DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2000/2001 BIENNIAL BUDGET ESTIMATES

19990505 029

JUSTIFICATION OF ESTIMATES
FEBRUARY 1999

RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY
BUDGET ACTIVITIES 1-3

DTIC QUALITY INSPECTED 4

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Department of the Navy
FY 2000 RDT&E Program

Exhibit R-1

APPROPRIATION: 1319n Research, Development, Test and Evaluation, Navy

DATE: February 1999

R-1 Line Number	Program Element Number	Item Nomenclature	Budget Activity	Thousands of Dollars FY 1998	FY 1999	FY 2000	Security Classification
1	0601152N	In-House Independent Lab Research	1	13,268	14,663	15,630	U
2	0601153N	Defense Research Sciences	1	318,176	346,836	361,118	U
		Total Basic Research		331,444	361,499	376,748	
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	22,886	40,823	37,616	U
4	0602121N	Surface Ship Technology	2	43,430	55,456	43,786	U
5	0602122N	Aircraft Technology	2	22,428	28,367	20,660	U
6	0602131M	Marine Corps Landing Force Technology	2	12,478	12,970	10,534	U
7	0602228N	Historically Black Colleges and Universities (Prior Year Only/R2 Not Required/Transferred to RDT&E-DW)	2		6,684		U
8	0602232N	C3 Technology	2	54,084	67,008	68,823	U
9	0602233N	Human Systems Technology	2	40,405	31,426	30,586	U
10	0602234N	Materials, Electronics & Computer Technology	2	76,194	87,698	77,987	U
11	0602270N	EW Technology	2	16,982	22,743	24,659	U
12	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	39,758	49,710	51,406	U
13	0602315N	MCM, Mining & Special Warfare Technology	2	35,221	45,496	45,022	U
14	0602435N	Ocean & Atmospheric Technology	2	74,767	68,726	60,334	U
15	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	28,726	39,717	34,066	U
16	0602805N	Dual Use Application Program	2	-	9,977	18,390	U
		Total Applied Research		467,359	566,801	523,869	
17	0603217N	Air Systems & Weapons Advanced Technology	3	38,082	47,398	42,046	U
18	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	57,426	69,466	52,580	U
19	0603270N	Advanced EW Technology	3	18,352	18,093	18,984	U
20	0603508N	Ship Propulsion System	3	48,369	52,889	41,515	U
21	0603640M	MC Advanced Technology Demo	3	58,467	56,187	56,943	U
22	0603706N	Medical Development (Advanced)	3	57,372	68,505	15,064	U
23	0603707N	Manpower, Pers, & Training Adv Tech Demo	3	20,340	26,466	20,632	U
24	0603712N	Environmental Quality & Logistics Adv Tech	3	27,327	23,373	23,809	U
25	0603727N	Joint Experimentation Program	3	-	15,900	41,840	U
26	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	44,548	57,341	57,956	U
27	0603782N	Shallow Water MCM Demos	3	40,352	44,220	48,711	U
28	0603792N	Advanced Technology Transition	3	86,094	73,652	75,635	U
29	0603794N	C3 Advanced Technology	3	21,888	39,686	23,808	U
		Total Advanced Technology Development		518,617	593,176	519,523	
		Total Science and Technology (S&T)		1,317,420	1,521,476	1,420,140	

Department of the Navy
FY 2000 RDT&E Program
Alphabetic Listing

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5	0602122N	Aircraft Technology	2	22,428	28,367	20,660	U
29	0603794N	C3 Advanced Technology	3	21,888	39,686	23,808	U
8	0602232N	C3 Technology	2	54,084	67,008	68,823	U
2	0601153N	Defense Research Sciences	1	318,176	346,836	361,118	U
16	0602805N	Dual Use Application Program	2	-	9,977	18,390	U
24	0603712N	Environmental Quality & Logistics Adv Tech	3	27,327	23,373	23,809	U
11	0602270N	EW Technology	2	16,982	22,743	24,659	U
18	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	57,426	69,466	52,580	U
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9	0602233N	Human Systems Technology	2	40,405	31,426	30,586	U
1	0601152N	In-House Independent Lab Research	1	13,268	14,663	15,630	U
25	0603727N	Joint Experimentation Program	3	-	15,900	41,840	U
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6	0602131M	Marine Corps Landing Force Technology	2	12,478	12,970	10,534	U
10	0602234N	Materials, Electronics & Computer Technology	2	76,194	87,698	77,987	U
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22	0603706N	Medical Development (Advanced)	3	57,372	68,505	15,064	U
14	0602435N	Ocean & Atmospheric Technology	2	74,767	68,726	60,334	U
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20	0603508N	Ship Propulsion System	3	48,369	52,889	41,515	U
4	0602121N	Surface Ship Technology	2	43,430	55,456	43,786	U
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	22,886	40,823	37,616	U
12	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	39,758	49,710	51,406	U
26	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	44,548	57,341	57,956	U
15	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	28,726	39,717	34,066	U
		Total Science and Technolgoy (S&T)		1,317,420	1,521,476	1,420,140	

Comparison of FY 1998 Financing as reflected in FY 1999 Budget with 1998 Financing as Shown in the FY 2000 Budget

($ In Thousands)

	Financing per FY 1999 Budget	Financing Per FY 2000 Budget	Increase (+) or Decrease (-)
Program Requirements (Service Account)	7,879,912	7,887,810	+7,898
Program Requirements (Reimbursable)	110,000	163,008	+53,008
Appropriation (Adjusted)	**7,989,912**	**8,050,818**	**+60,906**

Explanation of Changes in Financing
($ in Thousands)

The Fiscal Year 1998 program has changed since the presentation of the FY 1999 budget as noted below:

1. Program Requirements (Total). There has been a net increase to the appropriation (adjusted) of +$60,906 as a result of changes in program requirements as noted below.

2. Program Requirements (Service Account). There has been a net increase to the appropriation (adjusted) of +$7,898, resulting from various changes in program requirements. These changes included recissions reflected in the FY 99 DoD Appropriations Act (-$20,500), Line Item Veto Restorals (+$6,000), and other Congressional Actions (-$8,000). A number of Internal Reprogrammings were effected which reclassified funding between DoN appropriations to more properly align them into the correct programs for execution: Medical Research Projects (-$7,278), Tactical Tomahawk (+$19,600), PMRF Sensors (-$4,852), F/A-18 (-$14,855), and ASW Combat System Integration (+$5,861). Additionally, other transfers included Overseas Contingency Operations (+$7,500) and Counterdrug Operations (+$15,613).

3. Program Requirements (Reimbursable). There has been a net increase to the appropriation of $53,008, as a result of changes in reimbursable program requirements.

Comparison of FY 1998 Program Requirements as reflected in the FY 1999 Budget with FY 1998 Program Requirements as shown in the FY 2000 Budget

Summary of Requirements ($ in Thousands)

	Total Program Requirements per FY 1999 Budget	Total Program Requirements per FY 2000 Budget	Increase (+) or Decrease (-)
01 – Basic Research	338,743	331,444	-7,299
02 – Applied Research	493,622	467,359	-26,263
03 – Advanced Technology Development	514,781	518,617	+3,836
04 – Demonstration and Validation (DEM/VAL)	2,219,002	2,222,171	+3,169
05 – Engineering and Manufacturing Development (EMD)	2,227,348	2,153,289	-74,059
06 – RDTE Management Support	551,033	677,567	+126,534
07 – Operational Systems Development	1,535,383	1,517,363	-18,020
Total Fiscal Year Program	**7,879,912**	**7,887,810**	**+7,898**

Explanation by Budget Activity
($ in Thousands)

01. Basic Research (-$7,299) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$6,086) and other changes in program requirements which required minor reprogrammings (-$1,213).

02. Applied Research (-$26,263) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$8,125), other changes in program requirements which required minor reprogrammings (-$21,118) and the override by Congress of a line item veto for Terfenol-D (+$3,000).

03. Advanced Technology Development (+$3,836) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$3,897), other changes in program requirements which required minor reprogrammings (-$12,011), the override of a line item veto for COTS Airguns (+$3,000), and the transfer of Medical Research program funds to the Army (-$7,278).

04. Demonstration and Validation (DEM/VAL) (+$3,169) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$29,846), reductions reflected on the FY 1999 DoD Appropriations Act Rescission for VECTOR (-$3,000), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (+$36,015).

05. Engineering and Manufacturing Development (EMD) (-$74,059) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$56,113), transfers to support the Counterdrug Program (+$15,613), other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (-$26,019), a transfer to Defense Health Program and the Boy Scouts per a Congressional Supplemental (-$5,000) and Federal Technology (-$40), and a FY 1999 DoD Appropriation Act rescissions for Lightweight Torpedo (-$1,500) and Navigation/ID Systems (-$1,000).

06. RDTE Management Support (+$126,534) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (+$120,551), other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (+$5,747) and a transfer for Federal Technology (+$236).

07. Operational Systems Development (-$18,020) - Changes to this budget activity resulted from a transfer to support the Small Business Innovative Research (SBIR) program (-$16,484), other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (-$14,697), and transfers and major reprogrammings for Overseas Contingency Operations (+$7,500), PMRF Sensors (-$4,852), Tactical Tomahawk (+$19,600), Surface ASW Combat Integration (+$5,861), F/A-18 (-$14,855), and Federal Technology Transfer (-$93).

Comparison of FY 1999 Financing as reflected in FY 1999 Budget with 1999 Financing as Shown in the FY 2000 Budget

($ In Thousands)

	Financing per FY 1999 Budget	Financing Per FY 2000 Budget	Increase (+) or Decrease (-)
Program Requirements (Service Account)	8,108,923	8,660,809	+551,886
Program Requirements (Reimbursable)	110,000	150,000	+40,000
Appropriation (Adjusted)	**8,218,923**	**8,810,809**	**+591,886**

Explanation of Changes in Financing
($ in Thousands)

The Fiscal Year 1999 program has changed since the presentation of the FY 2000 budget as noted below:

1. Program Requirements (Total). There has been a net increase to the appropriation (adjusted) of +$591,886, as a result of changes in program requirements as noted below.

2. Program Requirements (Service Account). There has been a net increase to the appropriation (adjusted) of +$551,886, resulting from changes in program requirements as a result of Congressional appropriation changes in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$4,264)(Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$50,000)(Section 8054), a general reduction for revised economic assumptions (lower inflation rate)(-$20,000)(Section 8108), and a general undistributed reduction for civilian personnel underexecution (-$5,000). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 177 specific initiatives, including transfers) resulted in a net increase of +$584,726. Also, appropriation changes include the following reprogrammings, which require Congressional prior approval: ASW & Other Helo Development (CH-60) (+$9,352); Surface and Shallow Water Mines (+$8,980); Combat Systems Integration (+$12,526); Ship Self Defense (+12,672); partially financed by a reduction to Depot Maintenance (-$11,006). Additionally, FY 1999 includes a transfer for the USACOM Joint Experiments program (+$15,900), managed by the Navy as DoD executive agent.

3. Program Requirements (Reimbursable). There has been a net increase to the appropriation of +$40,000, as a result of changes in reimbursable program requirements (+$40,000).

Comparison of FY 1999 Program Requirements as reflected in the FY 1999 Budget with FY 1999 Program Requirements as shown in the FY 2000 Budget

Summary of Requirements ($ in Thousands)

	Total Program Requirements per FY 1999 Budget	Total Program Requirements per FY 2000 Budget	Increase (+) or Decrease (-)
01 – Basic Research	362,679	361,499	-1,180
02 – Applied Research	524,723	566,801	+42,078
03 – Advanced Technology Development	460,725	593,176	+132,451
04 – Demonstration and Validation (DEM/VAL)	2,358,359	2,408,520	+50,161
05 – Engineering and Manufacturing Development (EMD)	2,063,281	2,199,737	+136,456
06 – RDTE Management Support	616,973	598,664	-18,309
07 – Operational Systems Development	1,722,183	1,932,412	+210,229
Total Fiscal Year Program	**8,108,923**	**8,660,809**	**+551,886**

Explanation by Budget Activity
($ in Thousands)

01. Basic Research (-$1,180) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$7)(Section 8034), an undistributed reduction for civilian personnel underexecution (-$338), and a general reduction for revised economic assumptions (lower inflation rate)(-$835)(Section 8108).

02. Applied Research (+$42,078) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$130)(Section 8034), an undistributed

reduction for Contract Advisory and Assistance Services (CAAS)(-$1,755)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$724), and a general reduction for revised economic assumptions (lower inflation rate)(-$1,313)(Section 8108). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 31 specific initiatives, including transfers) resulted in a net increase of +$46,000.

03. Advanced Technology Development (+$132,451) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$146)(Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$1,571)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$516), and a general reduction for revised economic assumptions (lower inflation rate)(-$1,316)(Section 8108). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 33 specific initiatives, including transfers) resulted in a net increase of +$113,100. Additionally, FY 1999 includes a transfer for the USACOM Joint Experiments program (+$15,900), managed by the Navy as DoD executive agent. Last, the FY 1999 program is increased by +$7,000 to fully fund the VECTOR program.

04. Demonstration and Validation (DEM/VAL) (+$50,161) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$1,228)(Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$5,650)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$1,234), and a general reduction for revised economic assumptions (lower inflation rate)(-$5,550)(Section 8108). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 46 specific initiatives, including transfers) resulted in a net increase of +$55,101. Also, appropriation changes include the following reprogrammings, which require Congressional prior approval: Surface and Shallow Water Mines (+$8,980); Combat Systems Integration (+$12,526); and CEC (+15,000); partially financed by a reduction to Gun Weapons Systems Technology (-$11,301) and Hardened Target Munitions (-$9,827). Additionally, changes in program requirements required minor reprogrammings (-$6,656).

05. Engineering and Manufacturing Development (EMD) (+$136,456) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$151) (Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$23,648)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$878) and a general reduction for revised economic assumptions (lower inflation rate) (-$5,065)(Section 8108). Specific FY 1999 Congressional adjustments (to

start, continue, discontinue, reduce or earmark 41 specific initiatives, including transfers) resulted in a net increase of +$136,979. Also, appropriation changes include the following reprogrammings, which require Congressional prior approval: AEGIS Combat System Improvements (-$5,050); AEGIS Combat Systems Engineering (+$24,300); AV-8B Aircraft (Engineering) (-$9,615); ASW and Other Helo Developments (+$9,352); and Ship Self-Defense (+$12,672). Additionally, changes in program requirements required minor reprogrammings (-$1,440).

06. RDTE Management Support (-$18,309) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$2,292)(Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$3,338)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$485) and a general reduction for revised economic assumptions (lower inflation rate)(-$1,394)(Section 8108). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 10 specific initiatives, including transfers) resulted in a net decrease of -$10,800.

07. Operational Systems Development (+$210,229) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1999 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$310)(Section 8034), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-$14,038)(Section 8054), an undistributed reduction for civilian personnel underexecution (-$825) and a general reduction for revised economic assumptions (lower inflation rate)(-$4,527)(Section 8108). Specific FY 1999 Congressional adjustments (to start, continue, discontinue, reduce or earmark 27 specific initiatives, including transfers) resulted in a net increase of +$243,346. Also, appropriation changes include the following reprogrammings, which require Congressional prior approval: Depot Maintenance -$10,922. Additionally, changes in program requirements required minor reprogrammings (-$2,495).

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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	531	586	786	821	1,002	1,038	1,242	1,274	CONT.	CONT.
Advanced Materials	1,725	1,760	2,202	2,300	2,504	2,595	2,838	2,911	CONT.	CONT.
Information Sciences	1,061	1,173	1,886	2,301	2,672	3,115	3,550	3,640	CONT.	CONT.
Sustaining Programs	9,951	11,144	10,756	10,999	10,519	10,553	10,113	10,373	CONT.	CONT.
TOTAL	13,268	14,663	15,630	16,421	16,697	17,301	17,743	18,198		

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the missions of the Naval Warfare Centers, Naval Personnel Research and Development Center (NPRDC), and Bureau of Medicine and Surgery (BUMED) with high-risk/high-payoff research, responding as shown below to the Department of the Navy (DON) Joint Mission Areas/Support Areas (JMA/SA) and enabling the technologies that could significantly improve Joint Chiefs of Staff's Future Joint Warfighting Capabilities. The research addresses fundamental questions regarding existing and anticipated naval systems, and is supported within the Office of Naval Research (ONR) by thrusts in Ocean Sciences, Advanced Materials, Information Sciences, and its Sustaining Programs. This program reflects the integration of efforts both within Warfare Centers, NPRDC, BUMED, and among other research performers. Research efforts are proposed and selected by the Warfare Centers, NPRDC, and BUMED, and reviewed after the fact for the quality of science produced and for relevance to the naval mission.

(U) This program responds to the Littoral Warfare JMA through ocean sciences research into the variability of the marine environment, such as acoustic shallow water (SW) models that incorporate wave-breaking sources, allowing superior signal

processing in SW environments. Research advancing fundamental understanding of DON-essential materials and processes responds to operational capability requirements in the Strategic Mobility JMA, such as the recent development of an aluminum based, metal-matrix, high-temperature superconducting material that can be extruded into wires for significantly improved naval electrical power systems. The program responds to the Intelligence, Surveillance, Reconnaissance JMA through thrusts in information sciences that address naval-relevant computing applications including software engineering, high performance computing, artificial intelligence, and the use of computers in manufacturing. For example, the development of an advanced signal processing technique for the analysis of real Anti-Submarine Warfare (ASW) broadband acoustic data provides detection performance, which exceeds the conventional energy detector in high noise ASW applications. Research in other areas supports requirements of the Readiness JMA, such as discovering redox chemicals for use in "smart" coatings, which alter color when degraded and serve as early warning systems for corrosion of naval systems.

(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) The DoN Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

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

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($531) Ocean Sciences responded to the Littoral Warfare JMA in the undersea battlespace dominance area by studying techniques for the near optimum detection of unknown signals and fluid-elastic interface modeling, both of which enhanced sonar performance in shallow water.

- (U) ($1,725) Advanced Materials responded to the Littoral Warfare JMA in the undersea battlespace dominance area by molecular modeling of new sonar transducer materials and the use of tessellation theory to design efficient multi-element transducers.
- (U) ($1,061) Information Sciences responded to the Littoral Warfare JMA by formulating new concepts and algorithms to fuse data collected from multiple sensor platforms deployed in the shallow water environment for the purpose of environmental mapping and classification/identification of bottom targets.
- (U) ($9,951) Sustaining Programs responded to the Strategic Mobility JMA, the Command, Control, Communications JMA, and Strike JMA by investigating: (1) drag reducing hull forms; (2) improved maneuvering performance of ships and subs in littoral waters; (3) new types of opto-electrical components for use in communications systems; (4) enhanced capabilities in computational fluid dynamics for the improved efficiency, maintainability, and reliability of naval propulsors and turbomachinery, and contributing to the detection of wake signatures. Sustaining Programs also responded to the readiness JMA with research into training methods and materials and into disease prevention and casualty care.

2. (U) FY 1999 PLAN:

- (U) ($586) Ocean Sciences will respond to the Littoral Warfare JMA by investigating physical mechanisms for deposition of high energy acoustic or seismic pulses on elastic objects deployed on or in the bottom of a shallow water ocean environment.
- (U) ($1,760) Advanced Materials will respond to the Strike and Littoral Warfare JMAs by studying energetic materials using nanosize fuels and high heat of reaction intermetallic ingredients to enhance warhead performance; by synthesizing high performance, insensitive explosive ingredients (based on principles of molecular charge delocalization and graphitic-like crystal structures) for penetrator applications; by studying the dynamic shock wave properties of warhead materials to support the modeling and design of warheads; and by developing equations of state and reaction rate models for use in hydrodynamic code modeling of warheads.
- (U) ($1,173) Information Sciences statistical analyses will reduce the complexities of signals and of the algorithms for signal processing to advance the capability for electronic warfare and electronic countermeasures in Strike and Intelligence, Surveillance, and Reconnaissance JMA, with enhanced detection probability and diminished tracking time in cluttered environments and in the presence of false targets.

- (U) ($11,144) Sustaining Programs will respond to the Strike and Command, Control, Communications, Computers and Information Warfare JMAs by investigating the three-dimensional effects of loss mechanisms in non-ideal, thin-film, integrated waveguide structures for opto-electronic applications, and will respond to the readiness JMA with research focused on the medical areas of Aviation Medicine, Diving and Submarine Medicine, Toxicology, Human Performance, Infectious Disease, and Combat Casualty Care.

3. (U) FY 2000 PLAN:

- (U) ($786) Ocean Sciences will respond to the Littoral JMA, to the Air and Sea Superiority JMA, and to the Strike JMA by investigating acoustical propagation with application in mine countermeasures, underwater acoustic communications, and underwater target detection.
- (U) ($2,202) Advanced Materials will respond to: (1) The Readiness JMA by investigating material corrosion reduction and coatings; (2) the Strike JMA and the Sea and Air Superiority JMA by investigating energetic materials; (3) the Strike JMA, the Littoral JMA, and the Strategic Sealift JMA through research into new types of structural and electronic materials.
- (U) ($1,886) Information Sciences will respond to the Joint Surveillance JMA, the Strike JMA, the Littoral JMA, the Sea and Air Superiority JMA, and the EW JMA through research into network controls and security, displays, and advanced methods in digital signal processing.
- (U) ($10,756) Sustaining Programs will respond to the EW JMA through research into: (1) the electromagnetic response of materials, and (2) sensors. It will respond to the Strategic Mobility JMA through research into ways to improve the protection of the assets by improved defensive warheads. It will respond to the readiness JMA with medical research in the areas of Aviation Medicine, Diving and Submarine Medicine, Toxicology, Human Performance, Infectious Disease, and Combat Casualty Care.

B. (U) PROGRAM CHANGE SUMMARY:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	14,248	14,734	15,680
(U) Appropriated Value:		14,734	0
(U) Adjustments from FY 2000 PRESBUDG:	-980	-71	-50
(U) FY 2000 PRESBUDG Submission:	13,268	14,663	15,630

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect Actual Update adjustments (-$980). FY 1999 adjustments reflect Congressional Undistributed Reductions (-$71). FY 2000 adjustments reflect Navy Working Capital Fund (NWCF) rate adjustment (+$125); Non Pay Inflation adjustment (-$227); Civilian Pay Rates adjustment (+$110); and Minor adjustment (-$58).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:

(U) PE 0601101A (In-House Laboratory Independent Research)
(U) PE 0601101F (In-House Laboratory Independent Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602111N (Air and Surface Launched Weapons Technology)
(U) PE 0602234N (Materials, Electronic & Computer Technology)
(U) PE 0602314N (Undersea Surveillance and Weapons Technology)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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	126,061	138,576	144,282	149,851	150,747	153,662	157,168	160,788	CONT.	CONT.
Advanced Materials	54,655	59,881	62,875	66,019	67,009	68,349	69,716	71,110	CONT.	CONT.
Information Sciences	40,194	45,100	47,355	49,723	50,469	51,983	53,542	55,148	CONT.	CONT.
Sustaining Programs	97,266	103,279	106,606	109,463	109,073	110,599	112,943	115,384	CONT.	CONT.
TOTAL	318,176	346,836	361,118	375,056	377,298	384,593	393,369	402,430	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) Joint Mission Areas/Joint Support Areas (JMA/SA) 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.

