RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2003
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Marine Technology PE 0603763E, R-1 #47

COST (In Millions)	FY 2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009
Total Program Element (PE) Cost	36.141	32.224	13.898	0.000	0.000	0.000	0.000	0.000
Advanced Ship-Sensor Systems, MRN-02	36.141	32.224	13.898	0.000	0.000	0.000	0.000	0.000

(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) maintenance of U.S. naval force access to the littoral by countering the threat created by the worldwide spread of increasingly sophisticated technology; 2) enhancement of the ability of U.S. naval forces to interrogate and dominate the maritime battlespace, particularly in the littoral arena; 3) advances in the ability of U.S. naval assets to conduct operations as a seamlessly networked and integrated theater level force; and 4) improved power projection capabilities of U.S. naval forces, particularly with respect to their ability to influence the land battle. 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 U.S. strategic considerations, necessitating continued development of increasingly affordable far-term solutions for enhancing the operating capability and survivability margins of U.S. naval forces in the littoral. This program element funds the Advanced Ship-Sensor Systems project (MRN-02), comprised of the following programs: the Robust Passive Sonar (RPS) program; the Loki Systems Development Program; the Undersea Littoral Warfare thrust which includes the Piranha effort, the Long Range Mine Detection effort, and the Smart Actuators and Marine Projects Demonstration effort; and the Buoyant Cable Array Antenna (BCAA) program. This project draws to an end in FY 2004. Programs traditionally budgeted in this project will instead be budgeted in PE 0603766E, Project NET-02 to better reflect today's emphasis on network centric warfare.

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(U) Program Accomplishments/Planned Programs:

	FY 2002	FY 2003	FY 2004	FY 2005
Robust Passive Sonar (RPS)	19.315	16.600	9.242	0.000

(U) The Robust Passive Sonar (RPS) program is developing innovative, adaptive signal processing algorithms for passive submarine and surface ship towed arrays that suppress the acoustic interference generated by surface shipping and increase the detectability of threat submarines. At the lower acoustic frequencies, shipping interference represents the primary noise background limiting the performance of existing sonar systems in littoral areas. Precise notching of shipping interference could result in net system performance gains of 10-20 dB, and the algorithms and array geometries used to accomplish this will dictate future tactical sonar designs. The program has successfully collected high quality, mobile, multi-line, towed array acoustic and ancillary data and utilized this data to develop and assess signal processing architectures and algorithms. Initial performance assessments indicate significant suppression of acoustic interference is achievable.

(U) Program Plans:

- Complete end-to-end prototype signal processing architecture with advanced surface shipping interference rejection algorithms and demonstrate extended target detection.
- Conduct non real-time system performance using RPS sea-test data.
- Initiate real-time processing architecture and algorithms development.
- Demonstrate real-time end-to-end prototype signal processing system at-sea.
- Initiate planning of real-time at-sea system demonstration.
- Continue system trade studies for alternative acoustic aperture concepts.

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	FY 2002	FY 2003	FY 2004	FY 2005
Loki Program	4.809	9.570	0.000	0.000

(U) The Loki program is developing technologies to enable a revolutionary "fighter-like" submersible to counter the asymmetric threat posed by diesel submarines and other forces operating in the littorals. Loki has two major technology component elements: The Vortex Combustor propulsion technology and the Loki Systems technology development efforts. Objectives include: 1) the development of an energy-dense air independent underwater power source as a potential propulsion system for an underwater fighter, and 2) the investigation and development of detailed concepts of supporting systems and potential hull forms necessary for the operational viability of a future underwater fighter. Such an underwater vehicle would have the potential to revolutionize military and commercial undersea operations and the operational agility of maritime operations in the littoral. The results of these efforts will include: (1) the fabrication and testing of a small-scale vortex combustor power system, and (2) detailed concept and technical feasibility studies on supporting systems such as piloting, navigation, and collision avoidance systems as well as useful hull forms for conceptual high speed submersibles. These efforts transition to PE 0603766E, Project NET-02 beginning in FY 2004 to better incorporate them with other network centric warfighting capabilities.

(U) Program Plans:

- Vortex Combustor (VC).
  - Conduct analysis and performance evaluation.
  - Fabricate additional test units.
  - Develop start and restart system.
  - Develop control system.

- Loki Systems Development.
  - Conduct concept of operations and military utility studies.
  - Initiate system structural materials explorations.
    - -- Hydrodynamic performance modeling.
    - -- System structural materials explorations.
    - -- Advanced personnel pod design.

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-- Initiate sensor guidance and control design studies.
-- Simulation modeling of high agility, full speed control authority.
-- Concept development of autonomous control systems.

	FY 2002	FY 2003	FY 2004	FY 2005
Undersea Littoral Warfare (ULW)	3.268	6.054	4.656	0.000

(U) The ULW program is developing approaches to undersea warfare that will revolutionize the ability to classify and identify underwater objects such as mines. The ULW program seeks to provide the Navy with technologies that will allow U.S. submarines to dominate in the littoral battlespace and transform the submarine's role in littoral warfare. In doing so, the program will investigate: technologies and demonstrations for locating and tracking maritime targets of interest; innovative networking; sensor and array technologies; technologies and demonstrations enabling unique weapons or payload concepts for potential deployment on submarines and other undersea vehicles; and technologies for buried mine identification and classification in the littoral. The following specific efforts are included.

