FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2000

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1999 ACTUAL	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	33,557	38,889	37,432	38,261	37,427	29,773	29,138	CONT.	CONT.
R2328 Project M	7,058	2,396	0	0	0	0	0	0	22,770
R2373 Composite Helicopter Hangar	4,856	4,973	0	0	0	0	0	0	19,320
R2488 Power Electronic Building Blocks	5,826	0	0	0	0	0	0	0	5,826
R2489 Power Node Control Centers	1,942	2,984	0	0	0	0	0	0	4,926
R2705 Virtual Test Bed	0	4,973	0	0	0	0	0	0	4,973
R2706 Project M	0	4,973	0	0	0	0	0	0	4,973
R2707 Reconfig. Ship Simulation	0	1,989	0	0	0	0	0	0	1,989
R2708 Electromagnetic Propulsion Systems	0	2,984	0	0	0	0	0	0	2,984

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PROJECT NUMBER & TITLE	FY 1999 ACTUAL	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2709 High Temperature Superconducting Synchronous Motor	0	1,989	0	0	0	0	0	0	1,989
R2710 Permanent Magnet Motor	0	4,973	0	0	0	0	0	0	4,973
R2711 Superconducting DC Motor	0	4,973	0	0	0	0	0	0	4,973
TOTAL	53,239	76,096	37,432	38,261	37,427	29,773	29,138	CONT.	CONT.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides for the continued development of affordable surface ship and submarine hull, mechanical, and electrical system core technology demonstrations that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff; namely, to promptly engage regional forces in decisive combat on a global level.

In FY 2001, there is one active project: Ship and Submarine HM&E Advanced Technology (R2224). Products from this PE will improve the effectiveness and operational efficiency of all Navy ship and submarine platforms in all Joint Mission Areas. Affordability is addressed through large-scale demonstrations and validation of concepts that reduce costs associated with design, fabrication, outfitting, maintenance, and operation. All naval platforms inherently require mobility, efficiency, reliability, and availability as primary requirements for Naval Warfare. This program directly supports the Readiness and Support and Infrastructure Joint Mission Areas in the area of sustainability and supports Strike, Littoral Warfare, Joint Surveillance, Joint Surface Electronic Warfare, Strategic Deterrence, and Maritime Support for Land Forces, and Strategic Sealift relative to reduced signatures and increased survivability.

The Navy S&T program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2000

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity 3 because it encompasses development, simulation, or experimental testing of prototype hardware to validate technological feasibility and/or concept of operations and to reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2000

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

PROGRAM CHANGE FOR TOTAL P.E.:

	FY 1999	FY 2000	FY 2001
FY 2000 President's Budget:	52,889	41,515	35,353
Appropriated Value:	-	76,515	-
Adjustments from FY 2000 PRESBUD:			
Execution Adjustments:	1,192	0	0
SBIR/STTR Transfers:	-842	0	0
Program Adjustments:	0	0	2,379
Congressional Plus-ups	0	35,000	0
Various Rate Adjustments:	0	0	-300
Congressional Recission:	0	-419	0
FY 2001 PRESBUDG Submission:	53,239	76,096	37,432

CHANGE SUMMARY EXPLANATION:

- Schedule: Not applicable.
- Technical: Not applicable.

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2000

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	33,557	38,889	37,432	38,261	37,427	29,773	29,138	CONT.	CONT.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Project R2224 develops and demonstrates technological improvements for Ship and Submarine Hull, Mechanical, and Electrical (HM&E) systems in support of present and future surface ship and submarine platforms. This project demonstrates technology that has been explored for system feasibility at the applied research level, primarily in PE 0602121N, and focuses on system level development and demonstration for transition to higher budget category funding, or acquisition programs. Thus, this project is a continuing effort that demonstrates system technology to improve overall platform performance (stealth, affordability, survivability, mobility, efficiency, reliability and availability) and reduces maintenance, overhaul, and life cycle costs. Areas of current technology development and demonstration are Automation to Reduce Manning (ARM), Ship/Submarine Hull Systems (SSHS), and Advanced Electrical Systems (AES).