(U) This program responds to the Strike JMA 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; and physics and chemistry foundations for improved multispectral, all-weather

sensors and electronics. Responses to the Innovation in Naval Warfare/Engagement and Littoral Warfare JMAs, which cover forward operations in high-threat coastal regions, 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; novel structural materials for better ship damage tolerance; data fusion research to integrate environmental prediction products into Command, Control, Communications, Computers & Information Warfare (C4/IW) systems; and new concepts in batteries and propellants for improved torpedo performance. The program responds to requirements in the Intelligence/Surveillance/Reconnaissance JMA with research into 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 Nuclear Deterrence Counterproliferation of Weapons of Mass Destruction (NDC/WMD) JMA. Research in response to the Readiness and Support/Infrastructure SAs 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 and Training SAs.

(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.

(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.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

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

(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.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 ACCOMPLISHMENTS:

- (U) ($126,061) Ocean Sciences responded to Littoral Warfare requirements by undertaking experiments to identify and understand processes unique to marginal and semi-enclosed seas (e.g., Red Sea, Mediterranean, Okhsotsk, and Persian Gulf) to support higher resolution environmental nowcasts/forecasts, improved mine drift prediction, and improved acoustic/nonacoustic antisubmarine warfare environmental information; and by continuing development of advanced models coupled to remote sensor observations for higher resolution, improved coastal waves prediction.
- (U) ($54,655) Advanced Materials responded to Innovation in Naval Warfare/Engagement requirements through investigations into improved materials for airframes and radomes; and to requirements for Support/Infrastructure SA through exploration of thermal spray nanoscale coatings for wear, corrosion, and thermal barrier applications. Reflects Congressional plus-up for Molecular Design Institute ($8M).
- (U) ($40,194) Information Sciences responded to Strike requirements through investigation of H-Infinity waves leading to improved computational models for increased efficiency of shipboard electromagnetics (EM) design, increased efficiency of shipboard EM systems, and reduction/control of ship's EM signature. It responded to Strategic Mobility through development of mathematical and computational tools for analysis, estimation, and prediction of oceanographic and meterological environmental conditions on the regional scale.
- (U) ($97,266) Sustaining Programs responded to Strike requirements by investigating techniques for radio frequency (RF) clutter suppression for ship defense and missile seekers, and multi-spectral sensors/data fusion in support of avionics and weapons. They responded to C4/IW requirements through exploring potentially simpler and more robust spin-injected electron devices for: magnetic sensors and magneto-optics; non-volatile memory for satellites, missiles, and mobile communication units; high-speed, low-power switches; low-power digital electronics such as memory elements; and phased-array radar antenna elements.

(U) FY 1999 PLAN:

- (U) ($138,576) Ocean Sciences will respond to Intelligence/Surveillance/Reconnaissance requirements through investigating predictability in the ocean and atmosphere, examining sensitivities to initial and boundary conditions in order to develop improved strategies for targeting observations from deployable sensor systems; and to Strike requirements through continuing biodynamic sensing/processing effort using signals from two precisely located sensors to improve detection/classification/localization of submarines with low/no Doppler effects.
- (U) ($59,881) Advanced Materials will respond to Support/Infrastructure SA requirements through new understanding of affordable composite technology for naval structures gained from exploration of methods to characterize composites for their use in various designs; and through sub-grid modeling to characterize small scale structural phenomena leading to new material properties. It will respond to Strike requirements through continued studies of improved energetic materials to achieve higher lethality with reduced weight.
- (U) ($45,100) Information Sciences will respond to Strike requirements by exploring adaptive non-linear control for integrated flight propulsion avionics, and to Support/Infrastructure SA requirements by investigating the applications of chaos theory to nonlinear control of cranes, and tools for adaptive intelligent systems, such as autonomous agents and unmanned vehicles.
- (U) ($97,497) Sustaining Programs will respond to Support/Infrastructure requirements through hybrid modeling analysis of genetic logic to yield control of shipboard processes, including bioreactors/biomaterials and (responding also to NDC/WMD requirements) rapid, rational identification of molecular targets for therapeutic interventions against old and new chemical biological defense (CBD) agents.
- (U) ($5,782) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

(U) FY 2000 PLAN:

- (U) ($144,282) Ocean Sciences will respond to Littoral Warfare 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 & Air Superiority requirements by exploring in-situ measurement and sonar adaptation to specific environments for significantly improved 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) ($62,875) Advanced Materials will respond to Sea & Air Superiority requirements by developing low signature materials for autonomous robotic systems supporting Naval Special Warfare and Explosive Ordnance Disposal, and unique biomaterials for improved infrared (IR)/acoustic sensors. It will respond to C4/IW through advanced lithography, wide bandgap heterojunctions, and large area, wide bandgap materials for multifunctional wide bandwidth systems with high linearity, efficiency and power.
- (U) ($47,355) Information Sciences will respond to Intelligence/Surveillance/Reconnaissance 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 Support/Infrastructure SA requirements by research on virtual sensors and battery charger analyzer for improved maintenance, diagnostics and testing of naval machinery.
- (U) ($106,606) Sustaining Programs will respond to Sea & Air Superiority 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 Strike requirements by exploring new concepts for torpedo silencing, and by designing high power thermal systems for half-length and supercavitating weapons propulsion.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	324,495	347,945	364,159
Appropriated Value		347,945	
Adjustments from FY 1999 PRESBUDG	-6,319	-1,109	-3,041
FY 2000 President's Budget Submission	318,176	346,836	361,118

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect a Small Business Innovative Research reduction (-$6,086), Federal Technology Transfer (-$22), and an Actual Update Adjustment (-$211). FY 1999 adjustments reflect Revised Economic Assumptions (-$801), Civilian Personnel Underexecution (-$301), and FFRDC distribution (-$7). FY 2000 adjustments reflect a Program Balance Adjustment (-$1,348), a Civilian Pay Rate Adjustment (+$876), a Diesel Fuel Adjustment (-$5), Non Pay Inflation (-$5,220), and Navy Working Capital Fund Rate adjustment (+2,656).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:

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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) PE 0601102F Defense Research Sciences (Air Force)
(U) PE 0601152N In-House Laboratory Independent Research
(U) PE 0602111N Air and Surface Launched Weapons Technology
(U) PE 0602121N Ship, Submarine and Logistics Technology
(U) PE 0602122N Aircraft Technology
(U) PE 0602234N Materials, Electronics and Computer Technology
(U) PE 0602314N Undersea Warfare Surveillance Technology
(U) PE 0603207N Air/Ocean Tactical Applications
(U) PE 0603785N Combat Systems Oceanographic Performance Assessment

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
Air & Surface Launched Weapons Technology	22,886	40,823	37,616	39,572	39,959	40,565	41,541	42,549	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (P.E.) develops new and innovative technologies which will support future weapons systems for surface and air platforms for Naval Warfare.

(U) The Air and Surface Weapons Technology (ASWT) program has been developed to implement a structured weapons technology program that will maintain the Naval air and surface weapons capability through the 21st century. The ASWT program provides technology traceability by identifying System payoffs and warfighter benefits and the quantitative goals that will provide those payoffs/benefits. Objectives, technical challenges, and approaches that will meet the goals are then identified for each of the four mission areas. The following paragraphs describe the time phased technology goals for each of the four mission areas.

(U) Air Superiority: The projects within the ASWT Air Superiority mission area are focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame, which will reproduce a number of technology options for future air superiority weapons, significantly increase pilot survivability by allowing them to look first, shoot first, and kill first, while increasing air superiority weapon affordability. The 2005, 2010, and 2015 technology goals, which have been coordinated with N88, are to increase missile flyout range 25%, 50%, and 100%; increase missile average velocity 10%, 20%, and 30%; increase missile maneuverability 45%, 65%, and 85%; increase weapon launch angle 20%, 40%, and 60%, increase missile seeker acquisition range 100%, 250%, and 300%; increase seeker off boresight angle 135 degrees and 180 degrees; increase seeker probability of detect 10%, 20%, and 30%; decrease missile payload size 20%, 30% and 50%; and increase warhead control accuracy to centroid, image centroid, and edge detect. All improvements are relative to the

AIM-9x and AIM-120C system. Work being performed under the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) is supporting the achievement of the flyout range, average velocity, maneuverability, and weapon launch angle goals. As with the IHPRPT program, the ASWT program is an integrated Navy/industry program, comprised of government funded and industry funded projects. For FY 99 through FY04, the emphasis will be on the achievement of the Phase 1 goals. The technologies developed under this task will be transitioned to the Phase 1 air superiority demonstrator, which is funded under PE0603217N, R0447. After successful demonstration, these technologies are available for air superiority or ship-based defense weapon system demonstration/validation or Engineering and Manufacturing Development (EMD).

(U) Naval Surface Fire Support: The projects within the ASWT Naval Surface Fire Support mission area are focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce a number of technology options for future naval fire support weaponry, significantly improving the probability of kill per round as well as the amount of sustained call fire while increasing the affordability of future naval fire weapon systems. The 2005, 2010, and 2015 goals, which have been coordinated with N86, are increase gun launched projectile flyout range to 70 nmi, 150 nmi, and 200 nmi; increased missile flyout range to 150 nmi, 250 nmi, and 350 nmi; achieve gun projectile flyout times for the range goals of 6 minutes or less, 14 minutes or less, and 10 minutes or less; achieve missile flyout times for the range goals of 5 minutes, 4 minutes, and 4 minutes; increase target aimpoint accuracy to 10m, 1m, and 1m for moving targets; increase payload density to 15%, 30%, and 45%; decrease rounds per kill to 3, 1.2(stationary target), and 1.2 (hard target); and develop improved warheads that can: deliver a variety of submunitions, operate in a dual or multifunction mode and, utilize high energy reactive materials for greater effectiveness. All these goals are relative to 1995 state-of-the-art. The projectile range and time of flight goals are being supported in part by the IHPRPT program. The emphasis of the FY99-FY04 program will be on the achievement of the Phase 1 (2005) goals. Technologies developed to support this phase will be transitioned to the phase 1 Land Attack demonstrator, funded by P.E. 0603217N, R0447. Upon successful demonstration, these technologies are available for Naval Fire Support or Land Attack weapon system demonstration/validation or EMD. As with the IHPRPT program, the ASWT program in an integrated Navy/industry program with tasks being funded and performed by government and industry.

(U) Precision Strike: The ASWT Precision Strike program is focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce technology options to allow the warfighter to successfully engage time critical targets, improve weapon and platform survivability, significantly increase weapon hard target capability, and significantly increase single shot probability of kill while increasing the

affordability of future precision strike weapon systems. The 2005, 2010, and 2015 goals, which have been **coordinated** with N88, are to decrease target location error to 8m, 1m, and 1m; increase target/weapon pairing rate to 20/hr, 100/hr, and 500/hr; decrease mission planning and optimization time to less than 5 minutes, then to less than 1 minute; increase weapon based Automatic Target Recognition (ATR) capability to greater than 90% acquisition in limited clutter, greater than 90% acquisition in moderate clutter, and greater than 60% acquisition in heavy clutter; increase average weapon velocity to M4, M6, and M8; increase weapon flyout range 30%, 50%, and 100%; increase hard target penetration by 5x and 7x; and increase seeker Global Positioning System (GPS) antijam capability to +10db, +20db, and +30db. All goals are relative to 1995 state of the art. The weapon velocity and range goals are partially supported by the projects within the IHPRPT program. The emphasis of the FY99-FY04 projects are to achieve the Phase 1 goals. The technologies developed by the funded projects will be transitioned to the Land Attack demonstrator, funded by P.E. 0603217N, R0447. Upon successful demonstration, these technologies will be available for Precision Strike or Land Attack weapon system demonstration/validation or EMD. As with IHPRPT, the ASWT program is an integrated Navy/industry program with work being funded and performed by the government and industry.

(U) Ship Based Defense: The ASWT Ship-Based Defense program is focused on the achievement of time-phased technology goals for the 2005, 2010, and 2015 time frame. The achievement of these goals will produce technology options to significantly increase the effectiveness and affordability of future ship-based defense weapon systems. The 2005, 2010, 2015 goals, which have been coordinated with N86, are to increase the number of engagements per threat to 2-3, 6-7, and 6-7; increase the available command decision time to 15 sec, and 15 seconds in adverse conditions; increase the probability of catastrophic kill per intercept to 0.6, 0.8, and 0.95; increase the total number of targets simultaneously engagable to 2-4, 4-6, and 6-8; and increase maneuver counter capability to 15gs, 30gs, and 50gs. All goals are relative to 1995 state of the art. The emphasis of the FY99-FY04 projects are on the Phase 1 goals. The technologies developed to achieve these goals will be transitioned to a ship-based defense technology demonstrator, funded by P.E. 0603127N, R0447. Upon successful demonstration, these technologies will be available for Ship-Based Defense or Air Superiority demonstration/ validation or EMD. The ASWT program is an integrated Navy/industry program with projects being funded and performed by government and industry.

(U) Integrated High Payoff Rocket Propulsion Technology (IHPRPT): The projects within the IHPRPT program are focused on the achievement of time-phased technology goals for the 2000, 2005, and 2010 time frame, which will produce a number of rocket propulsion technology options to significantly increase the effectiveness of air superiority, naval fire support,

and precision strike weapon systems by increasing missile range 50%; increasing missile speed 20%, which results in shorter time to target, increased opportunity for shoot-look-shoot, allowing earlier disengagement of launch platforms, and allowing greater energy for maneuvering; increasing missile payload by 100%, decreasing propulsion size and weight by 25%, and doubling the missile no-escape zone and launch acceptability regions . The 2000, 2005, and 2010 goals, which have been coordinated with N86 and N88, and endorsed by DDR&E, are to improve the propulsion system delivered energy by 3%, 7% and 15%; improving motor mass fraction (without thrust vector control (TVC)/throttling) 2%, 5%, 10%; and improving motor mass fraction (with TVC/throttling) 10%, 20%, and 30%. IHPRPT is an integrated Department of Defense (DoD)/National Aeronautics and Space Administration (NASA)/Industry program with projects being funded and performed by government and industry.

(U) Due to the sheer volume of efforts involved in this P.E., the efforts described in the accomplishments and plans section are representative selections of the work included in this P.E..

(U) These efforts support the Joint Warfare Strategy "Forward...from the Sea". Programs in this P.E. are jointly planned in the Defense Reliance process with the Air Force and Army.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific naval problems, short of a major development effort.

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

PROGRAM ACCOMPLISHMENTS AND PLANS:

1. FY 1998 ACCOMPLISHMENTS:

- (U) (5,280) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE: The efforts in Ship Based Defense will develop weapons technologies to achieve minimum and maximum intercept ranges of 100 meters to 3 nmi, decreased reaction time of 10 seconds and increased probability of robust kills of 0.3 and 0.6.
  - (U) Initiated:
    -- (U) Testing and measurements for low altitude propagation by remote sensors for sensor adaptation.
    -- (U) Low altitude fuze technology assessment using a high power short pulse laser Target Detection Device (TDD) for improved performance in low visibility aerosol and smoke conditions.
  - (U) Continued:
    -- (U) Ram Accelerator technology development experiments at high fill (50 Atm) pressure.
  - (U) Completed:
    -- (U) Infrared Focal Plan Array (IRFPA) test bed tracker effort by field testing tracker and by successfully demonstrating non-uniformity signal processing compensation technique. Submitted and under review by Naval Sea Systems Command (NAVSEA) for potential transition to Electro Optic (EO) track AN/SWY-1 Thermal Imagery Sensor Systems (TISS) and MK-46 EO site. Proposed as an EO tracker for Theater Ballistic Missile Defense (TBMD) application.
    -- (U) Conformal aperture antenna characterization to be used for wideband and conformal seeker technology prototype.
    -- (U) Reactive Material air target warhead technology development. Transitioned **technology** to 6.3 Reactive Materials ATD.

- (U) ($2,210) AIR SUPERIORITY:
  - (U) Initiated:
    -- (U) Joint technology development effort with the Air Force for next generation air to air missile capabilities. Navy efforts include high-pressure rocket motor and Infrared (IR) seeker performance improvements.
  - (U) Continued:

-- (U) Radio Frequency (RF) Guidance-integrated Fuse (GIF) high range resolution lethality improvement assessment.
-- (U) Development of insensitive, high performance solid rocket propulsion components from screening of emerging energetic materials, scale-up and propellant formulation, through characterization of subscale performance.
-- (U) Propellant formulation investigations started in FY96 with Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Congressional plus-up funding and expanded ingredients base to include CL-20 and poly gamma Cyclodectrin Nitrate (CDN).
-- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of Advanced Medium Range Air to Air Missile (AMRAAM) warhead. Prioritize recommendations among the fireset, reactive materials and explosive kills provided.

- (U) Completed:
  -- (U) Diamond dome strength improvements and polishing efforts.
  -- (U) Aerodynamic advanced prediction code development for applications including non-axisymetric body configurations, nonlinear modes and core aeroprediction studies. Transition to Aero Prediction (AP)-98 aero codes for use by industry and government.

• (U) ($2,180) IHPRPT:
- (U) Initiated:
  -- (U) Award on-command pintle thrust magnitude control contract that helps achieve the Phase II goals of delivered energy and mass fraction.
  -- (U) Award low erosion nozzle material contract that investigates nozzle insert materials to meet Phase II delivered energy and improved mass fraction goals.
  -- (U) Award dual-movable nozzle throat vector control concepts to meet Phase II mass fraction with TVC/throttling goals.
- (U) Continued:
  -- (U) Develop plateau propellant ingredient test matrix to determine most appropriate ingredients for air-launched missiles and develop candidate propellant formulations.

-- (U) Develop ammonium dinitramide (ADN) propellant formulation test matrix to determine optimal formulation for highest delivered energy and processability to meet Phase II IHPRPT delivered energy goals.
-- (U) Develop aluminum hydride test matrix to determine optimal formulations for highest delivered energy and processability to meet IHPRPT Phase II delivered energy goals.
-- (U) Slow cook-off methodology task to develop a consistent methodology to determine the insensitive munition compliance of the develop IHPRPT Phase II and Phase III propellants.
-- (U) Hydrostatic testing of gun-launched projectile propellant grains and case design to meet IHPRPT Phase II mass fraction goals.

- (U) Completed:
-- (U) Demonstrate Innovative Vector (INOVEC) flexible nozzle TVC concept, preparing the component for possible Phase I air-launched motor demonstrator, showing achievement of the Phase improved mass fraction goal of 10%.
-- (U) Documentation for the combustion instability task, which provides the data for understanding of designing high-pressure solid propulsion motor which achieve the IHPRPT delivered energy performance goals.

• (U) ($7,290) STRIKE AND ANTI SURFACE WARFARE (ASUW) WEAPONRY:

- (U) Initiated:
-- (U) Precision Target Handoff task to demonstrate precision target coordinate handoff for both airborne direct fire control and tactical standoff weapons including unguided and Global Positioning System (GPS)/Inertial Navigation System (INS) weapons.
-- (U) Automatic Target Recognition (ATR) performance prediction task to develop a predictive capability for imaging seeker-based ATR systems.
-- (U) Investigate and develop a low cost Millimeter Wave (MMW) antenna element using Micro Electronic Machine System (MEMS) technology that will provide a less expensive seeker with higher angular resolution using MMW radar.
-- (U) Investigate advanced wavelet-based signal processing techniques to reject GPS jammers.

- (U) Continued:

-- (U) Assessment of optimized lifting body airframe technology for air launched supersonic strike weapon applications. Will investigate lightweight, low cost structural design concepts using composite materials and low cost/low temperature materials for high temperature applications.
-- (U) Laser Radar (Ladar) performance model development to identify optimal performance in mobile target engagements under a variety of background conditions.
-- (U) Tuned ATR extraction and registered data base that provides a feature set and algorithms for engaging the target using Ladar imagery within the constraints of operation (e.g. clutter, weather etc).
-- (U) Technology development in ATR/signal processing to include bio-vision techniques
-- (U) Fuzzy ATR characterization to develop Ladar seeker ATR algorithms that improve uncertainty management using fuzzy logic subprocesses. Improved noise cleaning using a context dependent filter for processing range anomalies.

- (U) Completed:
-- (U) Parallel distributed processing techniques for routing and mission planning applications with transition to P.E. 0603217N, for captive flight test evaluations.
-- (U) Techniques for Land Attack Bomb Damage Indication (LABDI) and classification developed for high resolution Synthetic Aperture Radar (SAR) imagery. Under review by Joint Surveillance Target Attack RADAR System (JSTARS), S3, and P3 programs for potential implementation. Created a DoD unique SAR Bomb Damage Indication (BDI) database of 10,000+ images that is to be delivered to multiple DoD locations.
-- (U) In cockpit target scene predictor algorithm developed and reported in North Atlantic Treaty Organization (NATO) RSG-9 compendium of fuzed sensor activities.

• (U) ($5,926) Naval Surface Fire Support (NSFS): The efforts in NSFS will develop the weapons technologies to achieve the following goals: Probability of detection (Pd)=0.9, the Probability of decoy rejection (Pdr)=0.9, Lethality (rounds/kill)= 3/mobility kill, Warhead flexibility = Lethality submunitions, and <2 min sensor to weapon and fire control timeline.

- (U) Continued:

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

-- (U) Electro Optic/Infrared and Quasi optical gun launched seeker to improve terminal guidance of projectiles and submunitions to place more ordnance on target and require less rounds for a target kill. Complete first order optimal designs and raydomes and initial output algorithms.
-- (U) Weapons modeling and simulation to provide tools for design of NSFS systems include Computational Fluid Dynamics (CFD) for vertical launchers and aeroprediction codes. Complete assessment of mid-body obdurator.
-- (U) Develop Mission Responsive Ordnance (MRO) technologies to enable a single ordnance package to produce a variety of kill effects to better match weapons against different target configurations. Complete evaluation of gun launched submunition designs.
-- (U) Investigate Image Video Analysis for near real time integrated ability to detect, track, classify, and precisely locate targets with image and video to increase targeting accuracy and provide a reduced response time for targeting. Finish architecture of demo processor.
-- (U) Hyperspectral decoy recognition to develop technology for low cost staring hyperspectral sensor to reject sophisticated land based decoys when viewed by air platforms such as Unmanned Air Vehicle (UAVs). Complete performance assessment of low cost hyperspectral sensor in laboratory.
-- (U) Precision targeting using GPS/IMU for altitude to provide 10m Target Location Error (TLE), providing required targeting accuracy required by Extended Range Guided Munition (ERGM), Best Buy, and other fire-on-coordinates weapons. Complete evaluation of effectiveness of GPS/IMU kinematic techniques on breadboard.
-- (U) Interferometric Synthetic Aperture Radar (IFSAR) to demonstrate and validate techniques for processing multipath IFSAR into digital elevation maps (DEMS) with techniques to control DEMS to GPS. These efforts will attempt to reduce the cost per kill through improved aimpoint accuracy as well as supporting mission planning and Bomb Damage Analysis (BDA). Evaluate precision of satellite denied DEMs relative to ground truth data from Germany.

