferometric Synthetic Aperture Sonar (IFSAS) for mine classification. ($ 1.300 Million)

- Within the context of Congressionally directed efforts in Smart Anti-Submarine Warfare (ASW) and Sonar Space-Time Adaptive Processing (STAP) conducted development of smart ASW sensors to support Netted Search, Acquisition and Targeting (NetSAT); commenced feasibility investigation of Robust Passive Sonar (RPS) using space-time processing (STP) techniques; by conducting a sonar STP and shipping noise characterization experiment. ($ 3.702 Million)

- Completed initial underwater mine neutralization explosive proof-of-concept experiments, successfully proving the feasibility of generating and propagating phased array pulse energy sufficient to destroy mine-like targets; completed single non-explosive source fabrication and testing; completed 1x 4 non-explosive source array fabrication and began testing to address technology issues; initiated 4x4 non-explosive source array design. ($ 1.577 Million)

- Conducted initial technology assessments and feasibility testing of advanced submarine communication system concepts, including signal exploitation, antenna array communications, and adaptive waveform generation. ($ 1.140 Million)

- Conducted initial technology assessment and feasibility testing of advanced submarine concepts, including: hydrodynamic design, acoustic smart skins, and detection of non-acoustic signatures. ($ 1.250 Million)

(U) **FY 1999 Plans:**

- Complete initial prototype ASW NetSAT system, incorporating acoustic space-time adaptive processing; integrated weapons control with countermeasures deconfliction; and integrated weapon/sensor signal processing approaches for enhanced attack performance. Conduct prototype testing to establish the detection-to-attack performance enhancements provided by networked approaches; and perform assessment of covert autonomous sensor deployment and tagging systems. ($ 12.409 Million)

- Complete final testing of multi-frequency Interferometric Synthetic Aperture Sonar (IFSAS) for mine classification; assess processing approaches for application of synthetic aperture sonar (SAS) to short sonar arrays. ($ 0.750 Million)

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- Complete feasibility investigation of Robust Passive Sonar (RPS) processing and array concepts, utilizing geographically referenced processing and space-time processing (STP) techniques. ($ 3.200 Million)

- Continue non-explosive underwater energy projection technology development for mine neutralization, including fabrication and test of 4x4 source array test article. ($ 3.526 Million)

- Conduct comparative testing of DARPA-generated multi-element buoyant cable array antenna concepts and Navy-generated single element approaches in Ultra High Frequency (UHF) bands and assess cost/performance tradeoffs; prepare for phenomenology and Global Positioning System (GPS) risk reduction, and communications link risk reduction experiments at L-band. ($ 3.774 Million)

(U) **FY 2000 Plans:**

- Update and complete development of prototype Anti-Submarine Warfare (ASW) Netted Search, Acquisition and Targeting (NetSAT) system; conduct final operational proof of concept demonstration, including an integrated detection/attack approach; coordinate transition of result to Navy. ($ 5.100 Million)

- Initiate development of synthetic aperture sonar (SAS) processing for short sonar arrays; conduct initial performance test sequence. ($ 2.200 Million)

- Complete extended feasibility investigation of the additional performance provided by external information (surface shipping positions and signatures) for the Robust Passive Sonar (RPS) processing and array concepts. ($ 3.818 Million)

- Design, fabricate, and demonstrate an underwater energy projection array prototype for at sea testing to be used to verify theoretical predictions, and to identify and address design issues in the Water Hammer concept. ($ 2.600 Million)

- Complete GPS and communications link risk reduction experiments at L-band; finalize system concept. Commence component technology development and initiate design and development of a full duplex (transmit/receive) submarine Buoyant Cable Array Antenna prototype. ($ 5.700 Million)

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- Conduct technology survey and assess system feasibility for an unmanned aerial vehicle non-acoustic submarine detection system. ($ 2.720 Million)

- Continue technology assessments and feasibility testing of advanced submarine concepts, including signature reduction, signal exploitation, autonomous sub-systems, and hydrodynamic flow control. ($ 0.400 Million)

