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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE February 2000		
<b>APPROPRIATION/BUDGET ACTIVITY</b> RDT&E, Defense-wide BA3 Advanced Technology Development					<b>R-1 ITEM NOMENCLATURE</b> Marine Technology PE 0603763E, R-1 #47				
<i>COST (In Millions)</i>	FY 1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost To Complete	Total Cost
Total Program Element (PE) Cost	24.779	21.681	30.304	38.257	54.896	59.696	70.496	Continuing	Continuing
Advanced Ship-Sensor Systems, MRN-02	24.779	21.681	30.304	38.257	54.896	59.696	70.496	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 interrogate and 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; 3) advances in the ability of US naval assets to conduct operations as a seamlessly networked and integrated theater level force; and 4) maintenance of US naval force access to the littoral by countering the threat created by the worldwide spread of increasingly sophisticated technology. Proliferating threats such as modern cruise missile technology, commercially available overhead surveillance, advanced undersea mine capabilities, and modern, quiet diesel/electric submarines, pose major challenges for operations in the restricted water, near-shore regimes that are of growing importance to US strategic considerations, necessitating continued development of increasingly affordable far-term solutions for enhancing the operating capability and survivability margins of US naval forces in the littoral. This program element consists of a single project, Advanced Ship-Sensor Systems (MRN-02), comprised of the following programs: Undersea Littoral Warfare (ULW), Water Hammer, Buoyant Cable Array Antenna (BCAA), Robust Passive Sonar (RPS) and Future Submarine Payloads Program.

(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 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. Seamless coupling to a previously developed active acoustic search system (Distant Thunder) will provide significant enhancements at all points in the Anti-Submarine Warfare (ASW) attack chain. In addition, the ULW program is developing approaches to Synthetic Aperture Sonar (SAS) that would revolutionize our

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ability to classify and identify underwater mines and improve search rates more than an order of magnitude greater than is possible with current techniques. A comprehensive proof of performance demonstration will be conducted to assure readiness for transition to formal development programs.

(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 developing an antenna capable of supporting full duplex (transmit and receive) connectivity for voice and data with communications satellites while floating on the ocean's surface. Towed behind a submarine, this capability will enable high quality, high data-rate connectivity with other military assets, even while operating at speed and depth. Supporting technologies to be developed include photonic signal and power links, enhanced antenna loading materials, processing algorithms for blind adaptive array calibration and washover mitigation, advanced communications protocols, and signature minimization techniques. In addition, the feasibility of related approaches to radio frequency (RF) communications at higher frequencies in a package physically remote from the actual submarine platform will be assessed.

(U) The Robust Passive Sonar (RPS) program is an outgrowth of the successful experiments performed under the ULW program. The RPS program will investigate the ability of innovative, optimal processing approaches, coupled as appropriate to multi-dimensional receive arrays and/or external information, to precisely cancel the acoustic interference generated by surface shipping. At the lower frequencies that increasingly dominate submarine detection by acoustic means, shipping interference represents the primary noise background limiting the performance of existing sonar systems; this is especially true in the dense shipping environment typical of many littoral areas. Precise notching of shipping interference could result in net system performance gains of 10-20 dB, and the means of accomplishing it are expected to dictate preferred future array and acoustic sensor field designs. A data-driven program of algorithmic development and performance demonstration will be conducted as a multi-disciplinary effort. Participation across a broad spectrum of organizations in close coordination with Navy resources and organizations is intended.

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(U) Investigations into advanced Friction Drag Reductions Techniques will be conducted under this project. The goal is to increase the overall efficiency of surface and sub-surface naval vessels by reducing the friction drag on the structure surface created by the flow of water over the structure. Polymers and water bubble technologies are of particular interest. Scalable modeling of the turbulent flow will be conducted by taking advantage of advanced computing techniques.

(U) The Future Submarine Payloads Program will continue to build upon the concepts generated under the Sub Payloads and Sensors program (PE 0602702E, Project TT-03). Mature and promising concepts will be further developed to expand the effectiveness and lethality of US submarine platforms.

(U) **Program Accomplishments and Plans:**

(U) **FY 1999 Accomplishments:**

- Undersea Littoral Warfare (ULW). (\$ 17.638 Million)
  - Completed initial prototype NetSAT system, integrating weapons control with countermeasures deconfliction.
  - Conducted laboratory testing to establish initial detection-to-attack performance enhancements provided by networked approaches.
  - Conducted engineering checkout of networked NetSAT hardware suite.
  - Conducted technical field testing of NetSAT prototype against submarine target.
  - Completed feasibility investigation of the Robust Passive Sonar processing and array concepts, utilizing geographically referenced processing and space-time processing (STP) techniques.
- Water Hammer. (\$ 3.526 Million)
  - Continued non-explosive underwater energy projection technology development for mine neutralization, including fabrication and component testing for 4x4 source array test article.
- Buoyant Cable Array Antenna (BCAA). (\$ 3.615 Million)
  - Conducted comparative testing of DARPA-generated BCAA concept and Navy-generated single element approaches in Ultra High Frequency (UHF) band; assessed cost/performance tradeoffs of differing approaches.