2. FY 1999 PLAN:

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) ($7,865) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE: The efforts in Ship Based Defense will develop weapons technologies to achieve minimum and maximum intercept ranges of 100 meters to 3 nmi, to reduce reaction time to 10 seconds, and to increase the probability of robust kills of 0.3 and 0.6.
  - (U) Initiate:
    - (U) Assessment of low cost seeker components in the MMW spectral region.
    - (U) Lethality assessments for high-energy lasers applied to ship self-defense.
    - (U) Conformal aperture seeker technology assessment for wideband terminal homing on low altitude threats.
    - (U) Surface launched propulsion investigations for increasing missile average velocity.
  - (U) Continue:
    - (U) Assessment of low altitude propagation and major demonstrations supporting interactive adaptation of radar sensors. Document technical results and conclusions from FY98 experiments
    - (U) Low altitude fuze technology assessment using a high power short pulse laser TDD for improved performance in low visibility aerosol and smoke conditions. Document FY98 technical assessment, select technologies for further investigation.
    - (U) Reactive materials warhead lethality investigation by testing baseline warhead design and conducting gas gun tests to facilitate development of shock induced reaction models, evaluate new lethal mechanisms, and improve predictive tools.
    - (U) Testing of infrared clutter suppression techniques for low altitude tracking.
  - (U) Complete:
    - (U) Demonstrate the terminal accuracy of a 60mm projectile attainable with low cost strapdown W-band seeker in a track-via-projectile mode.
    - (U) Ram Accelerator technology by conducting preliminary concept design studies for high-pressure gas management. Computational fluid dynamic modeling of in-bore high-pressure combustion processes. Documentation of results of experimental and computational high-pressure investigations.

- (U) ($4,377) AIR SUPERIORITY:
  - (U) Initiate:
    - (U) Development of weapon control and warhead burst methodologies for lethality refinements in cross geometry encounters.

-- (U) Establish objectives and candidate approaches to deal with emerging tuned decoy countermeasures.
-- (U) Precision intercept task to decrease payload size by 20% with equal or greater lethality. Evaluate functional allocation of lethality factors among the warhead fragments, timing, and missile kinematic subsystems.
-- (U) Seeker counter-counter measure (CCM) technology and IR seeker performance tasks to increase IR seeker performance by 100% over current state-of-the-art.

- (U) Continue:
-- (U) Development of high pressure rocket motor technology efforts begun in FY98 supporting the coordinated air-to-air missile technology investigations with the Air Force.
-- (U) RF GIF investigation by demonstrating algorithms to provide real time estimates of warhead firing commands under a range of high-speed air-to-air encounters.
-- (U) Quantify technology objectives and parameter matrix for clutter rejection in IR terminal seeker performance task.
-- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of AMRAAM warhead.

• (U) ($2,868) IHPRPT:
- (U) Initiate:
-- (U) Advanced Composite Case rocket motor task which will develop technologies to meet the Phase III mass fraction improvement goals

- (U) Continue:
-- (U) Develop test matrix and actuation system design trades for on-command pintle task.
-- (U) Conduct subsystem testing on dual movable nozzle task, preparing the components for a full scale motor firing in FY00
-- (U) Begin ballistic evaluation of candidate plateau propellant formulations.
-- (U) Begin ballistic evaluation of candidate aluminum hydride propellant formulations
-- (U) Continue ballistic and processing evaluation of ADN propellant formulation, preparing for large scale ballistic testing in FY00.

-- (U) Conduct subscale component gun-launch rocket case and propellant grain testing to determine optimal designs for high-g launches

- (U) Complete:
  -- (U) Testing of materials for low-erosion nozzle task complete. The results will be analyzed and documented.
  -- (U) Candidate nozzles will be fabricated for a Phase I improved delivered energy and improved mass fraction goals.
  -- (U) Validate slow cook-off engineering model, completing slow cook-off technology task.

• (U) ($11,384) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    -- (U) Thermal management technology development for high speed missiles
    -- (U) Development of weapon control and sensor approaches for high speed weapon configurations.
    -- (U) Preliminary investigation into the design of an autonomous attack and weaponeering capability for Uninhabited Combat Air Vehicles (UCAV).
    -- (U) Investigation and development of autonomous mission planning package for UCAV applications. Mission planning capability to include path planning, obstacle avoidance, and resource allocation.

  - (U) Continue:
    -- (U) ATR performance prediction task for imaging seeker-based ATR systems.
    -- (U) Development of a low cost MMW antenna element using MEMS technology using MMW radar.
    -- (U) Investigation of advanced wavelet-based signal processing techniques to reject GPS jammers.
    -- (U) Assessment of supersonic lifting body airframe technology with emphasis on high-speed propulsion/airframe integration issues.
    -- (U) Technology development in ATR signal processing to include bio-vision techniques.
    -- (U) Tuned ATR extraction and registered data base
    -- (U) Fuzzy ATR characterization to develop seeker ATR algorithms.
    -- (U) Assessment of low cost seeker components in the MMW spectral region.
  - (U) Complete:

-- (U) Portable Ladar performance model to identify optimum performance against mobile targets.
-- (U) Development of automatic target acquisition algorithms for standoff weapon seekers utilizing linear fracture correlation techniques.

- (U) ($10,043) NSFS:
  - (U) Initiate:
    -- (U) Investigation of real time retargetting, weapon control and target sensing techniques coupled with mission responsive ordnance concept as a means to improve responsiveness for time critical called fires.
  - (U) Continue:
    -- (U) Electro Optic/Infrared and Quasi optical gun launched seeker investigation. Conduct joint data collection with Direct Attack Munition Affordable Seeker (DAMASK) project (P.E. 0603238N).
    -- (U) Weapons modeling and simulation tools for NSFS including Computational Fluid Dynamics (CFD). Detailed definition of test sets and geographical layout.
    -- (U) Development of Mission Responsive Ordnance (MRO). Complete assessment of MRO submunition performance when operated as a unitary warhead.
    -- (U) Precision targeting using GPS/IMU to provide a 10m Target Location Error (TLE), supporting the requirements for fire control weapons. Design demo system and project altitude error of same using kinematic alignment algorithms. Finish in the field, direct measurements of breadboard GPS/IMU altitude determination system.
    -- (U) Image Video Analysis for near real time integrated detection, tracking, and location of targets with image. Complete fabrication of demo hardware and begin software modifications for rehost on the weapon host computer.
    -- (U) Hyperspectral decoy recognition technologies for use by air platforms such as UAVs. Perform field measurements against decoys and targets from aircraft.
    -- (U) Investigation of IFSAR technologies to reduce the cost per kill through improved aimpoint accuracy and supporting mission planning and BDA. Test using L-band and X-band IFSAR in aircraft.

- (U) ($2,926) Pulse Detonation Engine (PDE) - Congressional Plus-up:
  - (U) Initiate:

-- (U) Investigate pre-detonator to reduce on-board oxidizer and/or initiator volume requirements.
-- (U) Investigate rotary and butterfly valve concepts.
-- (U) Perform fuel management system definition.

- (U) ($975) Explosives - Congressional Plus-up:
  - (U) Initiate:
    -- (U) Investigation of environmentally friendly processing methods for gradient explosives formulations used in variable output explosives.
    -- (U) Development of formulations of survivable internal blast and metal accelerating explosives with high temperature resistant binders.
    -- (U)Development and evaluation of the effect of fluorine containing materials on the reaction rate of nanoaluminum formulations.
    -- (U) Develop continuous processing technologies to increase the content of fine particle size ingredients in explosive compositions.

- (U) ($385) Small Business Innovation Research (SBIR): Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. FY 2000 Plan:

- (U) ($7,885) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Initiate:
    -- (U) Weaponization assessment for High Energy Density Materials (HEDM) applied to ship defense weapons to improve probability of catastrophic kills
    -- (U) Investigation of technologies designed to reduce command decision time in littoral environments.
  - (U) Continue:
    -- (U) Lethality assessment for solid state High Energy Laser (HEL) self defense-investigate aerokill and critical component kill.
    -- (U) Conformal seeker technology development. Complete design of conformal seeker breadboard.
    -- (U) Low altitude TDD technology development.

- (U) Complete:
  - -- (U) Evaluation and testing of IR clutter suppression techniques. Documentation of results. Potential transitions to TISS, or MK56 Electro Optic sight, SM-2, Blk IV B.
  - -- (U) Evaluation of low altitude propagation sensing techniques applied to sensor real-time adaptation. Incorporate into P.E. 0603217N technology demonstration.
  - -- (U) Surface launched, high-speed propulsion investigations

• (U) ($4,665) AIR SUPERIORITY:
- (U) Initiate:
  - -- (U) Systems investigation of medium to long range target acquisition and track capabilities in conjunction with projected missile kinematic improvements.
- (U) Continue:
  - -- (U) Seeker CCM technology and IR seeker performance algorithm development based on wavelet transforms.
  - -- (U) Precision intercept task that evaluates functional allocation of lethality factors among the warhead fragments, timing, and missile kinematic subsystems.
- (U) Complete:
  - -- (U) Investigation of aimable ordnance to increase missile lethality equal to or less than 80% of the current weight/volume of AMRAAM warhead. Prioritize recommendations among the fireset, reactive materials and explosive kills provided.

• (U) ($2,905) IHPRPT:
- (U) Initiate:
  - -- (U) Propellant formulation tasks to identify and evaluate propellant ingredients to meet Phase III IHPRPT delivered energy and mass fraction goals.
  - -- (U) Surface launched propulsion task to develop innovation case, insulation, and liner technologies to meet Phase II IHPRPT mass fraction goals.
- (U) Continue:
  - -- (U) Conduct full-scale, "hot" testing of on-command pintle TVC components.
- (U) Complete:

-- (U) Complete "hot" testing of full-scale dual movable nozzle, demonstrating Phase I IHPRPT mass fraction goals.
-- (U) Complete ballistic and mechanical evaluation testing on dual plateau propellants, achieving Phase I delivered energy and mass fraction goals
-- (U) Conduct full scale firing of gun-launch rocket, using "optimal" grain and case design, which completes the gun-launched rocket task by demonstrating Phase II IHPRPT goals
-- (U) Complete ballistic characterization testing of aluminum hydride propellants, showing possible achievement of Phase II IHPRPT delivered energy goal.
-- (U) Complete ballistic characterization testing of ADN propellants, showing possible achievement of Phase II IHPRPT delivered energy goal.

• (U) ($11,679) STRIKE AND ASUW WEAPONRY:
- (U) Initiate:
-- (U) Precision auto weaponeering task that generates a desired meanpoint of impact (DMPI) in support of the achievement of ASWT fire control accuracy goal of <3m Circular Error Probability (CEP).
-- (U) Develop investment strategy for autonomous system weapon control capability.
- (U) Continue:
-- (U) Tuned ATR extraction and registered data base
-- (U) Fuzzy ATR characterization to develop seeker ATR algorithms.
-- (U) Assessment of low cost seeker components in the MMW spectral region.
-- (U) Counterflow TVC task to increase mass fraction performance.
-- (U) ATR performance prediction task for imaging seeker-based ATR systems.
-- (U) Development of a low cost MMW antenna element using MEMS technology using MMW radar.
-- (U) Investigation of advanced wavelet-based signal processing techniques to reject GPS jammers.
-- (U) Investigation into the design of an autonomous attack and weaponeering capability for Uninhabited Combat Air Vehicles (UCAV)
-- (U) Investigation and development of autonomous mission planning package for UCAV applications. Mission planning capability to include path planning, obstacle avoidance, and resource allocation.

-- (U) Precision Target Handoff and Advanced Data Assimilation for precision targeting tasks. These tasks are developing technology tasks to support the ASWT goals of 10m fire control accuracy and a 20/hr target/weapon pairing rate.
-- (U) Configurable ATR system and ATR performance prediction tasks supporting the weapons based ATR and Rapid planning ASWT goals.
-- (U) GPS Anti-jam and MEMS aperture tasks addressing the robust CEP and target detection goals.

- (U) Complete:
-- (U) Demonstration of Suppression of Energy Air Defenses (SEAD) fuze discrimination techniques for masted targets inclutter.
-- (U) Evaluation of laser radar image processing algorithms based on fuzzy logic and variational principal processing techniques supporting ATR of relocatable targets.
-- (U) Assessment of supersonic lifting body airframe technology with emphasis on high-speed propulsion/airframe integration issues.

• (U) ($10,482) NSFS:
- (U) Initiate:
-- (U) Surface target lethality assessment.
-- (U) Development of tunable explosives for controlled lethality effects.
- (U) Continue:
-- (U) Investigation of weapon control and target sensing techniques comparable with mission responsive ordnance concept. Complete direct capability analysis in selected weapons.
-- (U) Finalize algorithm and packaging design of seeker for the Electro Optic/Infrared gun launched seeker to improve terminal guidance of projectiles.
-- (U) Weapons modeling and simulation to provide tools for design of NSFS systems include CFD for vertical launchers and aero-prediction codes.
-- (U) Complete missile warhead feasibility analysis for the MRO technology task. Continue MRO effort to improve warhead capabilities.
-- (U) Investigate Image Video Analysis for near real time integrated ability to detect, track, classify, and precisely locate targets with image and video to increase targeting accuracy and provide a reduced response time for targeting.

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

-- (U) IFSAR to demonstrate and validate techniques for processing multi-path IFSAR into DEMS with techniques to control DEMS to GPS. These efforts will attempt to reduce the cost per kill through improved aimpoint accuracy as well as supporting mission planning and BDA. Evaluate optical computing for real time performance.
-- (U) Precision targeting with GPS/IMU for precise attitude. Demonstrate sub-milliradian attitude measurement accuracy.

- (U) Complete:
-- (U) Hyperspectral seeker tasks supporting target detection and location by air platforms.

B. (U) PROGRAM CHANGE SUMMARY

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	28,379	37,140	38,064
(U) Appropriated Value:		41,140	0
(U) Adjustments from FY 1999 PRESBUDG:	-5,493	+3,683	-448
(U) FY 2000 PRESBUDG Submission:	22,886	40,823	37,616

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments include Small Business Innovation Research (SBIR) reduction (-$3,058); and Actual update adjustments (-$2,435). FY 1999 adjustments include Congressional Plus Ups of (+3,000) for Pulse Detonation Engine Research and (+1,000) for Energetic Explosives Development; and Congressional Undistributed adjustments (-$317). FY 2000 adjustments includes an Outsourcing adjustments (-$90) Navy Working Capital Fund (NWCF) rate adjustment (+$12), Civilian pay adjustment (+$175); and Non Pay Inflation adjustment (-$545).

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not Applicable
(U) RELATED RDT&E: This P.E. adheres to Defense S&T Reliance agreements with oversight provided by the JDL. This P.E.
(U) CONVENTIONAL AIR/SURFACE WEAPONRY:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602203F (Aerospace Propulsion)
(U) PE 0602232N (Communications, Command and Control, Intelligence, Surveillance & Reconnaissance)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602302F (Rocket Propulsion and Astronautics Technology)
(U) PE 0602303A (Missile Technology)
(U) PE 0602601F (Advanced Weapons)
(U) PE 0602602F (Conventional Munitions)
(U) PE 0602618A (Ballistics Technology)
(U) PE 0602624A (Weapons and Munitions Technology)
(U) PE 0603004A (Weapons and Munitions Advanced Technology)
(U) PE 0603216F (Aerospace Propulsion and Power Technology)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603640M (Marine Corps Advanced Technology Demonstration)
(U) PE 0603790D (NATO Research and Development)
(U) This is in accordance with the ongoing Reliance joint planning processes.

(U) SCHEDULE PROFILE: Not applicable.

FY 2000 PRESBUDG RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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
Ship, Submarine & Logistics Technology	43,430	55,456	43,786	42,967	44,744	46,126	47,527	48,831	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides for surface ship, submarine, logistics, and environmental quality applied research that contributes to meeting joint warfare capabilities established by the Joint Chiefs of Staff; namely to promptly engage regional forces in decisive combat on a global level, to employ a range of capabilities more suitable to actions at the lower end of the full range of military operations which allow achievement of military objectives with minimum casualties and collateral damage, and to counter the threat of weapons of mass destruction and future ballistic and cruise missiles to the United States and deployed forces.

(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) This PE develops affordable hull, mechanical, and electrical (HM&E) technology options for both surface ships and submarines. There are four technology thrusts for both surface ships and submarines: Signature Control, Structural Systems, Power and Automation, and Maneuvering and Seakeeping. They address electromagnetic and acoustic signature reduction, structural and weapon related survivability improvement, electrical and mechanical system efficiency, damage control, hydrodynamics, and alternative propulsion.

(U) Logistics technologies increase operational readiness through effective management and movement of supplies ashore and at-sea, and advanced techniques for more cost-effective construction and maintenance of shore and offshore facilities. Technology development in these areas responds to a variety of requirements, including: the logistic support needed for amphibious landing, the diagnostic technologies that enable the implementation of a condition-based vs. time-based maintenance philosophy, and long distance logistics supply chains with short reaction time.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) Environmental quality technologies enable sustained world-wide Navy operations, in compliance with all national and international laws, regulations and agreements. Technology development in this area supports the Chief of Naval Operations (CNO) prioritized Navy user and Science and Technology (S&T) requirements and leads to systems and processes that provide the Fleet with environmentally compliant forward presence, ashore and afloat. Specifically, this area supports requirements to minimize the curtailment of military operations due to ship, shore and aircraft compliance with international regulations; and to sustain Naval forces anywhere in a timely and environmentally compliant manner.

(U) In addition, affordability for reduced acquisition and life-cycle costs is pursued within all technology thrusts. Concepts that reduce the cost of design, fabrication, outfitting, maintenance, and operation are being developed. This HM&E technology spans various Joint Mission Areas and supports the Joint Warfare Strategy "Forward ...From the Sea."

(U) In fiscal year 1998, funding for Logistics and Environmental Quality technology for ships and Naval infrastructure was transferred from PE 0602233N to this more appropriate PE.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within APPLIED RESEARCH, Budget Activity, because it investigates technical advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

(U) ($4,246) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATED:
- (U) Future combatant topside structural concepts. (Topside Structures)
- (U) Fire suppression and flooding prediction for automated damage control. (Damage Control)
- (U) Total ship structural/systems damage prediction from missile impact and penetration. (Weapons Effects)
- (U) Composite structural response prediction to explosion loads transmitted in water or air. (Weapon Effects)

(U) CONTINUED:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Demonstration and evaluation of dynamic failure prediction tools for composite hull structures. (Hull Structures)
- (U) Development of stainless steel advanced double hull concepts. (Hull Structures)
- (U) Model test studies of the effects of DD-21 hull features on seaway induced loads. (Hull Structures)
- (U) Development of analytical models to predict fire/smoke transport and flooding progression in naval surface ships. (Damage Control)

(U) ($1,116) SURFACE SHIP POWER AND AUTOMATION:
(U) INITIATED:

- (U) Development of smart, survivable machinery control system concepts. (Mechanical Power and Auxiliary Systems)
- (U) Development of heat pipe, thermal-electric and other advanced heat removal techniques for high heat load thermal management in distributed machinery and electrical systems. (Mechanical Power and Auxiliary Systems)

(U) COMPLETED:

- (U) 10 kilowatt (kW) fuel cell system brassboard demonstration to validate analytical models. (Mechanical Power and Auxiliary Systems)
- (U) Transition of fuel reformer and desulphurization concepts for high power diesel-fed fuel cell to PE 0603508N. (Mechanical Power and Auxiliary Systems)

(U) ($4,276) SURFACE SHIP SIGNATURE CONTROL:
(U) INITIATED:

- (U) Develop mathematical and physical scale model scattering prediction capabilities of surface ship resonance at high frequency (HF) frequencies. (Topside Signature Reduction)
- (U) Develop testing procedures to evaluate residual ferromagnetic signatures of non-ferrous materials (Underwater Signature Reduction)

(U) CONTINUED:

- (U) Evaluation of high-performance ship hull concepts, which meet low-observable (LO) requirements. (Topside Signature Reduction)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of lightning protection system concepts for composite structures. (Electromagnetic Compatibility)
- (U) Development of eddy current prediction modeling and advanced sensors (Underwater Signature Reduction)

(U) COMPLETED:

- (U) Development of Infrared (IR)/Radar Cross Section (RCS)/Visual signature suppression concepts for exhaust stack systems. (Topside Signature Reduction)
- (U) Integration of embedded communication sensors into topside exhaust stack structures. (Electromagnetic Compatibility)
- (U) Mine vulnerability display to allow ship operator to determine vulnerability/survivability in littoral environments. (Underwater Signature Reduction)

(U) ($1,634) SURFACE SHIP MANEUVERING & SEAKEEPING:

(U) INITIATED:

- (U) Development of dynamic damage stability method. (Seaway Operability and Survivability)

(U) COMPLETED:

- (U) Development and assessment of a Vertical Axis Propulsor concept (Phase I Engineering assessment). (Advanced Propulsor Concepts)

(U) ($3,579) SUBMARINE SIGNATURE CONTROL:

(U) INITIATED:

- (U) Development of Advanced Degaussing methodology based on foreign technologies. (Electromagnetic Silencing)
- (U) Development of methods to predict/reduce acoustic noise due to flow over appendages. (Hydroacoustics)

(U) CONTINUED:

- (U) Development of technology to predict real-time, far-field acoustic signatures from on-board measurements. (Structural Acoustic)
- (U) Small scale evaluation of quiet hull concepts. (Structural Acoustics)
- (U) Demonstration of proof-of-concept for control of near and far-field electromagnetic (EM) signatures in deep and shallow water. (EM Signature Reduction)
- (U) Develop integrated model for advanced propulsor noise at low/mid frequencies. (Hydroacoustics)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) COMPLETED:

- (U) Testing and evaluation of acoustically transparent sonar bow dome concept; transition concept and design methodology to Naval Sea Systems Command (NAVSEA). (Structural Acoustics)
- (U) Development and evaluation of the integrated model of propulsor noise in high frequency range. (Hydroacoustics)
- (U) Assessment of hydrodynamic wake prediction and mitigation capabilities. (Hydrodynamic Signature Reduction)
- (U) Development of algorithms for far-field EM signature control algorithms. (EM Signature Reduction)

(U) ($2,024) SUBMARINE STRUCTURAL SYSTEMS:
(U) INITIATED:

- (U) Investigation of double hull concepts. (Advanced Structures)
- (U) Develop monitoring system to balance weight distribution in truss and mount systems to eliminate acoustic shorts and to evaluate shock damage. (Advanced Structures)

(U) CONTINUED:

- (U) Development of quarter-scale shock and acoustic testing requirements for mounts. (Advanced Structures)
- (U) Development of strengthening options and joint flexibility concepts for shock attenuation in machinery support structures. (Advanced Structures)
- (U) Development of front end equipment emulators for shock evaluations. (Advanced Structures)

(U) COMPLETED:

- (U) Development of test capability for quarter-scale shock and acoustic evaluations in air and in water. (Advanced Structures)

(U) ($2,110) SUBMARINE POWER AND AUTOMATION:
(U) INITIATED:

- (U) Technology assessment and development of alternative emergency power energy storage technologies. (Electrical)

(U) CONTINUED:

- (U) Development of flow visualization and design tools for internal fluid systems. (Machinery)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Evaluation of power and response performance of candidate electrically powered actuator technologies for reduced cost improved reliability of steering and diving systems. (Electrical)
- (U) Development of adaptive self-energized magnetic bearings for reduced maintenance. (Machinery)
- (U) Development and verification of quiet electric motor analysis and design tools. (Electrical)

(U) ($2,751) SUBMARINE MANEUVERING AND SEAKEEPING:
(U) INITIATED:
- Inviscid inverse design and turbulent flow analysis of mixed flow propulsor concepts. (Advanced Propulsors)

(U) CONTINUED:
- (U) Laboratory demonstrations of maneuvering concepts with improved control authority and jam resistance. (Maneuvering and Control)
- (U) Simulation of jam resistant maneuvering concepts. (Maneuvering and Control)
- (U) Development of prediction methods of propulsor side forces. (Maneuvering and Control)
- (U) Demonstration of improved ability to simulate maneuvering in extreme conditions. (Maneuvering and Control)

(U) COMPLETED:
- (U) Development of models to predict near-field downstream flow features from hull feature inflow conditions and transition to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering and Control)
- (U) Radio controlled model tests to validate physics-based maneuvering tools; and transition first version Computational Fluid Dynamics (CFD) codes to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering and Control)
- (U) Advanced stern performance evaluation. (Advanced Propulsors)

(U) ($4,739) Power Electronic Building Block (PEBB):
(U) INITIATED:
- (U) Development of third generation PEBB demonstration modules for form, fit, and function. (Advanced Concept Electrical Systems)

(U) CONTINUED:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Transition PEBB science and technology to support active quieting of motors and other electrical components. (Advanced Concept Electrical Systems)

(U) COMPLETE:

- (U) Proof of concept of second-generation PEBB modules that demonstrate form and function; transition modules to PE 0603508N for Technology Demonstrations. (Advanced Concept Electrical Systems)
- (U) Demonstration of computational testbed for advanced concept electrical system simulation. (Advanced Concept Electrical Systems)

(U) ($5,413) LOGISTICS:

(U) INITIATED:

- (U) Development of a micro-electromechanical system (MEMS) diagnostic sensor net. (Maintenance)
- (U) Development of virtual sensors for diagnostics and prognostics. (Maintenance)
- (U) Develop and implement sensor technology that qualify for built-in calibration (BIC) integration that currently use a MEMS sensor technology base.