(U) The Piranha effort will enable submarines to engage elusive maneuvering land and sea targets by exploiting emerging battlefield Intelligence, Surveillance and Reconnaissance (ISR) sensors, wideband networked communications, real-time exploitation targeting algorithms, and existing/planned submarine strike weapon systems. Submarines are a key and enduring element of the current and future naval force with unique stealth, mobility, and endurance characteristics and are often the first strike unit on scene. Submarines have proven to be relatively immune to advances in weapons and information technology that increasingly put U.S. surface/air forces at risk and their importance as an effective forward deployed strike asset is likely to continue to increase. This effort will develop key technologies that enable attack and cruise missile submarines to play a wider role in responding to time-urgent maneuvering targets from a forward-deployed position. The Piranha effort will focus on the following key technology areas that enable submarine strike missions in the littorals: continuous asymmetric connectivity to intelligence, sensors, weapons and other vessels while at depth; ISR sensor data exploitation for targeting (sensor-to-weapon handoff); advanced offboard sensor concepts to include swarms of mini unmanned underwater vehicles (UUVs) for sensing sea targets; mobile underwater Global Positioning System (GPS) concepts; undersea networked sensor communications; and low latency target detection, identification, and geo-referencing. The effort will pursue a progression of more realistic demonstrations, culminating in closed loop submarine engagement of moving ground surface vehicles and sea targets. This effort will transition to PE 0603766E, Project NET-02 in FY 2004 to better reflect the inherent network centric emphasis.

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(U) Under the Long Range Mine Detection effort DARPA is investigating the potential capabilities of technologies for detection and discrimination of mines at long ranges. These technologies include: (1) acoustic projectors that could perform as compact and powerful low frequency sources, (2) the development of algorithms that enable adequate resolution and signal excess at long-range, (3) the development of signal processing algorithms for the detection, false alarm mitigation, and clutter rejection, and (4) the development of technologies associated with real-time processing of this data. This effort will also be coordinated with the Office of Naval Research (ONR) and the U.S. Navy's Mine and Undersea Warfare offices. Each of these other offices assists in this program to develop criteria and technologies that advance the state of mine detection in littoral regions.

(U) The Smart Actuators and Marine ProjectS demonstratiON (SAMPSON) effort is a systems level demonstration of the application of Smart Materials/Structures to enable vehicles to change the way they operate and take on new missions. By employing this technology aircraft will achieve dramatically improved range, maneuverability and enhanced survivability and marine vehicle turbo-machinery will operate with improved performance characteristics. SAMPSON core technology efforts have produced several new concepts and designs for high force, large displacement, low rate actuation using both shape memory alloys (SMAs) and piezoceramics. Preliminary designs for a high force and high stroke SMA tendon actuator that will considerably exceed the force/stroke capabilities of any SMA actuator known to date have been completed.

(U) Program Plans:

- Piranha.
  - Design and prototype off-board antenna.
  - Demonstrate endurance of underwater fiber optic link between antenna and moving platform.
  - Investigate submarine-deployed surface ISR sensor concepts.
  - Demonstrate wideband asymmetric communications at depth.
  - Develop and demonstrate real-time submarine ISR data processing and targeting algorithms.
  - Demonstrate closed-loop submarine engagement of a moving ground surface vehicle using non-organic sensors.
  - Develop and demonstrate submarine-deployed ISR sensor.
  - Demonstrate closed-loop submarine engagement of a moving ground surface vehicle incorporating submarine-deployed sensor inputs.

- Long Range Mine Detection.
  - Proof of Concept Phase: demonstrate the feasibility of long-range mine discrimination.
    - -- Perform at-sea data collections.

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-- Develop signal-processing algorithms based on data.
-- Develop detailed models to enable future engineering development decisions.

- Smart Actuator and Marine ProjectS demonstratiON (SAMPSON).
  - Demonstrate Smart Structures benefits by maximizing the integration of actuators with structures.
  - Develop smart materials based actuator performance.
  - Explore actuator performance.
  - Conduct SAMPSON performance testing and demonstration.
  - Model recent advances in low cost nanofluids shown to reduce friction.
  - Design, fabricate and test novel parasitic energy devices and associated supporting concepts/technologies.

	FY 2002	FY 2003	FY 2004	FY 2005
Buoyant Cable Array Antenna (BCAA)	8.749	0.000	0.000	0.000

(U) The Buoyant Cable Array Antenna (BCAA) program developed 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 enables high quality, high data-rate connectivity with other military assets, even while operating at speed and depth. Supporting technologies included photonic signal and power links, enhanced antenna loading materials, processing algorithms for blind adaptive array calibration and wash over mitigation, advanced communications protocols and signature minimization techniques. This program transitioned to the Navy at the end of FY 2002.

(U) Program Plans:
- Completed at-sea technical validation of BCAA prototype.
- Transitioned BCAA technology to Navy for follow-on development.

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

	FY 2002	FY 2003	FY 2004	FY2005
Previous President's Budget	36.497	33.000	47.638	74.367
Current President's Budget	36.141	32.224	13.898	0.000
Total Adjustments	-0.356	-0.776	-33.740	-74.367
Congressional program reductions	0.000	-0.776		
Congressional increases	0.000	0.000		
Reprogrammings	-0.356	0.000		
SBIR/STTR transfer	0.000	0.000		

(U) Change Summary Explanation:

FY 2002	Decrease reflects below threshold reprogramming.
FY 2003	Decrease reflects Congressional undistributed reductions.
FY 2004 – FY 2005	Decrease reflects transfer of programs to PE 0603766E, Project NET-02.

(U) Other Program Funding Summary Cost:

Buoyant Cable Array Antenna (BCAA)	FY 2002	FY 2003	FY 2004	FY 2005
PE 0604503N, Submarine Integrated Antenna Systems/X0742	1.705	2.723	0.000	0.000