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(U) **FY 2000 Plans :**

- Undersea Littoral Warfare (ULW). (\$ 16.951 Million)
  - Update and complete development of prototype NetSAT system.
  - Conduct NetSAT follow-on technical demonstration, emphasizing endgame coordination with existing systems for final target updates.
  - Integrate end-to-end SAS processing chain in laboratory; commence development of advanced mine classification algorithms.
  - Commence integration of SAS testbed for proof of performance testing.
  - Assess potential Robust Passive Sonar (RPS) performance improvements in passive sonar from exploitation of external information (overhead surveillance and acoustic monitors).
  - Commence RPS development of space-time processing algorithms for advanced surface shipping interference rejection.
  
- Buoyant Cable Array Antenna (BCAA). (\$ 3.980 Million)
  - Conduct component technology risk reduction and maturation.
  - Initiate design and development of a full duplex (transmit/receive) submarine BCAA prototype antenna; conduct preliminary design review.
  - Conduct risk mitigation testing of transmit link technologies.
  
- Water Hammer. (\$ 0.750 Million)
  - Complete 4x4 source array and test subsystem.
  - Validate nonlinear numerical model from test results.

(U) **FY 2001 Plans:**

- Undersea Littoral Warfare (ULW). (\$ 20.959 Million)
  - Conduct final NetSAT operational demonstration.
  - Coordinate transition of NetSAT technologies to Navy.
  - Conduct Synthetic Aperture Sonar (SAS) data collection exercises; complete SAS classification performance assessment.

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- Coordinate transition of Robust Passive Sonar technologies to Navy.
- Continue development of space-time processing algorithms for advanced surface shipping interference rejection.
- Conduct initial Robust Passive Sonar data collection field exercises.
- Create baseline integrated Robust Passive Sonar interference rejection processing stream; conduct preliminary performance assessment.
- **Bouyant Cable Array Antenna (BCAA). (\$ 5.345 Million)**
  - Complete algorithm and software development for space-time adaptive communications link processor.
  - Complete design of BCAA prototype antenna; conduct critical design review.
  - Fabricate BCAA prototype antenna; commence integration with submarine deployment and retrieval systems.
  - Assess feasibility of remotely operated antenna concepts for improving submarine stealth while providing round-the-clock two-way communications.
- **Future Submarine Payloads Program. (\$ 4.000 Million)**
  - Conduct structural, material, and architectural trade studies to allow storage and launch of existing payloads in an underwater environment.
  - Commence conceptual designs for the underwater launch and recovery of future submarine payloads

<b>(U)</b>	<b><u>Program Change Summary:</u> <i>(In Millions)</i></b>	<b><u>FY1999</u></b>	<b><u>FY 2000</u></b>	<b><u>FY 2001</u></b>
	Previous President's Budget	23.659	22.538	21.964
	Current Budget	24.779	21.681	30.304

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**(U) Change Summary Explanation:**

FY 1999      Increase reflects minor repricing and completion of Anti-Submarine Warfare Netted Search, Acquisition and Targeting (NetSAT) effort.

FY 2000      Decrease reflects repricing of the Buoyant Cable array program and a government-wide rescission offset by a Congressional increase for the Water Hammer effort.

FY 2001      Increase reflects emphasis on the advanced technology associated with the development of hydrodynamic friction reduction and turbulent flow scalable models.

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

Not Applicable.

**(U) Schedule Profile:**

<u>Plan</u>	<u>Milestones</u>
Undersea Littoral Warfare (ULW):	
Jul 00	Conduct follow-on technical demonstration of prototype NetSAT system in a controlled test range environment
Dec 00	Initial end-to-end SAS processing chain complete.
Jun 01	Conduct sensor-to-shooter operational demonstration including surveillance detection, handoff, targeting and attack in a countermeasure environment.
Sep 01	SAS classification performance assessment complete.
Water Hammer:	
Sep 00	Complete 4 x 4 Water Hammer source array and test subsystem.
Buoyant Cable Array Antenna (BCAA):	
Jun 00	Conduct Preliminary Design Review (PDR) for BCAA prototype system.

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- Mar 01 Conduct Critical Design Review (CDR) for BCAA prototype system.
- Mar 01 Conduct feasibility assessment for remotely operated submarine communications concepts.
- Nov 01 BCAA multi-element antenna prototype system complete.

Robust Passive Sonar (RPS):

- Mar 00 Exploitation of external information feasibility assessment complete.
- Mar 01 Initial RPS data collection field exercise complete.
- Jun 01 Baseline interference rejection processing stream for passive sonar created.
- Sep 01 Preliminary RPS performance assessment complete.

Friction Drag Reduction Techniques:

- Jun 01 Initiate effort to exploit results from PE0601101E (Project MS-01) Fast Ship effort to Naval/sea lift fleets
- Sep 01 Design near full-scale test to demonstrate efficiency improvement.