(U) CONTINUED:

- (U) Development of magnetostrictive actuators for cargo/weapons elevator doors. (Replenishment)
- (U) Development of metrology for high-speed optical interconnections. (Maintenance)
- (U) Development of IR focal plane array test set. (Maintenance)
- (U) Enhancement of crane control technologies resulting in reduced manpower and increased equipment performance. (Replenishment)
- (U) Development of prognostics for real-time status monitoring and troubleshooting for high-power microwave tubes in combat systems. (Maintenance)
- (U) Development of nondestructive techniques coupled with computer modeling to rapidly assess pier capacity to resist lateral loads. (Infrastructure)
- (U) Development of technologies required for an easily transported, high sea state modular platform system. (Amphibious Logistics)
- (U) Development of an autonomous marine booster pump. (Amphibious Logistics)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of technology to significantly improve throughput by providing lighterage the ability to moor alongside ships and piers enabling cargo transfer in higher sea states. (Amphibious Logistics)
- (U) Development of a collaborative infrastructure assessment tool. (Amphibious Logistics)

(U) COMPLETED:

- (U) Development of electroset desktop manufacturing of parts. (Amphibious Logistics)
- (U) Development of rapid nearshore geotechnical survey technology. (Amphibious Logistics)

(U) ($3,491) ENVIRONMENTAL QUALITY TECHNOLOGY:

(U) INITIATED:

- (U) Assessment of need for oil pollution control technology for submarine external systems. (Environmentally Compliant Platforms)
- (U) Development of non-fouling coatings for shipboard ceramic membrane oily wastewater treatment systems. (Environmentally Compliant Platforms)
- (U) Development of process control technology for shipboard waste processing systems. (Environmentally Compliant Platforms)
- (U) Development of surface ship pollution prevention technologies. (Environmentally Compliant Platforms)
- (U) Development of submarine heat exchanger fouling control technologies. (Environmentally Compliant Platforms)
- (U) Development of the Navy RDT&E needs for contaminated sediments and their impact on ship/shore facilities operations. (Environmentally Compliant Shore Facilities)

(U) CONTINUED:

- (U) Development of enhanced copper speciation and fate methodology as an alternate approach to meet copper discharge regulations. (Environmentally Compliant Shore Facilities)
- (U) Electrochemical pre/post treatment technology development for shipboard non-oily wastewater. (Environmentally Compliant Platforms)
- (U) Development of near critical fluid extraction technology for shipboard bilgewater treatment. (Environmentally Compliant Platforms)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of automated dry dock ship painting, application, overspray control and collection technologies. (Environmentally Compliant Shore Facilities)
- (U) Development of decontamination cleaning of surfaces technology of Polychlorinated Biphenyls (PCBs) and other toxic substances. (Environmentally Compliant Shore Facilities)
- (U) Development of Industrial Wastewater Treatment Plant (IWTP) technologies for pollution prevention. (Environmentally Compliant Shore Facilities)
- (U) Development of environmentally sound substitute for steam catapult lubricants. (Environmentally Compliant Platforms)

(U) COMPLETED:

- (U) Development of molecular recognition (MRT), advanced reverse osmosis (ARO) and electrodialysis (ED) technologies for IWTPs and transitioned to Environmental Security Technology Certification Program (ESTCP) and 6.4 programs for technology demonstration/validation and certification. (Environmentally Compliant Shore Facilities)
- (U) Initiation Decision Report (IDR) for development of technology for control of pollution from submarine external hydraulic systems (Environmentally Compliant Platforms)

(U) ($5,687) PEBB TECHNOLOGY CONGRESSIONAL PLUS-UP:
(U) COMPLETED:

- (U) Complete Phase I virtual testbed (equipment simulation and analysis) and successfully incorporate it into virtual PEBB-2 design. (Advanced Concept Electrical Systems)

(U) ($1,418) POWER NODE CONTROL CENTERS CONGRESSIONAL PLUS-UP:
(U) COMPLETED:

- (U) Design and cost analysis of the Power Node Control Center prototypes. (Advanced Concept Electrical Systems)

(U) ($946) UNDERWATER VEHICLE DERIVED CONTROL TECHNOLOGY CONGRESSIONAL PLUS-UP:
(U)COMPLETED:

- (U) Using Component Level Intelligent Distributed Control Systems (CLIDCS) develop and demonstrate concepts for intelligent, reconfigurable networks that control HM&E systems.

2. (U) FY 1999 PLAN:

(U) ($5,050) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATE:
- (U) Design tool for integrated composite topside structures. (Topside Structures)
- (U) Development of survivable DC sensor/system principles. (Weapons Effects)

(U) CONTINUE:
- (U) Development of improved design criteria and tools for analysis of composite primary hulls. (Hull Structures)
- (U) Development of stainless steel advanced double hull concepts. (Hull Structures)
- (U) Future combatant topside structural concepts. (Topside Structures)
- (U) Composite structural response prediction to explosion loads transmitted in water or air. (Weapon Effects)
- (U) Fire suppression and flooding prediction for automated damage control. (Damage Control)

(U) COMPLETE:
- (U) Transition of probabilistic hull strength design methods to NAVSEA. (Hull Structures)
- (U) Development of magazine protection concepts to reduce probability of mass detonation. (Weapons Effects)
- (U) Physical modeling studies of hull features versus seaway loading. (Hull Structures)
- (U) Methodology for predicting local hull response to near hull weapons detonation. (Weapons Effects)
- (U) Advanced damage control flooding prediction sensor technology. (Damage Control)
- (U) Total ship structural/systems damage prediction from missile impact and penetration. (Weapons Effects)
- (U) Demonstration and evaluation of dynamic failure prediction tools for composite hull structures. (Hull Structures)

(U) ($1,456) SURFACE SHIP POWER AND AUTOMATION:
(U) INITIATE:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Dynamic modeling and simulation of fuel cell based power systems for shipboard use. (Mechanical Power and Auxiliary Systems)
- (U) Simulation of machinery plant control system. (Mechanical Power and Auxiliary Systems)

(U) CONTINUE:

- (U) Development of heat pipe, thermal-electric and other advanced heat removal techniques for high heat load thermal management in distributed machinery and electrical systems. (Mechanical Power and Auxiliary Systems)
- (U) Development of smart, survivable distributed machinery control concepts. (Mechanical Power and Auxiliary Systems)

(U) COMPLETE:

- (U) Shock and vibration testing of reduced scale fuel cell power systems. (Mechanical Power and Auxiliary Systems)
- (U) Salt contamination testing of reduced scale fuel cell power systems. (Mechanical Power and Auxiliary Systems)

(U) ($4,789) SURFACE SHIP SIGNATURE CONTROL:

(U) INITIATE:

- (U) Development of next generation topside signature control concepts (Topside Signature Reduction)
- (U) Development of double hull signature reduction technologies for underwater electromagnetic signatures (Underwater Signature Reduction)

(U) CONTINUE:

- (U) Mathematical and physical scale model scattering prediction analyses for surface ship resonance at high frequencies. (Topside Signature Reduction/Electromagnetic Compatibility)
- (U) Testing procedures to evaluate residual ferromagnetic signatures of non-ferrous materials (Underwater Signature Reduction)
- (U) Evaluation of high-performance ship hull concepts, which meet low-observable requirements. (Topside Signature Reduction)
- (U) Development of eddy current prediction modeling and advanced sensors (Underwater Signature Reduction)

(U) COMPLETE:

- (U) Assessment of the vulnerability of surface ships to eddy current signatures. (Underwater Signatures)

- (U) Development of lightning protection system concepts for composite structures. (Electromagnetic Compatibility)

(U) ($1,343) SURFACE SHIP MANEUVERING & SEAKEEPING:
(U) INITIATE:
- (U) Development of numerical methods for predicting ship loads. (Seaway Maneuverabilty, Motions and Loads)
- (U) Development of an integrated propulsor/hull concept to improve signature behavior. (Integrated Propulsor/Hull)

(U) COMPLETE:
- (U) Development and validation of dynamic damage stability method. (Seaway Maneuverabilty, Motions and Loads)

(U) ($4,341) SUBMARINE SIGNATURE CONTROL:
(U) INITIATE:
- (U) Development of coating concepts to reduce submarine detection from active acoustic interrogation. (Structural Acoustics)
- (U) Development of next generation structural acoustics numerical modeling capability. (Structural Acoustics)
- (U) Develop models for wake signatures for littoral parameter ranges. (Hydrodynamic Signature Reduction)
- (U) Development of sensors/electronics concepts to embed in exterior coating materials to assess technology impact/advantages of sampling the EM field exterior to the hull. (Electromagnetic Signature Reduction)

(U) CONTINUE:
- (U) Demonstration of proof-of-concept for controlling near-field electromagnetic signatures in shallow water. (EM Signature Reduction)
- (U) Development of advanced degaussing based on foreign technology assessments. (Electromagnetic Signature Reduction)
- (U) Assess first generation experimental results and revise concept and analysis methods for hull structural concepts with intrinsic acoustic benefit. (Structural Acoustics)
- (U) Development of methods to predict/reduce acoustic noise due to flow over appendages. (Hydroacoustics)
- (U) Develop integrated model for advanced propulsor noise at low/mid frequencies. (Hydroacoustics)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of technology to predict far-field acoustic signature in real-time from on-board measurements. (Structural Acoustics)

(U) COMPLETE:

- (U) Evaluation of the control methodologies for far-field EM signatures in deep and shallow water. (EM Signature Reduction)
- (U) Small scale evaluation of quiet hull concepts. (Structural Acoustics)

(U) ($2,540) SUBMARINE STRUCTURAL SYSTEMS:
(U) CONTINUE:

- (U) Investigation of double hull concepts. (Advanced Structures)
- (U) Development of equipment emulators for aft end shock and acoustic applications. (Advanced Structures)
- (U) Develop system requirements and sensor configurations to implement structural monitoring system. (Advanced Structures)

(U) ($2,400) SUBMARINE POWER AND AUTOMATION:
(U) INITIATE:

- (U) Integrated modeling and simulation of electric motor with mounting, shaft, propulsor and machinery support systems to investigate shipboard overall acoustic noise reduction. (Machinery)

(U) CONTINUE:

- (U) Technology assessment and development of alternative emergency power energy storage technologies. (Electrical)
- (U) Verification of design tools for internal fluid systems. (Machinery)
- (U) Development of most promising electrically powered actuator technologies for reduced cost improved reliability steering and diving systems. (Machinery)
- (U) Development and validation analysis of 3-D design tools for quiet electric motors. (Electrical)

(U) COMPLETE:

- (U) Validation of 2-D analysis and design tools for quiet electric motors; transition to NAVSEA. (Electrical)
- (U) Transition adaptive self-energized magnetic bearing technology to NAVSEA. (Electrical)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of measurement techniques for electrical motor dynamics. (Electrical)

(U) ($3,639) SUBMARINE MANEUVERING AND SEAKEEPING:
(U) INITIATE:
- (U) Development of maneuvering effectors to increase control authority at low speeds. (Maneuvering Systems)
- (U) Hydroacoustic design and analysis for mixed flow propulsors. (Advanced Propulsors)
- (U) Active control for hydroacoustics. (Advanced Propulsors)
- (U) Validate propulsor side force technology and transition to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering and Control)

(U) CONTINUE:
- (U) Demonstration of improved ability to simulate maneuvering in extreme conditions. (Maneuvering and Control)

(U) COMPLETE:
- (U) Simulation of jam resistant maneuvering concepts. (Maneuvering and Control)
- (U) Laboratory demonstrations of maneuvering concepts with improved control authority and jam resistance.
- (U) Inviscid inverse design and turbulent flow analysis of mixed flow propulsor concepts. (Advanced Propulsors)

(U) ($5,567) PEBB:
(U) INITIATE:
- (U) Development of advanced PEBB fast turn off modules. (Advanced Concept Electrical Systems)
- (U) Development of system regulation and stability concepts, algorithms. (Advanced Concept Electrical Systems)
- (U) Development of energy generation and storage concepts and components. (Advanced Concept Electrical Systems)

(U) CONTINUE:
- (U) Evaluation of third-generation modules to demonstrate form, fit, and function of PEBB. (Advanced Concept Electrical Systems)

(U) COMPLETE:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Proof of concept for third-generation modules to demonstrate form, fit, and function of PEBB. (Advanced Concept Electrical Systems)
- (U) Transition of third-generation PEBB modules to PE 0603508N to support Electrically Re-configurable Ship demonstration. (Advanced Concept Electrical Systems)

(U) ($6,459) LOGISTICS:
(U) INITIATE:

- (U) Investigate concepts to provide mooring and fendering systems, which would safely, control or reduce the relative motion in sea state 3 conditions. (Amphibious Logistics)
- (U) Development of the use of existing assets to provide for mobile piers. (Amphibious Logistics)
- (U) Development of seabased logistics communications link. (Amphibious Logistics)

(U) CONTINUE:

- (U) Development of a high power microwave built-in test set. (Maintenance)
- (U) Development of a collaborative infrastructure assessment tool. (Infrastructure)
- (U) Improvement of throughput in higher sea states by identifying and developing new and emerging technologies that can be applied to critical lighterage operations. (Amphibious Logistics)
- (U) Development of micro-electrical mechanical sensor systems. (Maintenance)
- (U) Development of virtual sensors. (Maintenance)
- (U) Development of BIC of MEMS. (Maintenance)

(U) COMPLETE:

- (U) Development of magnetostrictive actuators for cargo/weapons elevator doors. (Replenishment)
- (U) Development of advanced shipboard crane technology. (Replenishment)
- (U) Development of metrology for high-speed optical interconnections. (Maintenance)
- (U) Development of an infrared focal plane array test set. (Maintenance)
- (U) Development of a diagnostic rule extraction technology. (Maintenance)
- (U) Development of nondestructive techniques coupled with computer modeling to rapidly assess pier capacity to resist lateral loads. (Infrastructure)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of technologies required for and easily transported, high sea state modular platform system. (Amphibious Logistics)
- (U) Development of an autonomous marine booster pump. (Amphibious Logistics)
- (U) Development of technology to significantly improve throughput by providing lighterage the ability to moor alongside ships and piers enabling cargo transfer in higher sea states. (Amphibious Logistics)

(U) ($3,860) ENVIRONMENTAL QUALITY TECHNOLOGY:
(U) INITIATE:

- (U) Development of technology for management of contaminated marine sediments. (Environmentally Compliant Shore Facilities)
- Development of miniaturized acoustic data logging technology for marine mammals. (Environmentally Compliant Platforms)
- Development of acoustic integration technology for projecting 3-D marine mammal tracks to generate noise exposure data for risk assessment predictions. (Environmentally Compliant Platforms)

(U) CONTINUE:

- (U) Development of enhanced methodology for alternate approach to meet copper discharge regulations. (Environmentally Compliant Shore Facilities)
- (U) Pollution prevention technology development for surface combatants. (Environmentally Compliant Platforms)
- (U) Development of automated dry dock ship paint application, overspray control and collection technologies. (Environmentally Compliant Shore Facilities)
- (U) Development of submarine heat exchanger fouling control technology. (Environmentally Compliant Platforms)
- (U) Development of decontamination cleaning technology for PCBs (Environmentally Compliant Shore Facilities)

(U) COMPLETE:

- (U) Electrochemical treatment technology development for shipboard non-oily wastewater polishing; transition to Demonstration/Validation (DEM/VAL) (NAVSEA 03R16) for advanced development. (Environmentally Compliant Platforms)
- (U) Technology development of near-critical CO2 extraction for ship bilgewater treatment; transition to EQ DEM/VAL program (NAVSEA 03L1) and PMS 400D for advanced development. (Environmentally Compliant Platforms)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of technologies for Industrial Wastewater Treatment Plants (IWTP); transition to NAVFAC (15R) for integration and implementation. (Environmentally Compliant Shore Facilities)
- (U) Development of environmentally acceptable lubricant for carrier catapult systems; transition to NAVAIR PMA 251 for qualification and implementation. (Environmentally Compliant Platforms)
- (U) Development of non-fouling coatings for shipboard ceramic membrane oily wastewater treatment systems; transition to NAVSEA for DEM/VAL and integration. (Environmentally Compliant Platforms)
- (U) Development of neural network algorithm for shipboard oil content monitors; transition to NAVSEA 03L for integration and implementation (Environmentally Compliant Platforms)

(U) ($1,500) STAINLESS STEEL DOUBLE HULL CONGRESSIONAL PLUS-UP:
(U) INITIATED:
- This effort will entail a large scale testing to validate material, corrosion, coatings, and structural guidelines for stainless steel.

(U) ($2,000) CONTROL SYSTEMS FOR AUTONOMOUS UNDERWATER VEHICLES CONGRESSIONAL PLUS-UP:
(U) INITIATED:
- (U) This program will demonstrate the viability of Component Level Intelligent Distributed Control Systems (CLIDCS) through laboratory demonstration on a representative marine system.

(U) ($5,000) CURVED PLATE TECHNOLOGY CONGRESSIONAL PLUS-UP:
(U) INITIATED:
- (U) Develop, design, construct and test high precision fabrication technology for large steel structural components requiring curvatures and precise dimensional control to be used in advanced ship designs.

(U) ($5,000) BIOENVIRONMENTAL HAZARDS CONGRESSIONAL PLUS-UP:
(U) INITIATED:
- (U) An integrated bioenvironmental hazards program will be conducted to develop biosensors and biomarkers for human and ecological bioenvironmental problems.

(U) ($512) SMALL BUSINESS INNOVATION RESEARCH:

- (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 2000 PLAN:

(U) ($5,653) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATE:
- (U) Develop shock/acoustic mount design methods and energy absorbing structures. (Weapons Effects)

(U) CONTINUE:
- (U) Development of improved design criteria and tools for analysis of composite primary hulls. (Hull Structures)
- (U) Development of stainless steel advanced double hull concepts. (Hull Structures)
- (U) Composite structural response prediction to explosion loads transmitted in water or air. (Weapon Effects)
- (U) Design tool for integrated composite topside structures. (Topside Structures)

(U) COMPLETE:
- (U) Fire suppression and flooding prediction for automated damage control. (Damage Control)
- (U) Development of survivable DC sensor/system principles. (Weapons Effects)
- (U) Future combatant composite topside structural concepts. (Topside Structures)

(U) ($1,161) SURFACE SHIP POWER AND AUTOMATION:
(U) INITIATE:
- (U) Demonstration of advanced thermal management techniques for heat load machinery and electrical. (Mechanical Power and Auxiliary Systems)
- (U) Demonstration of smart, survivable distributed machinery control concepts on reduced scale systems. (Mechanical Power and Auxiliary Systems)

(U) CONTINUE:
- (U) Dynamic modeling and simulation of fuel cell based power systems for shipboard use. (Mechanical Power and Auxiliary Systems)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Simulation of machinery plant control system. (Mechanical Power and Auxiliary Systems)
- (U) Development of smart, survivable distributed machinery control concepts. (Mechanical Power and Auxiliary Systems)

(U) ($5,175) SURFACE SHIP SIGNATURE CONTROL:
(U) INITIATE:
- (U) Advanced integrated topside reduction and EM compatibility prediction capabilities for LO structures. (Topside Signature Reduction/EM Compatibility)

(U) CONTINUE:
- (U) Develop testing procedures to evaluate residual ferromagnetic signatures of non-ferrous materials. (Underwater Signature Reduction)
- (U) Evaluation of high-performance ship hull concepts, which meet low-observable requirements. (Topside Signature Reduction)
- (U) Development of double hull signature reduction technologies for underwater electromagnetic signatures. (Underwater Signature Reduction)
- (U) Development of next generation topside signature control concepts. (Topside Signature Reduction)

(U) COMPLETE:
- (U) Development of eddy current prediction modeling and advanced sensors. (Underwater Signature Reduction)
- (U) Develop mathematical and physical scale model scattering prediction capabilities of surface ship resonance at high frequencies. (Topside Signature Reduction/Electromagnetic Compatibility)

(U) ($1,529) SURFACE SHIP MANEUVERING & SEAKEEPING:
(U) CONTINUE:
- (U) Development of numerical methods for predicting ship loads. (Seaway Maneuverabilty, Motions and Loads)
- (U) Development of an integrated propulsor/hull concept to improve signature behavior. (Integrated Propulsor/Hull)

(U) ($4,283) SUBMARINE SIGNATURE CONTROL:
(U) INITIATE:

- (U) Develop noise model version for reduced complexity propulsors. (Hydroacoustics)

(U) CONTINUE:

- (U) Develop models for wake signatures for littoral parameter ranges. (Hydrodynamic Signature Reduction)
- (U) Development of hull structural concepts with intrinsic acoustic benefit; integrate acoustic coatings and double hull concepts. (Structural Acoustics)
- (U) Development of sensors/electronics concepts to embed in exterior coating materials to assess technology impact/advantages of sampling the EM field exterior to the hull. (Electromagnetic Signature Reduction)
- (U) Development of active and passive degaussing control techniques based on double hull construction. (Electromagnetic Signature Reduction)

(U) COMPLETE:

- (U) Development integrated model for advanced propulsor noise at low/mid frequencies. (Hydroacoustics)
- (U) Development of methods to predict reduction of acoustic noise due to flow over appendages. (Hydroacoustics)
- (U) Development of technology to predict far-field acoustic signature in real-time from on-board measurements. (Structural Acoustics)
- (U) Demonstration of proof-of-concept for controlling near-field electromagnetic signatures in shallow water. (EM Signature Reduction)

(U) ($3,438) SUBMARINE STRUCTURAL SYSTEMS:

(U) CONTINUE:

- (U) Investigation of double hull concepts. (Advanced Structures)

(U) COMPLETE:

- (U) Development of equipment emulators for aft end shock and acoustic applications. (Advanced Structures)
- (U) Develop system requirements and sensor configurations to implement structural monitoring system. (Advanced Structures)

(U) ($2,517) SUBMARINE POWER AND AUTOMATION:

(U) INITIATE:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Investigation of electric power distribution and machinery system automation for improved system performance and reduced manning. (Machinery and Electrical)
- Reduced scale demonstration of advanced control and motor design techniques. (Electrical)

(U) CONTINUE:

- (U) Development of alternative emergency power energy storage technologies. (Electrical)
- (U) Integrated modeling and simulation of electric motor with mounting, shaft, propulsor and machinery support systems to investigate shipboard overall acoustic noise reduction. (Machinery)
- (U) Development of most promising electrically powered actuator technologies for reduced cost improved reliability steering and diving systems. (Machinery)
- (U) Development and validation analysis of 3-D design tools for quiet electric motors. (Electrical)

(U) COMPLETE:

- (U) Technology assessment and development of alternative emergency power energy storage technologies. (Electrical)

(U) ($3,281) SUBMARINE MANEUVERING AND SEAKEEPING:

(U) INITIATE:

- (U) Validation of advanced maneuvering prediction codes. (Maneuvering Systems)

(U) CONTINUE:

- (U) Demonstration of improved ability to simulate maneuvering in extreme conditions. (Maneuvering and Control)
- (U) Development of maneuvering effectors to increased control authority at low speeds. (Maneuvering Systems)
- (U) Hydroacoustic design and analysis for mixed flow propulsors. (Advanced Propulsors)
- (U) Active control for hydroacoustics. (Advanced Propulsors)

(U) COMPLETE:

- (U) Validate propulsor side force technology and transition to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering and Control)

(U) ($6,358) PEBB:

(U) INITIATE:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- Development of advanced energy management and control concepts based on advanced regulation, stability, generation and storage concepts and components. (Advanced Concept Electrical Systems)

(U) CONTINUE:

- (U) Development of advanced PEBB fast turn off modules. (Advanced Concept Electrical Systems)
- (U) Development of system regulation and stability concepts, algorithms, and components. (Advanced Concept Electrical Systems)
- (U) Development of energy generation and storage concepts. (Advanced Concept Electrical Systems)

(U) COMPLETE:

- (U) Transition Cost and efficiency models for advanced electrical systems and solid-state components to PE 0603508N to support Electrically Re-configurable Ship Demonstrations. (Advanced Concept Electrical Systems)

(U) ($7,274) LOGISTICS:
(U) INITIATE:

- (U) Development of a submersible cache for prepositioning equipment. (Amphibious Logistics)

(U) CONTINUE:

- (U) Development of expeditionary mooring technology. (Amphibious Logistics)
- (U) Development of sea-based logistics communications link. (Amphibious Logistics)
- (U) Development of existing assets for mobile piers. (Amphibious Logistics)
- (U) Development of micro-electrical mechanical sensor systems. (Maintenance)
- (U) Development of virtual sensors. (Maintenance)
- (U) Development of BIC of MEMS. (Maintenance)

(U) COMPLETE:

- (U) Development of high power microwave built-in test set. (Maintenance)
- (U) Development of collaborative infrastructure assessment tool. (Infrastructure)

(U) ($3,117) ENVIRONMENTAL QUALITY TECHNOLOGY:
(U) INITIATE:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of advanced air pollutant emissions control and treatment technologies for ships. (Environmentally Compliant Platforms)
- (U) Development of advanced waste treatment system process control technology for surface ships and submarines. (Environmentally Compliant Platforms)
- (U) Development of ballast water non-indigenous species control technology for ships and submarines. (Environmentally Compliant Platforms)
- (U) Development of enhanced display technology for marine mammal information systems. (Environmentally Compliant Platforms)
- (U) Development of pollutant sensor technology for Navy wastewater treatment/control systems. (Environmentally Compliant Shore Facilities)

(U) CONTINUE:

- (U) Development of technologies for management of Navy contaminated marine sediments. (Environmentally Compliant Shore Facilities)
- (U) Development of submarine heat exchanger fouling control technology. (Environmentally Compliant Platforms)
- (U) Development of acoustic data logging technology for marine mammals. (Environmentally Compliant Platforms)
- (U) Development of marine mammal sound exposure model. (Environmentally Compliant Platforms)
- (U) Development of automated dry dock paint application, overspray control, collection and treatment technologies. (Environmentally Compliant Shore Facilities)

(U) COMPLETE:

- (U) Development of surface ship pollution prevention technologies; transition to NAVSEA. (Environmentally Compliant Platforms)
- (U) Development of enhanced methodology for alternative approach to meet copper discharge regulations; transition to NAVFAC (FAC 15R) for implementation. (Environmentally Compliant Shore facilities)
- (U) Development of decontamination cleaning technology for PCBs; transition to NAVFAC (ISR) and NAVSEA 07 for advanced development. (Environmentally Compliant Shore Facilities)

B. (U) PROGRAM CHANGE SUMMARY:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	48,865	43,177	44,775
(U) Appropriated Value:	-	56,677	-
(U) Adjustments from FY99 PRESBUD:	-5,435	+12,279	-989
(U) FY 2000 PRESBUDG Submission:	43,430	55,456	43,786

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 changes reflect Small Business Innovative Research reduction (-$1,267) and actual update adjustments (-$4,168). FY 1999 changes reflect Congressional Undistributed Reductions (-$221), Comparability adjustment (-$1,000) with P.E. 0602232N and Congressional Plus ups: Intelligent Distributed Control Systems (+$1,500), Stainless Steel Double Hull (+$2,000), Bioenvironmental Hazards (+$5,000) and Curved Plate Technology (+$5,000). FY 2000 reduction reflects program balance adjustment (-$949), outsourcing adjustment (-$103), Navy Working Capital Fund (NWCF) rate adjustments (+$397) and civilian personnel pay adjustments (-$334).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(U) OTHER APPROPRIATION FUNDS: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) RELATED RDT&E:
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602131M (Marine Corps Landing Force Technology)
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0602234N (Materials, Electronics, and Computer Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
- (U) PE 0603502N (Surface and Shallow Water MCM)
- (U) PE 0603508N (Surface Ship & Submarine HM&E Advanced Technology)
- (U) PE 0603513N (Shipboard System Component Development)
- (U) PE 0603514N (Ship Combat Survivability)
- (U) PE 0603553N (Surface Anti-Submarine Warfare)
- (U) PE 0603561N (Advanced Submarine Systems Development)
- (U) PE 0603563N (Ship Concept Advanced Design)
- (U) PE 0603564N (Ship Preliminary Design and Feasibility Studies)
- (U) PE 0603569E (DARPA S&T Program)
- (U) PE 0603573N (Advanced Surface Machinery Systems)
- (U) PE 0603712N (Environmental Quality & Logistics Advanced Technology)
- (U) PE 0603721N (Environmental Protection)
- (U) PE 0603726N (Merchant Ship Naval Augmentation Program)
- (U) PE 0603792N (Advanced Technology Transition)
- (U) PE 0604558N (New Design SSN Development)
- (U) PE 0604561N (SSN-21 Development Program)
- (U) Under the Tri-Service Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
Aircraft Technology	22,428	28,367	20,660	22,372	22,806	23,755	24,619	25,251	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program develops technology for naval aviation, with emphasis on the demands imposed by aircraft carrier flight operations and Marine Corps amphibious and field operations relating to the Joint Mission Areas of Strike and Littoral Warfare. This program exploits the emerging technologies of: (a) composite and matrix materials for structures to reduce airframe and propulsion system weight and the effects of saltwater corrosion; (b) reduced observables, (c) aerodynamic designs of Navy-unique aircraft components; (d) advanced gas turbine engine component designs and power systems for extended range/endurance; and (e) predicting safer, more reliable at-sea operating envelopes. The program provides mission area analysis and concept definition required for the Applied Research phase of air vehicle programs.

(U) Aircraft Technology develops manned and unmanned airborne platform technologies for future joint warfighting capabilities to promptly engage regional forces in decisive combat on a global basis and to employ a range of capabilities more suitable to actions at the lower end of the full range of military operations, which allow achievement of military objectives with minimum casualties and collateral damage. This element adheres to Defense Science and Technology (S&T) Reliance Agreements and supports the Department of Defense Science and Technology Strategy, which coordinates and minimizes duplication of aircraft technology efforts. The individual Navy aircraft technology exploratory efforts are selected to fill Naval Aviation needs that are not being met by the United States Air Force, Army, National Aeronautics and Space Administration (NASA), Defense Advanced Research Projects Agency (DARPA) and industry programs.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Aircraft Technology addresses the Air Platforms Defense Technology Area Plan (DTAP), which develops goals and payoffs from both the operational user's and system & technology developer's perspective. At the Project Reliance Fixed Wing Vehicle taxonomy level, goals include Aerodynamics, Flight Control, Subsystems, Structures and Integration technologies. The following reflects the Joint Subarea Level goals for fighter/attack aircraft for the year 2003 (baseline F-22 & F-18E/F),: 0% increase in production cost/Air Vehicle Weight; 0% increase in development costs/Air Vehicle Weight; 20% reduction in support costs per flight hour/Air Vehicle Weight; 10% increase in lift-to-drag; 8% reduction in Air Vehicle weight fraction; 20% increase in controllable angle-of-attack envelope. Holding constant the three cost goals (0%) represents a break in the paradigm currently faced with high-performance tactical aircraft of ever increasing cost per pound of airframe. There is also an increasing emphasis on developing technology which addresses the cost-of-ownership of legacy airframes.

(U) Based on the Secretary of Defense's Blue Ribbon panel's recommendation, after studying F/A-18E/F transonic wing drop, a joint program to develop an understanding of the fundamental flow phenomenon and develop technology to reduce /control abrupt asymmetric wing stall of fighter aircraft will be funded under this and other program elements. This effort will fund the development of a basic understanding of the transonic abrupt wing stall problem, figures of merit and guidelines to prevent abrupt transonic wing stall and improve maneuverability. This effort is planned as a joint effort with Navy, NASA, Air Force (AF) and industry.

(U) Aircraft Technology has a limited investment in Navy unique or critical technology for Rotary Wing Vehicles and seabased vertical flight operations. These efforts are coordinated with the Army's Rotary Wing Vehicle (RWV) science and technology subarea under the DTAP.

(U) Other Joint Subarea Level quantified goals are addressed under the Air Platforms DTAP: Aeropropulsion (by year 2003; baseline engine YF-119 for fighter/attack aircraft, T700/T406 for patrol/transport/rotary wing aircraft, and F107 for missiles/Unmanned Air Vehicles (UAVs)): 100% increase in thrust-to-weight, 35% reduction in acquisition & maintenance cost, 40% reduction in fuel consumption, and 120% increase in specific thrust; and by year 2010, 150% increase in thrust-to-weight and 50% reduction in development costs. Aircraft Power (by year 2000; baseline F-18E/F & F-22): Eliminate hydraulic system; 10 times increase in reliability.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Other DTAPs addressed by Aircraft Technology: Sensors, Electronics & Battlespace Environment; Integrated Platform Electronics (by year 2005): Reduce size, weight and cooling requirements by 50% for Fixed Wing Vehicle (FWV) and 40% for RWV; and 50% reduction in cost for multifunction Radio Frequency (RF) avionics.

(U) Human Systems (by year 2001; baseline F-18E/F & F-22): Achieve crew safe escape to 700 KEAS; 50% reduction in aircrew workload attributable to effective crew station integration, enabling single-seat, air-to-ground precision weapons delivery at night and in adverse weather; Improve mission effectiveness (50% reduction in target acquisition time); Improve lethality (3:1 increase in targets killed per pass); Increase survivability (2:1 improvement in kill ratio); Enhanced situational awareness (75% reduction of head-in cockpit time).

(U) Due to the sheer volume of efforts included in this Program Element (PE), the programs described in the Accomplishment/Plans sections are representative selections of the work included in this PE.

(U) The Navy S&T program includes projects that focus on or have attributes that enhance the affordability of warfighting systems. This program develops the Condition Based Maintenance (CBM) enabling technologies for aviation, with the emphasis on increased affordability, safety and operational flexibility. Specific goals of the program include an 80% reduction in aircraft mechanical mishaps, 35% reduction in the required inventory of spare parts and a 30% reduction in overall aircraft maintenance costs. This effort is part of a vertically integrated, multi-disciplinary program in condition based maintenance that leverages from Program Elements 0602233N, 0602234N and 0601153N.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) ($6,861) PROPULSION & POWER:
  (U) Completed:
  - (U) Aerodynamic and mechanical design of an advanced compression system that increases stage loading by 50% and reduces cost by 30% in a Vertical/Short TakeOff & Landing (V/STOL) relevant configuration.
  - (U) Demonstration of an advanced combustor, compressor and turbine components in a subsonic core that reduces fuel consumption by 30% and increases power-to-weight by 40%.

- (U) ($5,541) INTEGRATED AVIONICS (includes DISPLAYS AND ADVANCED COCKPIT TECHNOLOGIES):
  (U) Initiated:
  - (U) An effort that focuses on enhanced affordability and safety by advancing state-of-the-art maintenance technologies, and develops the capability for critical machinery self-diagnosis, in order to transition from a time-based to a condition-based maintenance philosophy. This program includes the development of enabling technologies such as advanced sensing and signal processing techniques, high speed image processing and particulate classification (Oil Analysis), galvanic, electrical potential and guided wave ultrasonic sensing (Corrosion Detection) and embedded training with intelligent tutoring systems and aircrew coordination protocols.

  (U) Continued:
  - (U) Development of preliminary smart escape system algorithms to improve aircrew survivability within the aircraft flight envelope.
  - (U) Development of preliminary smart aircrew interface algorithms to provide effective information management between the aircrew and the aircraft subsystems.
  - (U) Development of an intelligent crewstation concept to unobtrusively monitor aircrew mission performance.
  - (U) Development of fault tolerant processing and network elements based on the selected vehicle management system architecture and information flow control structure.
  - (U) Work towards multiple platform applicability demonstrations of emerging Advanced Helmet Vision systems for enhanced aircrew mission effectiveness and improved targeting accuracy.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Demonstration of component building block technology for a (non-moving parts) 3-Dimensional volumetric display.
- (U) Development of advanced common electronic modules (ACEMs) that will be smaller, and have less power consumption and higher performance than their analog counterparts, while accomplishing all the requisite acquisition, transmission and digital processing of RF signals over a very wide frequency range (50 MHz to 45 GHz). The family of ACEMs consists of advanced analog-to-digital technology and will be integrated to create systems capable of performing multiple functions. This enhances affordability through a 10-fold projected decrease in systems weight and power consumption, a 15-fold increase in systems performance, and substantial Life Cycle Cost savings.

(U) Completed:
- (U) Design and validation of effective information fusion concepts for helmet-mounted displays which contribute toward providing 3:1 improvement in target kills per first pass, 75% reduction in head-in cockpit time and enhanced situational awareness. Concepts and validation data available on multi-media CD-ROM.

- (U) ($2,640) PIXEL FLAT PANEL DISPLAY CONGRESSIONAL PLUS-UP:
(U) Initiated:
- (U) Development of the laboratory integration of the solid state high-brightness pixel miniature flat panel display technology with the enhanced Crusader Helmet Mounted Display precision optics and helmet/vehicle interface assembly.

- (U) ($4,106) NAVAL AIR VEHICLE TECHNOLOGY (formerly FUTURE AND LEGACY AIRCRAFT TECHNOLOGY):
(U) Initiated:
- (U) Detailed design and fabrication of an unmanned air vehicle (UAV) platform to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept. This effort will include risk reduction activities (e.g., stability & control testing, full scale engine testing, control law development, hardware-in-the-loop simulation, and operational analysis/concept of operations development).

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Development of novel concepts to control or limit the suckdown, thermal and acoustical environment penalty associated with the VSTOL from a surface combatant. Develop more accurate and efficient modeling and prediction capability to evaluate VSTOL aerodynamic characteristics of manned aircraft and uninhabited combat air vehicles (UCAVs). Update current VSTOL design handbook for modern configurations.
- (U) Development of a corrosion-fatigue interaction analysis to support the aging aircraft service life extension requirements. It provides prediction capabilities to optimize maintenance inspection and repair thereby reducing the corresponding operations and maintenance (O&M) cost by at least 10%.
- (U) Development of a durability-based design criteria for bonded composite patching of metal structures. The product will allow a service life extension of aircraft heretofore required to be replaced by new platforms.
- (U) System architecture for the Real-Time Battle and Mid-Air Collision Damage Identification System for flight controls reconfiguration.

(U) Continued:
- (U) Improvement of high-lift system aircraft configurations and a validated 3D optimization/design method for high-lift systems.
- (U) Development of methods and concepts to alleviate empennage buffet during high alpha maneuvering of fighter/attack aircraft.
- (U) Refinement, optimization and testing of control augmentation system most appropriate for compensating for aircraft operational deficiencies in degraded operational conditions.
- (U) Development of structural life enhancement techniques applicable to both new and aging aircraft to support FY 2005 objective of increasing fatigue life by 25%.
- (U) Development and refinement of Molecular Air Data System based on laboratory testing. Validated system performance prediction versus testing in controlled environment and during atmospheric tests.
- (U) Develop concept for uninhabited naval strike aircraft (UNSA) to reduce future air vehicle operation and support costs.

(U) Completed:

- (U) Demonstration of wing fabrication cost savings of 15% with the use of structural joints based on low cost composite substructure.

- (U) ($3,280) OXIDE PURPLE:
  - (U) Classified.

2. (U) FY 1999 PLAN:

- (U) ($7,876) PROPULSION & POWER:
  (U) Initiate:
  - (U) Development of power electronic building blocks (PEBBs) for Naval aircraft applications.
  - (U) Testing of Carbon/Carbon lightweight heat exchanger technology for Naval Aircraft application.
  - (U) Development of dynamic system simulation tool for electric power systems.

  (U) Continue:
  - (U) Development of technology to reduce the weight and volume of the Inverter Converter Controller (ICC) by 45% in support of the More Electric Aircraft (MEA) Initiative.
  - (U) Development of Joint Technology Demonstrator Engine (JTDE) Fighter/Attack Phase III Fan for 5% increased efficiency, 50% increase in stage loading and improved distortion tolerance.
  - (U) Development of improvements in turbine system components to increase durability by 50%.
  - (U) Rig testing of advanced high temperature turbine sealing concepts. The reduced leakage will result in a fuel consumption reduction of 2 percent and increased range for both subsonic support and fighter/attack applications.
  - (U) Design and fabrication of a ceramic matrix composite (CMC) turbine vane to increase temperature capability by 400 degrees over metallic designs.
  - (U) Design and sector rig testing of an Advanced Gas Generator/JTDE Phase III affordable combustor. It will provide reduced weight and cost for Fighter/Attack and VSTOL applications.

(U) Complete:
- (U) Rig demonstration of a fuel flow metering system that will provide more precise main fuel system delivery to the engine while reducing weight, production and maintenance costs.
- (U) Demonstration of Phase II Fighter/Attack category engine fan, turbine and afterburner components in a full engine configuration to increase thrust-to-weight by 60% and reduce cost by 20%.
- (U) Rig demonstration of a radial turbine blade damping concept which reduces stresses and increases turbine life by 50% and reduces weight by 20%.
- (U) Demonstration of a turbine blade leading edge cooling concept that will be incorporated into an engine design to improve durability.

- (U) ($4,972) INTEGRATED AVIONICS (includes DISPLAYS AND ADVANCED COCKPIT TECHNOLOGIES):
(U) Continue:
- (U) Effort that focuses on enhanced affordability and safety by advancing state-of-the-art maintenance technologies, and develops the capability for critical machinery self-diagnosis, in order to transition from a time-based to a condition-based maintenance philosophy.
- (U) Demonstration of an intelligent crewstation concept to include an onboard computer to continuously assess the conditions of the pilot and the aircraft relative to the escape envelope, and a measurement and control system to unobtrusively monitor aircrew physiological functions.
- (U) Development of the preliminary aircrew interface required to support the Aircrew Decision Aiding Interface effort.
- (U) Investigation of an Advanced Multi-Mode Helmet Vision System to effectively merge real-time sensor information as well as synthetically generated environment imagery.
- (U) Development of advanced analog-to-digital ACEMs technology to enhance air vehicle capability by performing multiple avionics functions. This work is expected to transition to the 0603217N P.E. by FY00.

(U) Complete:

- (U) Demonstration of a smart cockpit controller to effectively manage the functions of the life support, escape and control/display subsystems to achieve a 50% reduction in aircrew workload and 50% improvement in mission performance (i.e. target acquisition time/survivability/situational awareness).
- (U) Demonstration of component building block technology for a (non-moving parts) 3-Dimensional volumetric display.

- (U) ($1,000) ADVANCED 1000-PLUS LINE RESOLUTION CHARGED COUPLED DEVICE (CCD) II NIGHT VISION CAMERA CONGRESSIONAL PLUS-UP

  (U) Initiate:
  - (U) Design, fabrication and bench testing of a CCD camera breadboard mock-up. This will assess its suitability to meet safety criteria for a head-supported weight, ejection safe, high resolution camera for eventual integration into the Crusader day/night helmet vision system.

- (U) ($5,443) NAVAL AIR VEHICLE TECHNOLOGY (formerly FUTURE AND LEGACY AIRCRAFT TECHNOLOGY):

  (U) Initiate:
  - (U) Development of technology to reduce/control abrupt asymmetric wing stall (wing drop) of fighter aircraft. Develop the basic understanding, figures of merit and guidelines to prevent abrupt transonic wing stall and improve maneuverability under a joint effort with Navy, National Aeronautics and Space Administration (NASA), Air Force and industry.

  (U) Continue:
  - (U) Design, fabrication and testing of a UAV to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept.
  - (U) Development of novel concepts to control or limit the suckdown, thermal and acoustical environment penalty associated with the VSTOL from a surface combatant. Develop more accurate and efficient modeling and prediction capability to evaluate VSTOL aerodynamic characteristics of manned aircraft and UCAVs. Update current VSTOL design handbook for modern configurations.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Development of a corrosion-fatigue interaction analysis to support the aging aircraft service life extension requirements. It will provide prediction capabilities to optimize maintenance inspection and repair thereby reducing the corresponding O&M cost by at least 10%.
- (U) Development of a durability-based design criteria for bonded composite patching of metal structures. The product will allow a service life extension of aircraft heretofore required to be replaced by new platforms.
- (U) Development of structural life enhancement techniques applicable to both new and aging aircraft to support FY 2005 objective of increasing fatigue life by 25%.
- (U) Development of improved tactical aircraft high-lift system configurations and a validated 3-dimensional optimization/design method for high-lift systems.

(U) Complete:
- (U) Development of guidelines to alleviate empennage buffet during high alpha maneuvering of fighter/attack aircraft. Development of coupled unsteady aerodynamics and structures interaction methods. Contributes to FY-2000 objective of reducing twin-tail buffet by 20%.
- (U) Joint Service Flight demonstration of an Advanced Molecular Optical Air Data acquisition sensor.
- (U) Demonstration of Nonlinear Adaptive Control Algorithms on both damaged and undamaged aircraft simulations.
- (U) Demonstration of damage identification and estimation algorithms on a high fidelity nonlinear six degree of freedom high performance aircraft simulation.

