

UNCLASSIFIED

FY 2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 2000

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) 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
Ocean Sciences	136,266	144,028	148,731	151,252	154,318	157,738	161,430	CONT.	CONT.
Advanced Materials	58,882	62,875	70,333	66,648	68,647	71,050	73,537	CONT.	CONT.
Information Sciences	44,347	47,355	51,290	50,196	51,702	53,512	55,652	CONT.	CONT.
Sustaining Programs	99,928	104,499	110,785	108,655	109,722	110,608	111,485	CONT.	CONT.
TOTAL	339,423	358,757	381,139	376,751	384,389	392,908	402,104	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program sustains U.S. naval scientific and technological superiority, provides new concepts and technological options for the maintenance of naval power and national security, and provides the means to avoid scientific surprise, while exploiting scientific breakthroughs. The program responds to the science and technology (S&T) requirements from the Department of the Navy (DON) Integrated Warfare Architecture Requirements (IWARs) and enables the technologies that could significantly improve Joint Chiefs of Staff's Future Joint Warfighting Capabilities. It also seeks to exploit new science opportunities relevant to long term naval requirements. The Office of Naval Research (ONR) responds to requirements through major research thrusts in Ocean Sciences, Advanced Materials, Information Sciences, and the Sustaining Programs. These efforts are part of an integrated DON S&T process initiated in 1993.

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(U) This program responds to the Power Projection IWAR through research leading to better structural materials to increase platform survivability; automated target recognition algorithms to improve identification of friend or foe (IFF), and to help improve real-time targeting under camouflage conditions; new concepts in batteries and propellants for improved torpedo performance; and physics and chemistry foundations for improved multispectral, all-weather sensors and electronics. Responses to the Sea Dominance IWAR involve knowledge of near-shore ocean and atmospheric circulation, remote sensing, acoustics, and optical transmission to improve mine detection and removal, special operations capabilities and submarine detection; and novel structural materials for better ship damage tolerance. This program responds to the Information Superiority and Sensors IWAR through research in: data fusion, which integrates environmental prediction products into information systems; advanced materials for improved sensors and electronics; better signal processing for automated target recognition allowing rapid ship self-defense and identifying relocatable targets; ocean and atmospheric properties, allowing sensors to operate more effectively under highly variable (battlespace) environmental conditions; and network and data studies to address real-time, all-weather surveillance and targeting, with short revisit times using multiple high capacity data links. Research into improved aerodynamic shapes for high endurance surveillance responds directly to a requirement of the Deterrence IWAR. Research in response to the Readiness and Infrastructure IWAR Pillars includes developing knowledge of acoustic/boundary interactions for improved navigation capabilities in poorly charted areas; exploring longer service life materials for reduced logistics; and investigating chemical and biological processes for clean handling of shipboard waste. Finally, cognitive research leading to more efficient and cost-effective training, to more user-compatible decision support systems, and to principles for the design of reconfigurable command and control structures responds to the Manpower & Personnel, Force Structure, and Training & Education IWAR Pillars.

(U) Program response to affordability requirements includes research on condition based maintenance, embedded training, manufacturing science, antifouling coatings, advanced materials and coatings, biosensors, and electro-optical and multifunctional electronic devices and concepts that promise to greatly simplify future undersea surveillance arrays and radar systems while reducing life cycle cost.

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(U) Due to the sheer volume of efforts included in this program element, the programs described in the Accomplishments and Plans sections are representative selections of the work included in this program element.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is funded under Basic Research because it encompasses scientific study and experimentation directed toward increasing knowledge and understanding in broad fields directly related to long-term DON needs.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1999 ACCOMPLISHMENTS:

- (U) Ocean Sciences responded to Information Superiority and Sensors requirements through investigations of bioluminescence sensors and tactical decision aid software that provide risk-of-detection predictability of swimmers and SEAL delivery vehicles for inshore operations; and to Power Projection requirements with improved chirp sonar techniques and algorithms to analyze sea floor structure for use in rapid dock emplacement during amphibious operations. It also responded to Sea Dominance requirements through transition of a Lidar Model and transfer of data from the Worldwide Ocean Optics Database for improved oceanic weather prediction.
- (U) Advanced Materials responded to Air Dominance requirements through new understanding of low weight high strength composites with carbon nanotubes for conductive coatings with low signatures; and to Information Superiority and Sensors requirements through advances in molecular electronics leading to distributed processing networks, real-time tactical information to warfighters, autonomous surveillance, and reconnaissance with low energy sensors.
- (U) Information Sciences responded to Sea Dominance requirements by applying basic studies in wavelet image processing to autonomous robot search and localization programs for improved mine countermeasures area coverage; to Readiness requirements by using deformable shape methods to develop 3-D shape models for biochemical tracking,

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and anatomical structures in medical volume data for computer-assisted diagnosis and surgical planning; and to Infrastructure requirements by achieving ultra-high density random access memory for extremely robust and fast read/write operations to replace mechanical hard drive memories with instant-on high volume memories necessary for effective network-centric warfare.