(U) **FY 2001 Plans:**

- Complete development of synthetic aperture sonar (SAS) processing package for short sonar arrays; conduct final performance demonstration; transition to service for system implementation. ($ 2.300 Million)

- Conduct at sea testing of the Water Hammer subarray prototype. Assess implementation considerations of concept and address system issues such as platform, propulsion, sensors (if any), and concept of operations. Coordinate transition of program to Navy. ($ 2.564 Million)

- Complete design and begin fabrication of a full duplex (transmit/receive) submarine buoyant cable array antenna (BCAA) prototype; conduct algorithm and software development for spatial and temporal adaptive communications link processor. ($ 9.050 Million)

- Commence component technology development for an unmanned aerial vehicle non-acoustic submarine detection system, emphasizing transmitter and receiver size and weight reduction; develop design for initial prototype; establish baseline-processing approach and assess performance. ($ 8.050 Million)

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(U) **Program Change Summary:**(*In Millions*)

	FY1998	FY 1999	FY 2000	FY 2001
Previous President's Budget	19.626	24.788	33.998	43.464
Current Budget	19.597	23.659	22.538	21.964

(U) **Change Summary Explanation:**

FY 1998	Decrease reflects minor repricing and completion of the Electromagnetic Turbulence Control effort.
FY 1999	Decrease reflects minor repricing and completion of Anti-Submarine Warfare Netted Search, Acquisition and Targeting (NetSAT) effort.
FY 2000/01	Decrease reflects efforts scaling down as they near completion; transition ASW NetSAT effort to Navy; completion of Robust Passive Sonar effort; proposed new approaches for drag reduction technology shifted to BA1, in keeping with the speculative physics-based research necessary to prove the concept.

(U) **Other Program Funding Summary Cost:**

- Not Applicable.

(U) **Schedule Profile:**

Plan	Milestones
4QFY98	Complete final demonstration of Distant Thunder Anti-Submarine Warfare (ASW) detection system in western Pacific operations areas.
4QFY98	Complete test of 2 x 2 Water Hammer source array.
1QFY99	Conduct Netted Search, Acquisition and Targeting (NetSAT) system initial engineering checkout test.
2QFY99	Conduct at sea demonstration of a prototype space-time tactical sonar processor.
2QFY99	Complete fabrication of 4 x 4 Water Hammer source array as second test article.

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3QFY99	Complete interferometric synthetic aperture sonar (IFSAS) sea test.
3QFY99	Complete quantitative feasibility assessment of geographically referenced space-time processing approach.
3QFY99	Conduct at sea receives link testing at UHF in support of Buoyant Cable Array Antenna (BCAA) concept definition.
4QFY99	Conduct initial demonstration of prototype NetSAT system (targeting and attack only) in a controlled test range environment.
4QFY99	Complete feasibility assessment of short aperture Synthetic Aperture Sonar (SAS) processing.
4QFY99	Complete test of 4 x 4 Water Hammer source array.
4QFY99	Finalize BCAA concept at Ultra High Frequency (UHF).
1QFY00	Conduct initial feasibility sea test for BCAA concept at L-band.
2QFY00	Conduct Design Review for Water Hammer subarray prototype.
3QFY00	Conduct Design Review for short aperture SAS processor development.
3QFY00	Conduct Preliminary Design Review (PDR) for BCAA prototype system.
4QFY00	Conduct final NetSAT sensor-to-shooter operational demonstration including surveillance, detection, handoff, targeting and attack in a countermeasure environment.
4QFY00	Complete Feasibility assessment for Unmanned Aerial Vehicle (UAV) based non-acoustic Anti-Submarine Warfare (ASW) sensor.
1QFY01	Conduct initial at sea performance data collection experiment for ASW sensor.
2QFY01	Demonstrate Water Hammer subarray prototype at sea.
2QFY01	Conduct Critical Design Review (CDR) for BCAA prototype system.
3QFY01	Conduct sea test of short aperture SAS processor.
4QFY01	Complete system engineering definition of a Water Hammer array prototype.
4QFY01	Complete initial off-line performance assessment of non-acoustic ASW sensor.