- (U) ($5,000) VECTORED THRUST DUCTED PROPELLER (VTDP) HELICOPTER CONGRESSIONAL PLUS-UP

(U) Initiate:
- (U) Evaluation of the capability of the VTDP Compound Helicopter technology to: (i) perform/enhance Airborne Mine Counter-Measures (AMCM), (ii) improve multi-mission rotorcraft speed, range, survivability and reduce life cycle cost, (iii) evaluate and mitigate the impact of increased weight empty and hover power required, and (iv) utilize the H-60 as the technology demonstration platform.
- (U) Preliminary design of the YSH-60/VTDP compound demonstrator; conceptual design & operational performance/life cycle cost assessment of a CH-60/VTDP production upgrade configuration.
- (U) Component detail design & risk reduction.

- (U) Modeling & piloted simulation.
- (U) Refinement of the Flight Demonstration Program Plan.

(U) Complete (additional work funded from FY96 Congressional Plus-up):
- (U) Full-scale VTDP fabrication and ground testing.

- (U) ($3,701) OXIDE PURPLE:
  - (U) Classified.

- (U) ($375) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($8,417) PROPULSION & POWER
  (U) Initiate:
  - (U) Design of low cost efficient fuel control system to reduce weight and operate at higher fuel temperatures for Fighter/Attack and UCAV systems.
  - (U) Sector rig test of a CMC combustor for subsonic, UCAV and rotary wing aircraft applications. It will increase combustor temperature 900 degrees F for reduced fuel consumption and increased power density.

  (U) Continue:
  - (U) Development of technology to reduce the weight and volume of the Inverter Converter Controller (ICC) by 45%.
  - (U) Development of PEBBs for Naval aircraft applications in support of the MEA initiative.
  - (U) Development of dynamic system simulation tool for electric power systems.
  - (U) Design and fabrication of JTDE Phase III Fighter/Attack Fan for increased efficiency stage loading and distortion tolerance.
  - (U) Development of improvements in turbine system components to increase durability by 50%.

- (U) Rig testing of a CMC turbine vane to increase temperature capability by 400 degrees over metallic designs.

(U) Complete:
- (U) Testing of a Carbon/Carbon lightweight heat exchanger technology for application in Naval aircraft.
- (U) Rig testing of advanced high temperature turbine sealing concepts. The reduced leakage will result in a fuel consumption reduction of 2% and reduced costs of 50% for increased range for both subsonic support and fighter/attack applications.
- (U) Sector rig test of an Advanced Gas Generator/JTDE Phase III affordable combustor. It will provide reduced weight and cost for Fighter/Attack and VSTOL applications.
- (U) Demonstration of Fighter/Attack category engine fan, turbine, fuel metering system and afterburner components in a full engine configuration to increase thrust-to-weight by 60% and reduce cost by 20%.

- (U) ($4,169) INTEGRATED AVIONICS (includes DISPLAYS AND ADVANCED COCKPIT TECHNOLOGIES):

(U) Continue:
- (U) Refinement and validation of smart escape algorithms.
- (U) Validation of adaptive automation algorithms for managing the smart aircrew interface.
- (U) Integration of smart escape, smart aircrew interface, and smart life support systems into future tactical cockpit simulator.
- (U) Integration of high definition display prototype into flight worthy multi-mode helmet vision system configuration.

(U) Complete:
- (U) Effort that focuses on enhanced affordability and safety by advancing state-of-the-art maintenance technologies, and develops the capability for critical machinery self-diagnosis, in order to transition from a time-based to a condition-based maintenance philosophy.
- (U) Building block helmet mounted display technology for transition to Fleet via the Joint Helmet Mounted Cueing System (JHMCS); basic magnetic head tracker, common helmet vehicle interface, visor optics, and miniature cathode ray tube technology.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) ($4,474) NAVAL AIR VEHICLE TECHNOLOGY:

(U) Initiate:
- (U) Development of technology for integrated multi-disciplinary optimization of manned aircraft and UAVs.
- (U) Development of a statistically based flight certification design criteria. Such an approach will reduce experimental requirements thereby reducing development cost by 10%, allowing for optimal use of complex composite architectures providing weight reduction by 20% and acquisition cost by 10%.
- (U) Development of flight control technology for an automated maneuvering system that assists the pilot in air-to-air and air-to-ground combat phase and in maritime operations.

(U) Continue:
- (U) Design, fabrication and flight testing of a UAV to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept.
- (U) Development of figures of merit and design guidelines to prevent abrupt transonic asymmetric wing stall. Joint effort with Navy, NASA, Air Force and industry.
- (U) Development of concepts which will provide on-demand enhancement or degradation of the jet exhaust mixing process for enhanced Advanced Short Takeoff Vertical Landing (ASTOVL) performance for manned aircraft and UCAVs.
- (U) Development of a corrosion-fatigue interaction analysis with emphasis on random scatter of material properties.
- (U) Development of a reliability analysis capability for bonded composite patching of cracked metallic structure.

(U) Complete:
- (U) Improved tactical aircraft high-lift system configurations and a validated 3-dimensional optimization/design method for high-lift systems.

• (U) ($3,600) OXIDE PURPLE:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	24,553	23,229	22,735
(U) Appropriated Value		29,229	0
(U) Adjustments from FY 2000 PRESBUDG:	-2,125	+5,138	-2,075
(U) FY 2000 PRESBUDG Submission	22,428	28,367	20,660

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect Small Business Innovation Research (SBIR) reduction (-$427); Actual Update adjustments (-$1,698). FY 1999 adjustments reflect Congressional Undistributed Reductions (-$362); Comparability adjustments (-$500); Congressional Plus-Up Vectored Thrust Ducted Propeller and (-$1,000) Night Vision Camera. (+$5,000). FY 2000 adjustments reflect Program Rebalancing (-$1,760); Civilian Pay Rates adjustment (+$45); Non Pay Inflation adjustment (-$300); Navy Working Capital Fund (NAWC) adjustment (-$60).

(U) Schedule:. Unavailability of NASA wind tunnel will delay completion of a FY99 effort to develop a 3-D optimization/design method for high lift systems.

(U) Technical: Not applicable.

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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) RELATED RDT&E: This program adheres to Defense S&T Reliance Agreements on Air Vehicles (Fixed Wing, Rotary Wing, Integrated High Performance Turbine Engine Technology (IHPTET), and Aircraft Power), Sensors, Electronics & Battlespace Environment (Integrated Platform Electronics), and Human Systems.

(U) Work in this Program Element (PE) is related to and fully coordinated with efforts in the following PEs:

PE 0601101F (Geophysics)
PE 0601102F (Materials)
PE 0601153N (Defense Research Sciences)
PE 0602201F (Aerospace Flight Dynamics)
PE 0602202F (Human Systems Technology)
PE 0602203F (Aerospace Propulsion)
PE 0602204F (Aerospace Avionics)
PE 0602233N (Human Systems Technology)
PE 0602234N (Materials, Electronic and Computer Technology)
PE 0602708E (Cockpit Autonomous Landing)
PE 0603003A (Rotary Wing Aircraft Technology)
PE 0603106F (Logistics Systems Technology)
PE 0603112F (Advanced Materials)
PE 0603202F (Aerospace Propulsion Subsystems Integration)
PE 0603205F (Flight Vehicle Technology)
PE 0603211F (Aerospace Structures)
PE 0603216F (Aerospace Propulsion and Power Technology)
PE 0603217N (Air Systems and Weapons Advanced Technology)
PE 0603231F (Crew Systems and Personnel)
PE 0603238N (Precision Strike & Air Defense Technology)
PE 0603245F (Advanced Flight Technology Integration)
PE 0603706N (Medical Development(Advanced))
PE 0603707N (Manpower, Personnel, and Training Advanced Technology Development)
PE 0603792N (Advanced Technology Transition)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Advanced Technology Transition in accordance with the ongoing Reliance joint planning process and contains no unwarranted duplication of effort among the Military Departments.

D. (U) SCHEDULE PROFILE: Not applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 2 - Exploratory Development

PE NUMBER AND TITLE: 0602131M Marine Corps Landing force Technology

PROJECT: C3001

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
C3001 Marine Corps Landing Force Technology	12478	12970	10534	9867	11653	11715	11936	12202	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

A. (U) Mission Description and Budget Item Justification:

(U) The basic roles and missions of the Marine Corps (the seizure and defense of advanced naval bases, the conduct of land operations essential to the naval campaign, and other such duties as the President may direct) are specified in Title 10 USC 5063. The National Security Act of 1947 and DoD Directive 5000.1 are the basis for conducting this Marine Corps effort.

(U) By law, the Marine Corps is tasked to develop, in conjunction with the Army and Air Force, those phases of amphibious operations that pertain to tactics, techniques, and equipment used by the landing force. This program element (PE) is executed under project MQ1A. It is organized into five Warfighting Imperatives by the Science and Technology (S&T) Roundtable process. These Warfighting Imperatives are: Command and Control, Maneuver, Logistics, Firepower, and Training and Education.

(U) The primary objective of this Program Element (PE) is to develop and demonstrate the technologies needed to meet the Marine Corps unique responsibility for amphibious warfare and subsequent operations ashore. This PE provides the knowledge base to support Advanced Technology (6.3) and is the technology base for future amphibious/expeditionary warfare capabilities. This PE supports the Concept Based Requirements System of the Marine Corps Combat Development Center (MCCDC) and responds directly to the USMC S&T Roundtable process managed by MCCDC and Marine Corps Systems Command.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the Applied Research Budget Activity because it investigates technological advances with possible applications toward solution of specific Marine Corps problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 Accomplishments:

- (U) $ 3249 Maneuver Imperative: Completed Preliminary Design of tunable filter multi-spectral camera upgrade for mine detection and processing software development and transitioned to Coastal Battlefield Reconnaissance and Assessment (COBRA) ATD; multi-spectral laser diode array for night illumination were designed and fabricated. Completed Technical Assessment of the Small Unit Riverine Craft (SURC). Completed Technical Configuration Description of SURC to support Technology Demonstrator craft in FY99 and support USMC Riverine Center of Excellence for future operational concept development. Completed Technical Analysis of Mine Countermeasure systems that can be applied to Marine Corps Ground Combat vehicles to support on-the-move, In-Stride mine countermeasure. Completed Technical Analysis of Urban Warfare mobility study to address systems that can be applied to Marine Corps Ground Combat vehicles to support enhanced operations in urban environments. Continued long term corrosion exposure testing of materials, components and coatings that will be on future USMC platforms. Findings from 30 month exposure test supported the USMC Advanced Amphibious Assault Vehicle (AAAV) program in hull material downselection and provided a cost avoidance of greater than $50 million, in addition to Logistical Vehicle System Replacement (LVSR) and Medium Tactical Vehicle Replacement (MTVR). Helo-Transportable Tactical Vehicle participated in USMC STEEL KNIGHT exercise, US Special Operations exercises, and USMC Urban Warrior Limited Objective Exercises. These exercises support the ope rational capabilities definition for the Reconnaissance, Surveillance and Targeting Vehicle (RST/V) program. Completed Hull Life Analysis of the USMC Family of Light Armored Vehicles (LAV). This analysis supports the PMs acquisition plan to conduct a 10 year Service Life Extension Program. Completed testing and reporting of Joint Advanced Survivability Experiment program (classified).
- (U) $ 1999 Firepower Imperative: Continued development of sensor testbed (alignment/registration). Investigated sensor-to-shooter fire control systems integration. Demonstrated non-magnetic North-finding Azimuth systems. Investigated target discrimination systems integration into Advanced Field Artillery Tactical Data System (AFATDS). Investigated and demonstrated technology to Enhanced Target Acquisition and Location (ETALS) (formerly Forward Observer/Forward Air Controller (FO/FAC)). Investigated advanced small arms weapons systems. Demonstrated fire-from-enclosure technology for shoulder launched weapons systems. Continued Broad Area Announcement (BAA) solicitation/award cycle. Began integration of sensor technology into prototype Remote Reconnaissance Tactical Vehicle (RSTV).

• (U) $	2958	Command and Control Imperative: Completed requirement analysis and technology assessment for synchronizing information in order to achieve a federated database capability, developed necessary algorithms, and initiated the prototype design. Developed Communications Program Plan and strategy for the analysis and evaluation of DoD Mobile Network Radio programs. The analysis included verification modeling capability for mobile network radios to ensure they meet USMC requirements. Conducted analyses of potential candidate systems and prepared technical specifications for prototype system requirements. Completed the development of the Smart Tactical Jammer by expanding the spectrum of signals that can be attacked to include cellular and Personal Communications Systems (PCS). Initiated the development of a family of light weight expendable jammers using technology developed by the Cellular/PCS industry. Conducted analyses and developed a conceptual design for a Time Difference of Arrival (TDOA) system for precision location of communication transmitters. Initiated the development of software tools to provide USMC Commanders with decision support aids for battlefield decision making and programs to automatically generate, process and transfer Target List information to AFATDS and Contingency Theater Automated Planning System (CTAPS). Evaluated Commander's Critical Information Requirements Enhancement tools. Enhanced Unit Operation Center concept development.
• (U) $	3372	Logistics Imperative: Continued system development of Logistics Information Systems which focused on decision support tools and data warehousing. Decision support tool technology exploration through the BAA process included the use of neural networks, expert agents, mathematical modeling, spreadsheet modeling, and spares based modeling to increase visibility into the logistics picture. Data warehousing technologies included smart notification and data push, data warehouse modules to facilitate mining from mainframe legacy systems and technology to maintain data integrity, and web server architectures that can support both upper and lower command structures in a deployed environment. Developed bulk liquids technologies in support of future seabasing concept development, focused on innovation in packaging and distribution. Continued modeling and simulation support and technology development plan for future mission area analysis. Explored new technologies for high power density generators and deployable power distribution. Explored new technologies for expeditionary washdown. Supported transition of validated logistics equipment systems evolving through Advanced Warfighting Experiments.
• (U) $	900	Training and Education Imperative: Continued Rapid Virtual Data Base development. Developed intelligent automated forces. Continued training technology concept development. Began Integrated Family of Simulators concept development. Initiated efforts in Small Unit Tactical Training (SUTT).
(U)Total $	12478	

(U) FY 1999 Planned Program:

- (U) $ 3464 Maneuver Imperative: Conduct risk reduction for the RST/V platform and payload integration. Complete integration of survivability technology with RST/V and LAV and tested. Fabricate, integrate and test tunable filter multi-spectral camera upgrade for COBRA enhanced detection capability. Complete mine detection processing software development and test. Initiate investigation leading to the technology to enhance mobility of tactical systems. Continue corrosion and materials research and testing with insertion of technologies in Light Armored Vehicle/Medium Tactical Vehicle Replacement/Logistics Vehicle System (LAV/MTVR/LVS). Complete market survey of commercial craft and propulsion components to satisfy the Small Unit Riverine Craft (SURC). Conduct detailed analysis and modeling of notional solutions to support Mine Countermeasure systems that can be applied to Marine Corps Ground Combat vehicles to support on-the-move, in-stride mine countermeasure. Prepare acquisition plan and supporting documents for commencement of developmental program to test hardware in FY00/01. Conduct joint planning with US Army to leverage existing or non-developmental items to USMC needs. Continue long term corrosion exposure testing of materials, components and coatings that will be on future USMC platforms. Conduct in-field testing of advanced components and coatings on light and medium tactical vehicles. Helo-Transportable Tactical Vehicles participating in USMC Urban Warrior Advanced Warfighting Experiment and support Light Strike Vehicle acquisition program with Operational Evaluation and technical requirement assessments. Develop advanced hardware/software components for intergration and transition into ongoing acquisition efforts for the Coastal Battlefield Reconnaissance and Analysis (COBRA).
- (U) $ 2178 Firepower Imperative: Continue advanced lightweight weapons advanced technology efforts. Continue sensor integration technology efforts. Demonstrate advanced Enhanced Target Acquisition and Location technology. Continue sensor technology integration into RSTV.
- (U) $ 3590 Command and Control Imperative: Support USMC requirements for Joint Networked Radios by prototyping modules and capabilities that the USMC will insert into the requirements of the Joint Program Office. Demonstrate communication technologies that are of high relevance to evolving USMC warfighting objectives for possible insertion into joint communication requirements. Field demonstrated capability to jam cellular and other PCS devices that may be utilized for military purposes. Demonstrate technology capability for further miniaturization of expendable jammers. Field test target management capability for AFATDS and CTAPS and evaluate the requirement for targeting deconfliction including Naval surface fires in a USMC target management system. Assess the requirement and benefits of converting software developments to evolving Windows NT interface capabilities being made available by Marine Corps Tactical System Support Activity (MCTSSA) and Defense Information Systems Agency (DISA).

• (U) $	2350	Logistics Imperative: Continue system development of Logistics Information Systems, focusing on decision support tools and data warehousing. Incorporate technology for asset visibility, to include warranty tracking of high dollar items, electronic issue and direct vendor support for supply. Continue to develop bulk liquids technologies in support of future seabasing concept development, focusing on innovation in packaging and distribution. Additional attention will be focused on addressing the seamless Naval movement of bulk liquids from ship to shore, to include water, and to include unit issue or water in an NBC environment. Concept exploration in precision logistics, including containerized deployable warehousing, concept exploration for technologies to improve vehicle supportability over the full life cycle, and integrated diagnostics.
• (U) $	1264	Training and Education Imperative: Continue Rapid Virtual Data Base development. Continue development of intelligent automated forces and test and operational simulations. Continue training technology concepts development. Continue Integrated Family of Simulators development and test with Closed Loop Artillery Simulator (CLAS), Combat Vehicle Trainer (CVT). Continue efforts in Small Unit Tactical Training (SUTT).
• (U) $	124	Portion of extramural program reserved for Small Business Innovation Research (SBIR) assessment in accordance with 15 USC 638.
(U)Total $	12970	

(U) FY 2000 Planned Program:

• (U) $	3284	Maneuver Imperative: Conduct risk reduction for the RST/V platform and payload integration. Complete integration of survivability technology with RST/V and LAV and test. Complete integration and testing of enhanced minefield multi-spectral sensor, illuminator and processor. Test technology to enhance mobility of tactical systems. Continue corrosion and materials research and testing with insertion of technologies in LAV/MTVR/LVS. Begin design for advanced Mine Countermeasure systems that can be applied to Marine Corps Ground Combat vehicles to support on-the-move, In-Stride mine countermeasure. Continue long term corrosion exposure testing of materials, components and coatings that will be on future USMC platforms. Helo-Transportable Tactical Vehicles participating in USMC Capable Warrior Limited Objective Experiments and Extending the Littoral Battlespace ACTD experiments acting as surrogate platform for RST-V ATD.
• (U) $	1000	Firepower Imperative: Continue sensor integration technology efforts. Demonstrate advanced ETALS technology. Demonstrate sensor technology integration into RSTV.
• (U) $	2850	Command and Control Imperative: Demonstrate TDOA location finding in field tests with both USMC and Joint data link connectivity and fusion of data. Provide integrated intelligence database object manipulation for more realistic threat representations than icon presentations. The intelligence database presentations shall support both local and theater entries. Extend web based interfaces to tactical computer applications for selected visibility at lower echelons.

- (U) $ 2316 Logistics Imperative: Continue logistics technology efforts in direct support of emerging USMC logistics system and requirements. Continue specific technology development and insertion in the areas of Logistics Information Resources and Precision Logistics. Continue rapid prototype and experimentally validated logistics equipment concepts into Marine Corps acquisition programs.
- (U) $ 1084 Training and Education Imperative: Complete Rapid Virtual Data Base development and demo. Continue development of intelligent automated forces and test and operational simulations. Continue training technology concepts development. Continue Integrated Family of Simulators development and test with the Small Unit Tactical Trainer (SUTT). Initiate efforts in training technology.

(U)Total $ 10534

B. (U) Project Change Summary

	FY 1998	FY 1999	FY 2000
(U) Previous President's Budget	13458	12132	10609
(U) Adjustments to Previous President's Budget	-980	+838	-75
(U) Current Budget Submit	12478	12970	10534

(U) Change Summary Explanation:

(U) Funding: FY98 decreases and increases are due to reprioritization of programs within the Marine Corps. FY 1999 increases and decreases reflect a Congressional increase of One (1) million dollars for advanced hardware/software development for COBRA and minor affordability adjustments in the amount of 162 thousand. FY 2000 decrease is due to revised economic adjustments.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) Other Program Funding Summary (APPN, BLI #, NOMEN)

FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost

Not applicable.

(U) Related RDT&E

(U) This program adheres to Tri-Service Reliance Agreements in Chemical/Biological Defense; Command, Control and Communications; Conventional Air/Surface Weaponry; Electronic Devices; Ground Vehicles; Ships and Watercraft; Manpower and Personnel; and Training Systems.

(U) PE 0603606A (Improved Dispersed Explosives Technology)
(U) PE 0603619A (Improved Dispersed Explosives Technology)
(U) PE 0603611M (Marine Corps Assault Amphibious Vehicles)
(U) PE 0603612M (Marine Corps Mine/Countermeasures Systems)
(U) PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
(U) PE 0206624M (Marine Corps Combat Services Support)
(U) PE 0603635M (Marine Corps Ground Combat/Supporting Arms Systems)
(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations)
(U) PE 0602232N (Space and Electronic Warfare (SEW) technology)
(U) PE 0603782N (Shallow Water Mine Countermeasures Demonstrations)
(U) PE 0206313M (Marine Corps Air Ground Task Force Command/Control/Comm/Computers & Intel (MAGTF C4I)
(U) The Army, Air Force, and Navy Technology Base Programs are monitored by Marine Corps Project Officers through their counterparts in those organizations to ensure that no unwarranted duplication exists.

D. (U) Schedule Profile: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
C3ISR	54,084	68,108*	68,823	70,272	72,726	76,111	77,904	79,762	CONT.	CONT.

*FY 1999 transfer during execution from PE 0605866N to correct budgeting error (+1,100)

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) supports future command, control, communications (C^3) and intelligence, surveillance & reconnaissance (ISR) systems for surface, air and space platforms and ashore for Naval Warfare. C^3 technology focuses on the delivery of critical, time sensitive, tactical information to decision makers for fusion and management of information between the warrior, command centers, and National Command Authorities. Technology developments include network Centric architecture and information infrastructure, intelligent information exploitation and retrieval, consistent tactical picture development, collaboration environments, and interactive decision support including continuous plan-execute cycles, and navigation. The major goal is to provide the Navy with the capacity to interconnect government and commercial telecommunication assets, worldwide, that is efficient and responsive to regional theater challenges and the National interest. Surface/Aerospace ISR technology emphasizes advanced sensor and processing systems for theater wide air and surface surveillance, battle group surveillance, real-time reconnaissance and ship self-defense. Major technology goals include increased long-range target detection and discrimination, precision track and positive target identification in complex countermeasure and adverse environmental conditions. Both C^3 and ISR technologies directly support the Joint Warfighter Mission Areas and Areas of Precision Force (Strike Warfare) including Littoral Warfare, Combat Identification (ID), Joint Theater Missile Defense, and Information Superiority. Specifically: Precision Force efforts address technology issues in real-time targeting, long range target detection, track and engage and Battle Damage Assessment (BDA). Programs include mission planning, en-route C^3, precision targeting, multisensor fusion, and temporal and spectral discrimination algorithms. Precision Force in the Littorals addresses issues in air and surface battlespace and develops technology for ship self-defense, cooperative engagement and power projection systems including ship-based and off-ship radar and electro-optic/infrared (EO/IR) sensors, connectivity and robust, enduring communications. ISR technology efforts address issues of precise target location and real-time targeting, counter-jamming and deception. Program includes multi-platform radar and (IR) sensors for detection,

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

identification, tracking, BDA, and timely distribution of surveillance information to all levels of command. C^3 efforts address Networked Operations supported by distributed collaborative battle management. Operational focus areas are littoral warfare, strike and operations other than war (OOTW) e.g. humanitarian assistance. This PE emphasizes sensors and C^3 technology to provide Naval Warfighters with seamless, timely situational awareness of the total battlespace and indications and warning of threat operations and intentions.