ARM technology develops sensing, control, actuation and decision making technology to enable reduction in manning for future ships and submarines. This effort is currently focused on Damage Control Automation to Reduce Manning (DCARM) and Affordable Interfaces for Optimal Manning on the family of 21st century combatants (SC21 Manning). DCARM is transitioning automated damage control technology options for SC21 and CVX. DCARM technology will be demonstrated in a series of system tests culminating in a final integrated demonstration of a survivable HM&E damage control system. SC21 Manning will demonstrate at least 50% manning reduction in surface ship combat systems through human-centered systems engineering and advanced watchstation design for the new destroyer class of surface combatants (DD21). The Integrated Engineering Plant (IEP) Demonstration will begin in FY 2001 and continue the ARM initiative into the operational areas of the ship propulsion

and auxiliary systems by developing, assessing and demonstrating architectures and technologies conducive to reducing operational workload.

SSHS develops and demonstrates system level technology from a multi-disciplinary approach; the Advanced Machinery Support Structures (AMSS) effort is focused on modular structures for submarine machinery spaces, to demonstrate a unified system that controls shock, acoustic vibration, and radiated noise. This technology enables use of affordable modular construction and commercial-off-the-shelf equipment. The Advanced Topside Systems (ATS) effort will demonstrate general ship topside technologies for future ship classes.

Advanced Electrical Systems (AES) demonstrates technology that will provide the fleet with: 1) Ship Service Fuel Cells (SSFC) —— As an affordable alternative electrical source for ship service power, this technology addresses improvements in power density, fuel consumption, manning requirements, quiet operation, and emissions. Emphasis is placed on leveraging commercial fuel cell technology and solving Navy issues such as operation in salt-laden air, shipboard shock and vibration, and reforming diesel fuel. 2) Quiet Electric Drive (QED) technology for passive and active suppression of acoustic and electrical noise associated with electric motors —— This technology is focused on submarine applications and enables cost savings, improved quieting and radically new arrangements of propulsion and auxiliary machinery. 3) Advanced Electrical Distribution (AED) to enable an electrically reconfigurable ship to have a survivable fight-through capability for all electrical shipboard systems during battle —— This technology will contain intelligent electric power control modules, thereby creating a new paradigm in power network architectures and system control well beyond conventional capability. It will provide automatic, reconfigurable electric power distribution systems that are redundant, survivable, and reliable, with high quality power for ships and submarines. Solid State Switching Applications (SSSA) integrate Power Electronic Building Blocks (PEBB) into each of the above electrical technology demonstrations and provide the key undergirding technology for AES. This technology demonstrates the form, fit, and function of universal PEBB modules in shipboard system applications such as circuit breakers, current limiters, inverters, converters, motor controllers, etc. This multi-functional software controlled modular design reduces the size, cost and weight of all electrical systems.

PROGRAM ACCOMPLISHMENT AND PLANS:

1. FY 1999 ACCOMPLISHMETS:

AUTOMATION TO REDUCE MANNING:

INITIATED:

- Preparation for remote manual demonstration with 60% damage control manning reduction. (DCARM)
- Development and optimization of water mist distribution controls. (DCARM)

CONTINUED:

- Sensor evaluation to verify performance and environmental acceptability for automated ship damage control systems. (DCARM)
- Development and programming of supervisory control processor for the automated ship damage control system. (DCARM)
- Development and installation of integrated control topology for damage control. (DCARM)
- Validation of initial fire suppression water mist system. (DCARM)
- Development of systems engineering tool set for human centric systems. (SC21 Manning)
- Development and evaluation of human-system performance metrics and predictive engineering models of combat systems decision-makers in warfighting scenarios. (SC21 Manning)
- Development of Multi-Modal Watchstation team designs for DD21 warfighting missions. (SC21 Manning)

COMPLETED:

- Final Demonstration of 3-man Multi-Modal Watchstation team performance for current generation of surface combatants (AEGIS) Strike scenarios. (SC21 Manning)
- Fire parameter and alarm algorithms for a multi-criteria fire detection system. (DCARM)

ADVANCED ELECTRICAL SYSTEMS:

INITIATED:

- Application of 3D models for electric motor magnetic fields. (QED)
- Development of active control techniques for electric motors. (QED)
- Aircraft Electrical Servicing Station demonstration using programmable Power Electronic Build Blocks (PEBB) and Power Node Control Center technologies. (SSSA)
- Design reconfiguration demonstration electrical zone. (AED)

TRANSITIONED:

- Power Node Control Center technologies for Integrated Power System applications. (AED)
- PEBB-based Power Control Modules for Integrated Power System Applications. (SSSA)

CONTINUED:

- Design of a 500KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)
- Development of electric motor acoustic prediction capability. (QED)
- Development/selection of critical component technology for intermediate-scale Quiet Electric Drive demonstration. (QED)
- Demonstration of key equipment capabilities for the Electrically Reconfigurable Ship. (AED)
- Demonstration of physical and computational electrical network system simulations. (AED)

COMPLETED:

- Demonstration of prototype self-synthesizing, dynamically reconfigurable electric distribution systems. (AED)
- Ship Service Fuel Cell power system concept validation via numerical analysis, and testing of sub-scale articles. (SSFC)
- Multi-functional demonstration of second-generation PEBB modules for form and function. (SSSA)
- Demonstration of Power Controller Modules and Ship Service Inverter for Integrated Power System applications--key equipment capability for the Electrically Reconfigurable Ship demonstrations. (SSSA)
- Propulsion system concept studies. (QED)

SHIP STRUCTURES AND HULL SYSTEMS:

INITIATED:

- Design and demonstration of shock control features for Machinery Support Structure for in-water shock demonstrations. (AMSS)
- Preparation for in-water quarter-scale demonstration of Machinery Support Structure system concept for shock mitigation. (AMSS)
- Assessment of potential heavyweight Machinery Truss performance. (AMSS)
- Machinery flanking path component evaluation. (AMSS)

CONTINUED:
- Evaluation of flexible truss and shock strengthening concepts on acoustic performance of truss. (AMSS)
- Evaluation of coating system performance. (AMSS)

COMPLETED:
- Measurement of impact of incomplete hull coating coverage. (AMSS)
- Lightweight machinery truss acoustic performance evaluation. (AMSS)
- Demonstration of next generation advanced mast test article for the LDP-17. (ATS)

2. FY 2000 PLAN:

AUTOMATION TO REDUCE MANNING:
INITIATE:
- Casualty response/system reconfiguration for reflexive fluid systems. (DCARM)

CONTINUE:
- Sensor evaluation to verify performance and environmental acceptability for automated ship damage control systems. (DCARM)
- Installation of automated control topology for damage control. (DCARM)
- Development and programming of the supervisory control processor for the automated ship damage control system. (DCARM)
- Development of systems engineering tool set supporting design for humans as critical system elements. (SC21 Manning)

COMPLETE:
- Water mist distribution controls. (DCARM)
- Hardware and software systems integration of fire protection systems. (DCARM)
- Casualty response/ system reconfiguration for reflexive fluid systems. (DCARM)
- Remote manual demonstration with 60% Damage Control Manning Reduction. (DCARM)

- Final Demonstration and evaluation of Multi-Modal Watchstation individual and team performance for DD21 warfighting missions. (SC21 Manning)

ADVANCED ELECTRICAL SYSTEMS:
INITIATE:

- Development of scale electric motors and controllers for demonstration. (QED)
- Demonstration of equipment capabilities using PEBB-3 technology. (AED)
- High Voltage Switch demonstration for dynamically reconfigurable power systems. (SSSA)
- High Energy System technologies for dynamically reconfigurable power systems. (AED)
- Fabrication of a 500KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)

CONTINUE:

- Demonstration of key system capabilities for the Electrically Reconfigurable Ship. (AED)
- Aircraft Electrical Servicing Station demonstration using programmable PEBB and Power Node Control Center technologies. (SSSA)
- Design reconfiguration demonstration electrical zone. (AED)
- High Energy System technologies for dynamically reconfigurable power systems. (SSSA)
- Development of active control techniques for electric motors. (QED)
- Integration of submarine hydroacoustic model and structural response model. (QED)

COMPLETE:

- Multi-functional demonstration of third-generation PEBB modules for fit, form and function. (SSSA)
- Demonstration of physical and computational network system simulations. (AED)
- Application of 3D models for electric motor magnetic fields (QED)
- Conceptual design for 2.5 MW Ship Service Fuel Cell System. (SSFC)

SHIP STRUCTURES AND HULL SYSTEMS:
INITIATE:

- Heavyweight machinery truss design and demonstration. (AMSS)

- Advanced coating system concept definition. (AMSS)
- Machinery flanking path system mitigation demonstration. (AMSS)

CONTINUE:

- In-water quarter-scale demonstration of Machinery Support Structure system concept shock performance. (AMSS)

COMPLETE:

- Machinery flanking path component evaluation. (AMSS)
- Design and integration of shock control features into Machinery Support Structure for in-water shock demonstration. (AMSS)

3. FY 2001 PLAN:

AUTOMATION TO REDUCE MANNING:

INITIATE:

- Preparation for final demonstration of 85% reduction in damage control manning requirements. (DCARM)
- Conceptual systems engineering study and trade-off analysis of Integrated Engineering Plant demonstration system. (IEP)

CONTINUE:

- Evaluation of multi-criteria fire detection system. (DCARM)
- Design for zonal smoke control system. (DCARM)
- Detailed design and software interface for reflexive water mist system. (DCARM)

COMPLETE:

- Demonstration of 85% reduction in damage control manning and requirements. (DCARM)

ADVANCED ELECTRICAL SYSTEMS:

INITIATE:

- Demonstration of an electrical Mission Reconfiguration. (AED)
- Demonstration of advanced architecture motor controller. (QED)
- Demonstration of active control algorithms to control ship signatures using motor as an actuator. (QED)

CONTINUE:
- Demonstration of control of integrated motor/propulsor response. (QED)
- Development of 500-KW Ship Service Fuel Cell reduced-scale demonstrator. (SSFC)
- High Energy System technologies for dynamically reconfigurable power systems. (SSSA)
- Demonstration of key system capabilities for the Electrically Reconfigurable Ship. (AED)
- High Voltage Switch demonstration for dynamically reconfigurable power systems. (SSSA)

COMPLETE:
- Development of active control techniques for electric motors. (QED)
- Analytical model for fuel cell system dynamic performance. (SSFC)
- Demonstration of a 500-KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)
- Aircraft Electrical Servicing Station demonstration using programmable PEBB and Power Node Control Center technologies. (SSSA)
- Demonstration of design reconfiguration of an electrical zone. (AED)

SHIP STRUCTURES AND HULL SYSTEMS:
INITIATE:
- Large Scale Demonstration of advanced coating system concept. (AMSS)

CONTINUE:
- Machinery flanking path system mitigation concepts. (AMSS)
- Heavyweight machinery truss design and demonstration. (AMSS)

COMPLETE:
- In-water quarter-scale demonstration of Machinery Support Structure system concept for shock performance. (AMSS)

B. PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2000

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

PROJECT NUMBER: R2224 PROJECT TITLE: Ship & Submarine HM&E Advanced Technology

- RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602121N (Ship, Submarine & Logistics Technology)
PE 0602122N (Aircraft Technology)
PE 0602234N (Materials, Electronics, and Computer Technology)
PE 0603561N (Advanced Submarine Systems Development)
PE 0603573N (Advanced Surface Machinery Systems)
PE 0604558N (New Design SSN Development)
PE 0604561N (SSN-21 Development)
Under the Defense S&T Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. SCHEDULE PROFILE: Not applicable