- (U) Sustaining Programs responded to Power Projection requirements through investigations into silica-based composite aerogels for high performance battery and fuel cell electrodes, high surface area sensors for chemical/biological agent detection, and lightweight materials for selective optical absorption in stealth applications. They also responded to Sustainment requirements through work on new, nano-porous polymers for cheap, high-performance membranes for shipboard wastewater processing; to Readiness requirements by preparing and characterizing fluorinated oxetanes with promise for non-toxic, durable fouling release coatings; and to Information Superiority and Sensors requirements by investigations into stochastic resonance array detectors with potential for airborne magnetic detection of submarines in littoral areas.

(U) FY 2000 PLAN:

- (U) Ocean Sciences will respond to Power Projection requirements by developing more reliable coastal predictive models for battlespace environments, evaluating the linkages of small scale to large scale oceanic processes, and exploring environmentally adaptive systems for quantifying the role of the environment on ship systems in order to improve the probability of success of military operations conducted from coastal regions of the sea. It will also respond to Sea Dominance and Air Dominance requirements by exploring in-situ measurement and sonar adaptation to specific environments for significantly improved antisubmarine warfare (ASW) performance, automatic target recognition methods for ultra-low false alarm rate periscope detection radar, wake detection sensors, and theater-level data fusion for cooperative ASW.
- (U) Advanced Materials will respond to Sea Dominance requirements by developing low signature materials for autonomous robotic systems supporting Naval Special Warfare and Explosive Ordnance Disposal, and unique

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biomaterials for improved infrared (IR)/acoustic sensors. It will respond to Information Superiority and Sensors requirements through advanced lithography, wide bandgap heterojunctions, and large area, wide bandgap materials for multifunctional wide bandwidth systems with high linearity, efficiency and power.

- (U) Information Sciences will respond to Information Superiority and Sensors requirements by seeking the theoretical basis for high-performance man-machine multi-mode multi-media interface semi-autonomous systems for decision aids, optimal management of dynamic tactical and computer networks, and methods for automated defensive information warfare. It will respond to Infrastructure requirements by research on virtual sensors and battery charger analyzers for improved maintenance, diagnostics and testing of naval machinery.
- (U) Sustaining Programs will respond to Sea Dominance requirements by exploring integrated ship propulsion concepts for higher hydrodynamic efficiency, prediction models of damaged ship motions/loads for damage control and improved maneuvering/seakeeping, and by developing active and passive signature control concepts with compatible shock reduction technology and reduced weight, volume and cost impact for submarines. They will respond to Power Projection requirements by exploring new concepts for torpedo silencing, and by designing high power thermal systems for half-length and supercavitating weapons propulsion.

(U) FY 2001 PLAN:

- (U) Ocean Sciences will respond to Information Superiority and Sensors requirements through validation studies and model development of sediment dynamics for on-scene characterization of the ocean bottom and improved minefield detection capabilities, as well as through studies on the use of millimeter wave radar for imaging and classification of moving targets and for communication intrusion and denial.
- (U) Advanced Materials will respond to Power Projection requirements through synthesis/characterization of insensitive difluoroaminated nitramine ingredients for propellant/explosives for increased performance/lethality. It will respond to Infrastructure requirements through studies of nanometer scale tribology, rejuvenation/

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recycling damage and failure prediction, and miniaturized sensors/actuators for condition-based maintenance, damage control and mine countermeasures; and through multiple laser routes to new coatings for long-life engine materials and shafts.

- (U) Information Sciences will respond to Sustainment requirements by developing generic software to enable complex scheduling on a rapid basis, and to Manpower & Personnel requirements by developing computational models for matching command and control organizations to dynamic mission needs, human performance models for design and development of new ship systems, and models providing dynamic allocation of functions between humans and automated systems for an improved engineering/acquisition process.
- (U) Sustaining Programs will respond to Sustainment requirements through investigations of single walled carbon nanotubes for structural and electronic technologies, fluorinated oxetanes for tough, low surface energy fouling release surfaces, and superconducting wires for electric motors. Sustaining Programs will also respond to Information Superiority and Sensing requirements by investigating quantum effect devices and single-electron transistors for ultra-high functional density circuits from nanoelectric, nanomagnetic and nanooptic devices integrated into single and multi-chip configurations. They will respond to Power Projection requirements through exploration of bioluminescence mapping systems to protect covert operations, metal-ion biosensors for environmental/shipboard use, and biocatalysts for 'green' synthesis of explosives. They will respond to Training & Education requirements for better instruction and human learning from studies of scenario-based and case-based instruction; dynamic hybrid neural net and rule-based learning models for tactical decision-making, and synthetic team members and adversaries to improve outcomes in large-scale, simulation-based training.

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B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
(U) FY 2000 President's Budget:	346,836	361,118	375,056
(U) Appropriated Value:		361,118	
(U) Congressional Rescissions:		-2,361	
(U) Various Rate Adjustments:			-6,821
(U) Program Adjustments:			13,000
(U) Minor Program Adjustments:			-96
(U) SBIR/STTR Transfers:	-5,782		
(U) Inflation Adjustments:	-1,575		
(U) Execution Adjustments:	-56		
(U) FY 2001 PRESBUDG Submission:	339,423	358,757	381,139

(U) CHANGE SUMMARY EXPLANATION:

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

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(U) PE 0601102A Defense Research Sciences (Army)

(U) PE 0601102F Defense Research Sciences (Air Force)

Activities are coordinated through Defense S&T 6.1 Reliance Scientific Planning Groups.

D. (U) SCHEDULE PROFILE: Not applicable.

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