(U) These efforts support the Joint Warfare Strategy "Forward... From the Sea". Programs are jointly planned in the Defense Technology Area Planning Process within the Department of Defense.

(U) Due to the sheer volume of work included in this PE, the programs described in the Accomplishments and Plans sections are only representative selections of the work included in this PE and not an exhaustive presentation.

(U) The Navy Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications towards solution of specific Naval problems short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($20,430) RADAR TECHNOLOGY: The Radar Technology program investment addresses Navy surveillance needs and exploits radar sensor technology opportunities. Emphasis is on major platforms such as ships and aircraft and cross cutting technologies that apply across platforms. Major drivers include affordability and sensor performance in complex target, Electronic Countermeasure (ECM) and adverse environmental conditions including operations in the littorals.
  - (U) Developed multi-band shipboard radar system architecture including design concepts for a multi-frequency band, electronically steered phased array to enable search, track and engage functions from a single topside

radio frequency (RF) Aperture. This effort is also assessing effectiveness of adaptive waveforms for suppressing effects of clutter and ECM on system dynamic range. Addresses DD-21 needs to reduce topside signatures by reducing the number of RF apertures required for radar operations.

- (U) Fabricated scale model of voltage controlled diode affordable phased array radar for performance assessment. Cost of a shipboard four-face voltage controlled diode antenna array is estimated to be 20% of the cost of current active element, phase shifter steered arrays. Addresses Navy needs for affordable high performance radar antennas. Program was enabled by previous Small Business Innovation Research (SBIR) program investment.
- (U) Developed design for Millimeter Wave High Resolution Radar demonstration model to evaluate detection and precision track performance for short range, ship defense operations in countering high dynamic anti-ship missiles. Addresses Navy needs for precision fire control quality tracking and cueing of anti-ship missile defense engagement systems Program Executive Officer, Theater Air Defense (PEO-TAD, N091).
- (U) Developed scale model ultra high frequency (UHF) non rotating electronically scanned phased array that is form, fit and function with current Navy E-2C Aircraft rotodome antenna configuration. Identification Friend or Foe (IFF) antennas for 360° field of view (vice current 120 degree)are integral to the antenna and rotodome structure. Addresses PEO-T/PMA-231 needs for radar surveillance and tracking of cruise and theater ballistic missiles in littoral regions.
- (U) Initiated systems study to determine extent of upgrade to the Mountaintop experimental radar necessary to enable future technology feasibility demonstrations in theater ballistic missile and cruise missile defense scenarios. This study is being conducted in conjunction with Pacific Missile Range Facility staff to insure compatibility with range operations.
- (U) Developed compact UHF digital receiver for E-2C AN/APS-145 radar improvement program. Utilized Defense Advanced Research Projects Agency (DARPA) advances in Microwave Monolithic Integrated Circuit (MIMIC) technology to realize a high performance direct RF to digital receiver (that is less than one tenth the size and weight of current E-2C receiver). Addresses PEO-A/PMA-231 needs.
- (U) Established a program to develop airborne multi-mode radar technology to enable imaging of stationary and mobile land and sea targets from a single radar system. Technology needs of Navy AN/APS-137 (PMA-290) and Joint Surveillance Target Attack Radar System (JSTARS) are addressed.
- (U) Laboratory and field tested ultra wideband very high frequency (VHF/UHF) radar for concealed/buried target detection, location and imaging. Hyper resolution techniques have been developed to maximize image

quality and to minimize false alarm. This program is coordinated with Defense Advanced Research Project Agency (DARPA), Army and the Defense Intelligence Agency.
- (U) Completed Joint Program with Air Force and DARPA to develop Automatic Target Recognition technology including algorithms to extract and correlate target electromagnetic and dimensional characteristics from high resolution radar profiles and imagery. Addressed needs identified by Joint Combat Identification Office (JCIDO), CNO-N66, for high confidence target identification systems that are insensitive to target aspect angle and dynamics. Technology planned for transition to United States Air Force (USAF) F-16 in FY1999.
- (U) Demonstrated high resolution, passive imaging millimeter wave radiometric sensor for covert, all weather strike targeting, target identification and battle damage assessment. The sensor produced clearly defined images of visibly obscured (Fog) ground structures and vehicles such as buildings, bridges and various trucks and armored vehicles. This demonstration sensor was enabled by millimeter wave focal plane technology developed by DARPA under the Technology Reinvention Program (TRP). Demonstration addressed Navy and Marine Corps needs for low probability of intercept sensors identified by the Office of the Chief of Naval Operations (N88) and the Commander in Chief Atlantic Fleet (CINCLANTFLT) and is also responsive to PEO-TAD needs for covert navigation in restricted waters.

- (U) ($11,576) EO/IR TECHNOLOGY: The EO/IR technology investment addresses Navy surveillance needs and exploits technology opportunities leading to advanced EO sensor and autonomous processing capabilities. The program emphasizes needs of major Navy air platforms for detection, acquisition, precision targeting and fire control handoff. Technologies such as multi-wavelength passive/active sensors and multi-dimensional signal processing algorithms to enhance detection and track performance in adverse environments are stressed. Optical apertures to enable multiple EO sensors to operate simultaneously from a single aperture are being developed.
  - (U) Completed system design and architectural studies addressing deficiencies of scanned Infrared Search and Tracks (IRSTs) such as missed target detection due to atmospheric scintilation and need to mitigate ocean sun glint effects. This advanced staring infrared panoramic search and track sensor and signal processing technology uses spatial, temporal and spectral discriminates to detect subsonic and supersonic targets such as Anti Ship Missiles (ASMs) and TMBs while suppressing clutter (backlit clouds, surface reflections) and nuisance targets. The completed design incorporates DARPA-funded technology for high-performance 1024 x 1024 staring Focal Plane Arrays (FPAs). The Joint program with the United Kingdom Royal Navy and addressing PEO-TAD/SC needs for ship and TBM defense has been put on hold. The design concepts although not demonstrated have transitioned to PEO-TAD and NSWC-DD E&MD IRST program.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

- - (U) Completed hardware and software integration of real time multi-dimensional commercial off the shelf (COTS) signal processor with the ship two-color IRST, and transitioned to PEO-TAD and NSWC-DD for use in E&MD IRST program.
  - (U) Developed compact dual-band airborne IRST sensor with active laser aperture for E-2C to enable long range detection and tracking of TBMs and cruise missiles (CMs). Laser development funded by Ballistic Missile Defense Organization (BMDO). Program addresses needs identified by the Fleet Commander In Chiefs, PEO-TAD and PEO-A for long range detection and precision track of TBM's and CM's.
  - (U) Developed Hyper Spectral Infrared sensor jointly with USAF and Defense Airborne Reconnaissance Office (DARO) with greater than one hundred sub-bands in both the mid wave (3-5 microns) and long wave (8-12 microns) spectral bands and developed IR signal processing algorithms to recognize/exploit man-made target signatures relative to natural backgrounds and countermeasures in support of tactical and airborne reconnaissance, surveillance and strike warfare needs identified by Commander In Chief Pacific Fleet (CINCPACFLT) and N091.
  - (U) Developed modeling and simulations to enable fusion of multiple wavelength EO passive and active sensor attributes. Incorporated worldwide threat, scene/terrain and environmental databases. Conducted analysis and simulation of sensor and operating characteristics in environments representative of worldwide conditions. Products of this development are being utilized by Government laboratories and industry to optimize sensor designs and architectures without incurring the cost of hardware and field tests.

- (U) ($2,872) MULTI-SENSOR TECHNOLOGY: The Multi-Sensor technology program investment addresses Navy Intelligence, Surveillance and Reconnaissance needs and exploits technology opportunities leading to the integration, fusion and automated management of sensors operating within a platforms Combat System Architecture. The program emphasizes needs of major ship and air platforms and is developing crosscutting technologies that apply across platforms. Technologies such as processing architectures and algorithms to fuse, filter and correlate data and automated resource management procession are pursued.
  - (U) Completed development of F/A-18 aircraft SUU-63A wing station configured receivers, processors and antennas to enable precision targeting of emitters at ranges beyond the defensive weapons systems. Addresses Fleet needs and those of NAVAIR-PMA 242 and PMA 265 for passive RF targeting for High Speed Anti-Radiation Missile (HARM).

- (U) Developed/integrated encoded modulation waveforms into existing aircraft (AV-8B) targeting laser for laser interrogation of an IFF system. Implemented corresponding decoding logic into existing laser warning receivers to cue standard IFF response on own aircraft. Addresses Fleet and Chief of Naval Operations (CNO) N66 needs for positive Combat ID to eliminate/minimize fratricide during close air support operations.
- (U) Developed data fusion/resource management processing architecture in an interactive simulation to facilitate autonomous multi-sensor operation. Integrated models of current operational sensors (Radar, Electronic Support Measures (ESM), EO into a multi-sensor test bed enabling evaluation and demonstration of emerging fusion and resource management processing technology without costly flight tests. Responds to Fleet requirements/needs for timely integration and dissemination of on-board and all source sensor data with automated data fusion and tactical decision aids for real time sensor optimization.

- (U) ($1,835) COMMUNICATIONS NETWORKS: Continue development of technologies critical to performance and robustness of Naval Communications networks.
  - (U) Designed and tested prototype software for the high performance reliable multicast transport protocol and Quality of Service (QOS) enhancements to the Internet Protocol (IP). Coordinated via the Information Superiority Technology (IST) Panel of the Defense S&T Reliance.
  - (U) Installed the ATM networking testbed. Prepared test plans and procedures in coordination with French experts. Coordinated via IST Panel of the Defense S&T Reliance.
  - (U) Developed Domain Name Server for heterogeneous mobile networks. Coordinated with the DARPA Warfighters Internet program. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Analyzed the QOS Channel Allocation Protocol for throughput, delay and robustness.

- (U) ($10,028) RADIO COMMUNICATIONS: Continued development of key communications technologies for air, ship and submarines.
  - (U) Conducted full-configuration at-sea testing of the compact low-profile buoyant cable submarine antenna.
  - (U) Developed the design software for the structurally-embedded, reconfigurable aircraft antenna array panel on a curved surface, and compared, with computed predictions. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Developed an improved modem for UHF line-of-sight communications employing bandwidth efficient modulations and adaptive equalization of the fading and multi-path maritime channel. Incorporated power

management and control algorithms to achieve efficient use of available power resources. Coordinated via the IST Panel of the Defense S&T Reliance.
- (U) Adapted commercial code division multiple access (CDMA) wireless technologies to naval applications. Employed power management and control algorithms for improved network design. Coordinated via the (IST) Panel of the Defense S&T Reliance.
- (U) Based on at-sea experiments conducted with the National Aeronautics and Space Administration (NASA) Advanced Communications Technology Satellite (ACTS), developed framework for reception of Global Broadcast Service (GBS) on naval ships and aircraft.

- (U) ($5,714) COMMAND SUPPORT: This program develops and demonstrates software components and technologies that enable the Navy's concept of Network-Centric Warfare and the Joint Chiefs Joint Vision 2010. The focus is on militarily-unique information processing technologies that enable information dominance through vastly improved speed of command. Particular emphasis is directed to issues involving the ability of geographically distributed Naval decision-makers to collectively generate and perceive a Common Tactical/Operational Picture, and to jointly plan and monitor military missions. All of the research efforts recognize the important role of COTS software components and standards, and consequently they focus on maximizing the integration of such software into software functionality for Naval applications.
- (U) Demonstrated support of the Common Operational Picture/Common Tactical Picture (COP/CTP) and mission planning, demonstrated an intelligent agent architecture and agents for the smart retrieval of tactically useful information (e.g. an agent for retrieving weather at a planned landing zone).
- (U) Completed prototype and demonstrated an object oriented database management architecture using real time interface mechanism to access hybrid databases (flat files, relational, or object oriented) in a distributed real time information system. Real-time extensions submitted to the Object Management Group for incorporation as an international computing industry standard.
- (U) Transitioned collaborative environment technology integrating COTS groupware and collaborative tools to support day-to-day ops, etc. to Space and Naval Warfare Systems (SPAWAR) (PE 0603794N).
- (U) Initiated development of an Element Level Strike Planner using collaborative and distributive technology that will integrate operations of a strike mission plan from receipt of the Air Tasking Order to passing and briefing the completed plan to the Commanding Officer. Jointly funded with N88 and N63.

- (U) In support of information system security, developed a formal model for protecting against data storage spoofing in large scale systems. Implemented an integrity cluster controller for combating malicious software attacks.

- (U) ($1,629) NAVIGATION: Continued development of key navigation technologies for air, ship and submarines.
  - (U) Performed concept demonstration of the candidate signal structure for reduced Global Positioning System (GPS) vulnerability.
  - (U) Analyzed measured reductions in the dead-band lock-in for the quantum-well mirror ring laser gyro technology.
  - (U) Completed laboratory evaluation of high performance fiber-optic gyro (FOG) Advanced Development Model I for submarine applications and transitioned to the Navy Special Projects Office (SP-24).
  - (U) Developed and tested the high power fiber-optic light source for high performance FOGs.
  - (U) Identified techniques for data compression and bulk processing applicable to fast processing of GPS signals.

3. (U) FY 1999 PLAN:

- (U) ($32,342) RADAR TECHNOLOGY: The Radar Technology program investment addresses Navy surveillance needs and exploits radar sensor technology opportunities. Emphasis is on major platforms such as Ships and aircraft and cross cutting technologies that apply across platforms. Major drivers include affordability and sensor performance in complex target, ECM and adverse environmental conditions including operations in the littorals.
- FY 1999 funding for this thrust includes an $11.0M Congressional add-on for UHF Electronically steered Array development and for Kauai, Hawaii Mountain Top facility capability improvements. This Congressional add-on is for FY 1999 only.
  - (U) Install multi-band, flexible waveform, shipboard radar sensor at Wallops Island for performance and operational utility assessments against representative targets in varying environmental clutter and sea state conditions. Assessments jointly conducted with PEO-TAD/SC.
  - (U) Continue development of adaptive waveforms for multi-band shipboard radar to maximize detection and track performance in complex target and multi-path conditions and to minimize system dynamic range and analog-to-

digital converter requirements. Addresses PEO-TAD/SC and N-86 needs for continuous track in severe multi-path and clutter conditions.
- (U) Integrate scale model voltage controlled diode array with test bed radar system to develop performance versus cost trade-off metrics. Responds to Navy needs for affordable high performance RF apertures. Joint program with DARPA.
- (U) Continue development of Millimeter Wave High Resolution Radar Demonstration Model for close in anti-ship cruise missile (ASCM) tracking. Incorporate High Power source developed by the Electronics program under PE 0602234N.
- (U) Characterize performance of scale model UHF electronically scanned array in static chamber testing and at the experimental radar facility at Pacific Missile Range Facility (PMRF), Kauai, Hawaii. Compare overall performance to existing E-2C TRAC-A, and ADS-18 antenna systems. Conduct E-2C integration studies to include electromagnetic compatibility determinations. This development addresses technology needs identified by CNO-N88, PEO-A and PMA-231 for multi-target tracking of theater ballistic and cruise missiles and for 360 degree continuous (IFF) capability.
- (U) Complete technology development of UHF digital receiver and characterize performance in preparation for field testing at the Mountaintop Radar Facility in Kauai, Hawaii.
- (U) Flight test concealed/buried target detection ultra-wideband radar to quantify target detection and image qualities in high false alarm conditions. DARPA and Army will participate in flight test effort.
- (U) Integrate test bed model of airborne multi-mode radar system into test aircraft for performance evaluation against small seaborne craft and moving and stationary ground targets. DARPA, Air Force (Wright Laboratories) and JSTARS program will participate in evaluation.
- (U) Continue joint program with Air Force and DARPA to develop automatic target recognition algorithms in support of Tri-Service needs for long range identification of stationary and slow moving ground targets.
- (U) Congressional Plus Up: Integrate UHF Electronically Steered Array in Kauai, Hawaii Mountain Top Test Facility. Effort includes improvements to the facilities experimental radar and will establish connectivity to the Maui High Performance Computing Center.

- (U) ($11,568) EO/IR TECHNOLOGY: The EO/IR technology investment addresses Navy surveillance needs and exploits technology opportunities leading to advanced EO sensor and autonomous processing capabilities. The program emphasizes needs of major Navy air platforms for detection, acquisition, precision targeting and fire control

handoff. Technologies such as multi-wavelength passive/active sensors and multi-dimensional signal processing algorithms to enhance detection and track performance in adverse environments are stressed. Optical apertures to enable multiple EO sensors to operate simultaneously from a single aperture are being developed.
- (U) Integrate dual band airborne IRST sensor into a fleet configured E-2C aircraft for aircraft compatibility and performance evaluation. Optical aperture to enable insertion of BMDO funded laser sensor when sufficiently mature is included. This technology addresses needs for long range detection and tracking of Theater Ballistic Missiles identified by PEO TAD/SC and PEO-T.
- (U) Continue development of target discrimination and recognition algorithms to distinguish unique characteristics of man made objects relative to naturally occurring background clutter.
- (U) Continue joint program with Air Force and DARO to develop Hyper-spectral infrared sensors for Naval airborne Intelligence, surveillance and reconnaissance missions. Addresses needs identified by PMA-290 and PMA-265.
- (U) Continue modeling and simulation to optimize sensor operating characteristics and fusion of multi-wavelength EO passive and active sensor attributes. Develop cueing and control processing strategies to enable rapid hand-off of precision fire control data to on and off-board engagement systems.
- (U) Integrate multi-function electro-optic sensor technology completed in FY 98 into a distributed aperture infrared sensor system (DAIRS) specifically for the Joint Strike Fighter (JSF). This development addresses the JSF program office needs for passive infrared sensors to provide continuous situational awareness and missile warning. This development is coordinated with the Air Force within the JSF program office and within the Defense Reliance Sensors, Electronics and Battlespace Environments Panel.
- (U) Initiate joint program with DARPA and PMA-290 to develop and demonstrate Hyperspectral Electro-Optical Imaging technology on the EP-3 aircraft. Technology development emphasizes high resolution, multiband imaging sensor and algorithms for target detection and confirmation. Initial plans for insertion of this technology is for EP-3 with follow-on application to F-18F shared reconnaissance POD (SHARP). This effort addresses needs identified by CNO-N88 and PEO-T for real time situational awareness, precision targeting and battle damage assessment.

- (U) ($2,768) MULTI-SENSOR TECHNOLOGY: The Multi-Sensor technology program investment addresses Navy Intelligence, Surveillance and Reconnaissance needs and exploits technology opportunities leading to the integration, fusion and automated management of sensors operating within a platforms Combat System Architecture.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

The program emphasizes needs of major ship and air platforms and is developing crosscutting technologies that apply across platforms. Technologies such as processing architectures and algorithms to fuse, filter and correlate data and automated resource management procession are pursued.
- (U) Transition targeting avionics sensor technology to PMA 242 to provide precision targeting capabilities for U.S Navy and (HARM) capable International aircraft.
- (U) Demonstrate laser encoded IFF on AV-8B and F/A-18 aircraft at CNO-N66 sponsored All Service Combat ID Evaluation Team (ASCIET) trials with follow-on evaluation by North Atlantic Treaty Organization (NATO) Atlantic Council 243 Defense Research Group member Nations.

(U) Integrate Data Fusion/Resource management processing algorithms into the SPY-1 radar at the Aegis Combat Systems Center and conduct ground system characterization and effectiveness assessments during theater ballistic missile tracking exercises. Addresses PEO TAD/SC needs for sensor resource management technology.

(U) Initiate system studies for the E-2C aircraft to define integrated multisensor architecture to include tactical data link and the cooperative engagement capability (CEC) system. This effort responds to needs identified by CNO-N88 and PMA-231 for detection, discrimination, fire control quality tracking and engagements of missile threats.

- (U) ($1,809) COMMUNICATIONS NETWORKS: Continue development of technologies critical to performance and robustness of Naval Communications networks.
- (U) Test and analyze the prototype software for the high performance reliable multicast transport protocol and the QOS enhancements to the Internet Protocol (IP). This work extends COTS-based reliable multicast protocols to various military applications. Present the results to the Internet Engineering Task Force (IETF) for consideration in the next generation standards-track protocols. Coordinated via the IST Panel of the Defense S&T Reliance.
- (U) Incorporate the enhanced transport and IP prototype software in the ATM network testbed and test their performance relative to existing protocols. Borrow Asynchronous Transfer Mode (ATM) machines from France for performance testing. Conduct tests employing different ATM machines to determine quality of performance and interoperability. Coordinated via the IST Panel of the Defense S&T Reliance.
- (U) Investigate technical issues related to ATM use, such as signaling, interoperability robustness, and ability to support QOS at the application layer. Military use of ATM switches requires adaptation to RF media and is not limited to fiber-optic wires. Coordinated via the IST Panel of the Defense S&T Reliance.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

- (U) Develop intelligent local agents for heterogeneous mobile network management. Coordinated with the DARPA Warfighter Internet Program. Coordinated via the IST Panel of the Defense S&T Reliance.

- (U) ($10, 600) RADIO COMMUNICATIONS: Continue development of key communications technologies for air, ship and submarines. FY 1999 funding for this Thrust includes $1.0M Congressional add-on for development of Hybrid Wireless Fiber Communications Technology. Add-on is for FY 1999 only.
  - (U) Conclude the residual noise tests of the on-hull extremely low frequency (ELF) submarine antenna. This development provided first time capability for submarines to receive ELF transmissions without having to deploy a long trailing wire.
  - (U) Analyze data from the sea tests of the low profile buoyant cable submarine antenna. Perform comparative at-sea testing with DARPA buoyant-cable array design. This development enables up to order of magnitude increase in data rate with UHF operation at speed and depth.
  - (U) Complete development of the structurally-embedded, reconfigurable aircraft antenna array reconfiguration using optically activated switches. Structural embedment of antenna arrays reduces life cycle costs and radar cross-section. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Conduct laboratory and field tests of the improved modem for UHF line-of-sight ship communications. Compare results with expectations, and define further improvements as needed in the modem design and the power management algorithms. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Demonstrate the use of Code Division Multiple Access (CDMA) technologies in Navy tactical networks. CDMA requires adaptation from commercial networks to mobile military networks that require low probability of intercept/detection. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Develop Mechanically Assisted Phased Array (MAPA) antenna for the Ultra-Small Aperture Terminal (USAT)capable of GBS reception on board Navy ships and aircraft. Demonstrate use of back-channel connectivity to the GBS. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Congressional Plus-Up: Initiate investigation of hybrid fiberoptic/wireless communications systems. Coordinated via the IST Panel of the Defense S&T Reliance.

- (U) ($5, 552) COMMAND SUPPORT: This program develops and demonstrates software components and technologies that enable the Navy's concept of Network-Centric Warfare and the Joint Chiefs Joint Vision 2010. The focus is on militarily-unique information processing technologies that enable information dominance through vastly improved

speed of command. Particular emphasis is directed to issues involving the ability of geographically distributed Naval decision-makers to collectively generate and perceive a Common Tactical/Operational Picture, and to jointly plan and monitor military missions. All of the research efforts recognize the important role of COTS software components and standards, and consequently they focus on maximizing the integration of such software into software functionality for Naval applications.

- (U) In support of the Common Operational Picture/Common Tactical Picture (COP/CTP), continue development of software agents for intelligent data exploitation and retrieval. Specifically, implement a video abstract agent and web-based agents; develop a cooperative query capability; and test inter-agent architecture operation.
- (U) In support of COP/CTP, continue efforts to develop a real-time static scheduling service; advance the real-time operating mechanisms; define the real-time prototype environment to support distributed nodes; and integrate real-time mechanisms to support distributed collaboration.
- (U) In support of COP/CTP, evaluate the Covariance Intersection approach as a method to fuse data in a distributed environment.
- (U) Continue the development of collaborative environment tools specifically incorporating intelligent agent technology. Determine if the existing collaboration technology will support tactical environments and , if not, what modifications are required.
- (U) Advance decision support technologies through the development of case-based plan authoring and advanced use interfaces; implement intelligent agents into existing real-time execution decision support; develop common representation and interaction between planning and monitoring support capabilities.
- (U) In support of Network Operations, define the requirements and design specifications for Adaptive Rules of Engagement. Conduct user experiments with collaboration and decision support capabilities in coordination with SPAWAR and the Sea-Based Battle Lab (USS Coronado). Incorporate collaborative environment and execution monitoring capabilities into Extending the Littoral Battlespace (ELB) ACTD 1999 Demo.

• (U) ($1,814) NAVIGATION: Continue development of navigation technologies for air, ship and submarines.

- (U) Compare quantum-well mirror ring laser gyro measurement results with conventionally designed ring laser gyros. This development promises to eliminate mechanical dithering and make ring laser gyros more producible and affordable.
- (U) Investigate use of pseudolites for acquiring ranging in addition to timing data using GPS signals. This development would lower the vulnerability of GPS users to enemy jamming.

- (U) Apply modern digital signal processing technologies to the design and development of next generation Global Positioning System (GPS) receivers for improved anti-jam protection.
- (U) Test the Advanced Development Model II of the high performance fiber-optic gyro and transition to the Navy Special Project Office (SP-24). This development enables replacing the ESGN (Electrostatic Suspended Gyro Navigator) presently deployed on submarines with more affordable fiber-optic gyro navigators.
- (U) Integrate advanced electronics into strategic submarine navigation systems to reduce dependence on diminishing source of supply for older componentry.

- (U)($900) STRATEGIC SYSTEMS TECHNOLOGY: The objective of the Strategic System Sustainment project is to develop and demonstrate technologies in the areas of Missile Flight Science, Submarine Navigation, and Underwater Missile Launch to sustain these strategic capabilities that will (1) reduce the reliance on unique materials and processes, (2) reduce the reliance on human-expertise intensive processes, and (3) reduce the cost of maintaining these systems.
  - (U) Assess the existing missile flight science design and analysis codes for integration in to a platform-independent architecture.
  - (U) Develop Underwater Launch systems architecture.

- (U)($755) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance with 15 USC 638.

4. (U) FY 2000 PLAN:

- (U) ($22,193) RADAR TECHNOLOGY: The Radar Technology program investment addresses Navy surveillance needs and exploits radar sensor technology opportunities. Emphasis is on major platforms such as Ships and aircraft and cross cutting technologies that apply across all platforms. Major drivers include affordability and sensor performance in complex target, ECM and adverse environmental conditions including operations in the littorals.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

- (U) Implement adaptive waveforms into Multi-band shipboard radar test bed and assess detection, tracking and dynamic range performance in complex countermeasure, clutter and multi-path environments. Addresses PEO-TAD/SC and N-86 needs for continuous fire quality tracking in severe countermeasure and clutter environments.
- (U) Initiate laboratory and field evaluation of High Power Millimeter Wave Radar Demonstration Model. Tracking quality and consistency will be evaluated against a variety of representative targets and countermeasure environments. Jointly conducted with the Electronics program under PE 0602234N.
- (U) Transition UHF Electronically Steered Antenna (UESA) array to Advanced Technology Demonstration (ATD) program, PE 0603792N. ATD endorsed and supported by OPNAV N-88 and COMNAVAIRSYSCOM PMA-231 in the near term and to the Common Support Aircraft in the mid-long term.
- (U) Integrate UHF Digital Receiver into the improved Mountaintop experimental Radar at PMRF, Kauai, Hawaii. Technology supports the UESA ATD and scheduled to transition to PMA-231 E-2C Radar Modernization Program (RMP) in FY-2001.
- (U) Complete flight test characterization of the Concealed Target Detection/Ground Penetrating Ultra Wideband Radar. This project is coordinated with the Defense S&T Reliance Sensors, Electronics and Battlespace Environments (SEBE) Panel.
- (U) Conduct initial flight measurements of the airborne Multi-Mode Radar system to characterize performance against ground targets in all operating regimes (moving, stationary). Jointly conducted with DARPA, USAF Wright Laboratories and the JSTARS program.
- (U) Continue joint program with Air Force and DARPA to develop automatic target recognition algorithms and signal processing in support of joint Warfighter and Tri-Service needs for long range identification of stationary and slow moving ground targets. Coordinated with Defense Reliance SEBE Panel.

- (U) ($12,584) EO/IR TECHNOLOGY: The EO/IR technology program investment addresses Navy surveillance needs and exploits technology opportunities leading to advanced EO sensor and processing capabilities. The program emphasizes needs of major Navy air platforms and is developing crosscutting technologies that apply across platforms. Technologies such as multi-wavelength passive/active sensors and multi-dimensional signal processing algorithms to enhance detection and track performance in adverse environments are stressed. Optical apertures to enable multiple EO sensors to operate simultaneously from a single aperture are being developed.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

- (U) Complete in flight evaluation of the dual band (IRST) on a fleet E-2C aircraft participating in TBM detection and tracking exercises. This effort responds to stated needs of PEO TAD/SC and PEO-T for long range detection and precision tracking of TBMs. Jointly coordinated with the Air Force via Defense Reliance SEBE Panel.
- (U) Integrate BMDO funded eye safe laser sensor into dual band airborne E-2C IRST for sensor compatibility and performance evaluations. Responds to Joint Theater Air and Missile Office needs for long range, precision tracking of TBMs.
- (U) Continue development of target discrimination and recognition algorithms to distinguish unique characteristics of man made objects relative to naturally occurring background clutter.
- (U) Continue modeling and simulation to optimize sensor operating characteristics and fusion of multi-wavelength passive and active EO sensor attributes. Develop and optimize sensor cueing and control processing strategies to enable rapid hand-off of precision fire control information to on- and off-board engagement systems.
- (U) Transition Distributed Aperture Infrared Sensor (DAIRS) to (ATD) project as part of Multifunction Infrared Distributed Aperture System (MIDAS) under PE 0603792N. This technology is identified as a critical element of the Joint Strike Fighter roadmap for situational awareness and missile warning.
- (U) Continue joint program with DARPA and PMA-290 to develop Hyperspectral Imaging sensor and processing for demonstration on the EP-3 aircraft. This effort addresses needs identified by CNO-N88 and PEO-A for real time situational awareness, precision targeting and battlespace assessment.
- (U) Initiate development of laser and laser identification image profiling, leveraging DARPA developments in high frame rate Focal Plane Arrays to provide Navy and Marine Corps platforms with real-time long-range target discrimination and identification capability.

- (U) ($3,407) MULTI-SENSOR TECHNOLOGY: The Multi-Sensor technology program investment addresses Navy Intelligence, Surveillance and Reconnaissance needs and exploits technology opportunities leading to the integration, fusion and automated management of sensors operating within a platforms Combat System Architecture. The program emphasize needs of major ship and air platforms and is developing crosscutting technologies that apply across platforms. Technologies such as processing architectures and algorithms to fuse, filter and correlate data and automated resource management procession are pursued.

- (U) Complete flight test of the laser encoded IFF system on AV-8B and transition to the US Marine Corps program for Combat Identification. This effort responds to needs identified by Marine Corps and the Joint Combat Identification Office for positive combat ID to eliminate/minimize fratricide during close air support operations.

(U) Continue evaluation of Radar Resource Management processing algorithms in SPY-1 Radar at Aegis Combat Systems Center, Wallops Island, VA. This effort responds to needs identified by PEO TAD/SC for long range detection, discrimination and continuous tracking of theater ballistic missiles.

(U) Evaluate multi-sensor integration and data fusion algorithms in the E-2C aircraft Sensor Integration Laboratory and assess operational effectiveness improvements in Theater Air and missile defense operating environments. Responds to needs identified by the Fleet, Program Executive Officer, Tactical Aircraft Programs (PEO-T) for timely integration and dissemination of on and off board sensor information in all operating scenarios.

- (U) ($3,509) COMMUNICATIONS NETWORKS: Continue development of technologies critical to performance and robustness of Naval Communications networks.
  - (U) Continue development of key communications network technologies for air, ship and submarines necessary for network-centric warfare.
  - (U) Evaluate the performance of the new reliable multicast and IP Quality of Service (QOS) protocols. Make analytic results available to the IETF in order that the commercial standard is compatible with military applications. Coordinated with the IST Panel of the Defense S&T Reliance.
  - (U) Conduct performance and interoperability testing of different ATM switches over the high speed ATM testbed employing the new reliable multicast and IP QOS protocols. Coordinated with the IST Panel of the Defense S&T Reliance.
  - (U) Evaluate simulation results of wireless, mobile network performance in relation to projected needs of military applications. Transition results to the INSC (Interoperable Networks for Secure Communications) 6.3 program to enable test/demonstration for coalition warfare. Coordinated with the IST Panel of the Defense S&T Reliance.

- (U) ($10,573) RADIO COMMUNICATIONS: Continue development of key communications technologies for air, ship and submarines.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

- (U) Investigate CDMA links as back channel for GBS, employing very small aperture terminals appropriate for small craft use.
- (U) Transition the low-profile buoyant cable antenna enhancement to 6.3 Advanced Technology Development.
- (U) Transition the on-hull extremely low frequency (ELF) antenna to the Submarine Integrated Antenna System (SAIS) 6.4 project within PMW-173.
- (U) Develop technologies to enable large aperture multiple frequency band, multiple function antennas for current and future Navy attack submarines. Coordinated via the IST panel of the Defense S&T Reliance.

(U) Transition the improved modem technology for UHF line-of-sight communications to the Joint Tactical Radio System (JTRS). Coordinated via the IST Panel of the Defense S&T Reliance.

- (U) Incorporate the Mechanically Assisted Phased Array (MAPA) antenna as part of Ultra-Small Aperture Terminal (USAT). Test and evaluate performance of MAPA antenna on different naval platforms. Coordinated via the IST Panel of the Defense S&T Reliance.

- (U) ($9,107) COMMAND SUPPORT: This program develops and demonstrates software components and technologies that enable the Navy's concepts of Network-Centric Warfare and the Joint Chiefs Joint Vision 2010. The focus is on militarily-unique information processing technologies that enable information dominance through vastly improved speed of command. Particular emphasis is directed to issues involving the ability of geographically distributed Naval decision-makers to collectively generate and perceive a Common Tactical/Operational picture, and to jointly plan and monitor military missions. All of the research efforts recognize the important role of Commercial-off-the-Shelf software components, and consequently they focus on maximizing the integration of such software into software functionality for Naval applications.
  - (U) In support of (COP/CTP), continue development of intelligent agent technology to provide agent-based user profiling. Transition agent architecture to DISA GCCS. Integrate visualization basic research efforts into COP/CTP. Apply spatial database techniques for correlating covariance intersection estimates for corresponding entities to enhance consistency across different tactical pictures. Initiate effort on developing techniques to enhance real-time picture with non-real-time information.
  - (U) Develop initial prototype for a tactical collaborative environment to use during Littoral Warfare.

- (U) In support of continuous planning-execution cycle, continue advances in a case-based reasoning plan authoring tool; develop a prototype Dynamic Resource Allocation capability to support real-time retargeting situations; develop an initial prototype augmenting the COP/CTP with an intelligent decision support system incorporating multiple interacting views of status, plans and predicted effects, e.g. map-based, pert-chart.
-
- (U) In support of Network Operations, investigate the process and issues associated with Rules of Engagement at all echelons of control starting with the National Command Authority (NCA) through the CINC to the Battle Group to the individual Support Element Weapon System.
- (U) Identify requirements and functional building blocks of a CINCPAC HQ21 Architecture with the goal of developing a facility for test and evaluate of COTS software in a military operational context

• (U) ($3,950) NAVIGATION: Continue development of key navigation technologies for air, ship and submarines.
- (U) Transition the high performance fiber-optic gyro, Advanced Development Model-II to the Director, Navy Strategic Systems Project (SP-24).
- (U) Perform laboratory proof-of-concept demonstration of the next generation digital GPS receiver for anti-jam performance.
- (U) Develop advanced technologies that reduce the vulnerability of GPS to jamming and spoofing.
- (U) Transition the quantum-well mirror ring laser gyro technology to Navy tactical missiles and ring laser gyro manufacturers.
- (U) Develop the atom interferometer gravity gradiometry technology to achieve sensitivity of 0.1 E/(Hz)1/2.

• (U) ($3,500) STRATEGIC SYSTEMS TECHNOLOGY: The objective of the Strategic System Sustainment project is to develop and demonstrate technologies in the areas of Missile Flight Science, Submarine Navigation, and Underwater Missile Launch to sustain these strategic capabilities that will (1) reduce the reliance on unique materials and processes, (2) reduce the reliance on human-expertise intensive processes, and (3) reduce the cost of maintaining these systems.
- (U) Develop first order methodologies for drag reduction, nuclear survivability, and solid motor ignition codes for the missile flight science design and analysis tool.
- (U) Develop first order electronic database for Underwater Missile Launch tool.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	54,814	66,133	68,403
(U) Appropriated Value.		64,033	
(U) Adjustments from FY 1999 PRESBUD.	-730	+1,975	+420
(U) FY 2000 President's Budget	54,084	68,108	68,823

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustment reflects actual update adjustments (-730). FY 1999 adjustments reflect Congressional Undistributed Reductions (-525), Congressional Cut Strategic Sustainment (-8,000), Congressional Cut General Reduction (-5,000), Comparability Adjustments for FY00 (+3,500), Congressional Adds for Hybrid Wireless Fiber Comms (+1,000) and UESA Radar (+11,000). FY 2000 reflects minor program adjustments (+614), Navy Working Capital Fund adjustments (+559), Civilian Pay Rates (+242), and Non-Pay Inflation (-995).

(U) Schedule: Not applicable.

(U) Technical: Not applicable

C. (U) OTHER PROGRAM FUNDING SUMMARY:

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PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

(U) RELATED RDT&E: This program adheres to Defense Science and Technology Reliance Agreements with oversight provided by the JDL. Work in this PE is related to and fully coordinated with efforts in the following PEs:

(U) PE 0602702F (Command, Control and Communications)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602782A (Command, Control and Communications (C^3) Technology)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602709A (Night Vision Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

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DATE: February 1999

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PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

(U) COST: (Dollars in thousands)

PROJECT NUMBER &	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	TO	TOTAL
ACTUAL	ACTUAL	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	COMPLETE	PROGRAM
Readiness, Training and Environmental Quality Technologies										
	40,405	31,426	30,586	29,631	30,322	31,010	31,749	32,513	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides generic affordable technologies in support of all Joint Mission Areas/Joint Support Areas (JSA), in particular the JSAs for Readiness; Manpower & Personnel; and Training. These JSAs encompass requirements for manning, operating, and maintaining fleet assets and for providing the necessary training to maintain operating forces in a high state of readiness. The PE also supports the Joint Warfare Strategy "Forward...From the Sea" as well as three of the "Top Five" Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff--in particular, capabilities related to: (a) conducting limited-objective warfare (e.g., technology for enhancing the performance of special forces personnel, aiding decision makers in highly ambiguous situations, and improving casualty care); (b) promptly engaging regional forces worldwide (e.g., technology for deployable training and mission rehearsal); and (c) countering weapons of mass destruction (e.g., technology for responding to chemical and biological threats). This PE encompasses the following areas:

(U) Personnel, Training, and Human Factors technologies enhance the Navy's ability to select, assign, and manage its people; to train effectively and affordably in classroom settings, in simulated environments, and while deployed; and to operate effectively in the complex, high-stress, information-rich and ambiguous environments of modern warfare. Technology development in these areas responds to a variety of requirements, including: providing more affordable approaches to training and skill maintenance; managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

(U) Medical technologies increase cost savings; improve safety and enhance personnel performance capabilities under adverse conditions; enhance diagnosis of medical emergencies and treatment of casualties; and prevent costly occupational injury and disease in hazardous environments. Requirements which support technology development in these areas include: improving warfighting capabilities through enhanced supply and long-term storage of prepositioned medical supplies such as blood; providing better stress endurance/control for key personnel; and providing enhanced casualty care onboard amphibious casualty receiving ships.

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

(U) This PE also seeks to strengthen the educational pipeline vital for maintaining a strong technology development capability, by supporting programs at a wide range of educational institutions, including Historically Black Colleges & Universities, and other Minority Institutions. In addition, the PE provides funding for the Navy Science Assistance Program, (NSAP) the purpose of which is to improve the ability of the Navy's science and technology community to respond rapidly to urgent fleet needs. Programs in this PE are jointly planned in the Reliance process with the Air Force and Army via panels of the Joint Directors of Laboratories, the Training & Personnel Systems Science & Technology Evaluation and Management Committee, and the Armed Services Biomedical Research Evaluation and Management Committee.

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

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($20,817) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Initiated:
    - -- (U) development of computer-based tools to improve the Navy's force management capabilities.
    - -- (U) feasibility evaluation of continuous speech recognition technology for the development of a virtual instructor for training complex team skills.
  - Completed:
    - -- (U) evaluation of the perceptual effects of altered relationships between visual, haptic and auditory inputs using virtual reality interfaces.
    - -- (U) development of specifications for a sonar employment training system with improved instructional capability and reduced initial cost, achieved through real-time simulation of tactical sonar signal processing in Commercial Off the Shelf (COTS) hardware.
    - -- (U) development of guidelines for contextualized, computer based training of Basic Electricity and Electronics skills.
    - -- (U) development of "non-cognitive" selection tools, such as performance-based measures of personality and motivation, which can predict the future success of naval enlisted personnel.
    - -- (U) integration of team training strategies into a prototype tactical decision support system, and transition the product into the AEGIS combat system.
    - -- (U) development of advanced human computer interface technologies for multimedia presentation of tactical information in a Marine Corps combat operations center, thereby improving tactical data fusion and visualization.
    - -- (U) development of advanced headphone displays for three-dimensional presentation of sonar information to improve target localization.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

- (U) ($10,838) MEDICAL TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UP - $2,523 SMART AIRCREW INTEGRATED LIFE SUPPORT SYSTEM):
  - Initiated:
    - -- (U) system for biofeedback control of aircrew physiologic state and integrate with Vehicle Management System.
    - -- (U) investigation of pharmaceutical rescue of noise-induced hearing loss.
  - Continued:
    - -- (U) research and development of supportive resuscitation fluids that minimize tissue damage and facilitate stabilization of hemorrhagic and burn casualties.
    - -- (U) research and development of therapeutic regimens/modalities that prevent reperfusion injuries subsequent to combat trauma and hemorrhage.
    - -- (U) development of immune modulators for prevention of multiple organ failure.
    - -- (U) development of neuromodulators for therapy of non-freezing cold injury.
    - -- (U) programs that extend the diving operational envelope by permitting faster decompression and/or longer bottom times.
    - -- (U) undersea medicine programs that lead to preventive and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios.
    - -- (U) investigation of operational durability of G-tolerance due to pilot down time.
    - -- (U) mechanisms research necessary to prevent performance decrements during sustained operation in extreme environments implementing biomedical and pharmacologic interventions.
    - -- (U) research to address impact of exposures to induced body currents from radio frequency radiation; develop techniques to protect and/or ameliorate adverse human health effects.
    - -- (U) research to understand the biomechanisms involved with exposure to select neurotoxicants used in Navy operational environments.
  - Completed:

-- (U) development of recombinant enzymes for removing blood type antigens from red cells to produce universal donor transfusion blood units and transition effective enzymes to industry for universal donor red cells.
-- (U) evaluation of AICAR adenosine derivative in treatment of cardiac failure following hemorrhage.
-- (U) development of ONR Rinse for treatment of hemorrhagic shock (not beneficial)
-- (U) first phase of testing of trans-crocetinate for enhancing tissue oxygen delivery following hemorrhage.
-- (U) evaluation of immunoregulatory monoclonal antibodies as adjuvants in inflammatory diseases related to combat injury complications.
-- (U) transition polynitroxlyated macromolecule therapies to advanced development for large animal testing.

- (U) ($1,213) NSAP:
  -- (U) continue support to the operational Commands in Command, Control, Communications, Computers, Intelligence Surveillance & Reconnaissance (C4ISR) for deployed assets. Continued refinement of NSAP Global Tactical Technical Information Center, developed Gulf Coast Coalition (GCC) World Wide Web based information server for COMUSNAVCENT Area of Responsibility (AOR), supported C4I Interoperability Workshop in COMSIXTHFLT AOR to address issues with coalition and allied interoperability.
  -- (U) provide support to the Fleet/Force in high life cycle cost maintenance areas through application of innovative technologies to reduce maintenance frequency, manpower intensiveness, and incorporation of 'in the field' retro-fixes as applicable. Provided means to reduce High Mobility Medium Wheel Vehicle (HMMWV) box frame corrosion, and evaluated fiber optic lighting in hazardous spaces on Carrier Vessel.
  -- (U) addressed Fleet/Force operational readiness issues amenable by demonstration and application of COTs technology solutions. Completed "live fire" evaluation of Ship Deployable Surface Target & Second-Phase development of this system, performed study on feasibility of Unmanned Air Vehicles to meet

CINCUSNAVEUR needs, developed options for COMSEVENTHFLT Anti-Special Operation Forces, evaluated an Unmanned Surveillance Vehicle for COMMARFORLANT during a Riverine Exercise, deployed system to evaluate ability to perform contraband detection in bulk cargo, developed night vision countermeasures training for COMNAVSPECWAR evaluation, assisted COMNAVSAPECWAR with Bioluminescence software, supported evaluation of a third generation Forward Looking Infrared Radar (FLIR) for Joint Inter-Agency Task Force (JIATF) East, and continued investigation of sports medicine protocols for reduced USMC OCS attrition.

- (U) ($7,537) SEA-STATE 3 LIGHTERAGE - CONGRESSIONAL PLUS-UP:
  -- (U) initiated the development of a joint modular lighter system (JMLS) for ship-to-shore operations in higher sea states and for offloading supplies to beach or at the elevated causeway pier.

2. (U) FY 1999 PLAN:

- (U) ($20,085) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Initiate:
    -- (U) plans and designs to develop and conduct experiments to systematically investigate the human performance benefit of various perspective view technology features.
    -- (U) development of a testbed facility and models to enhance the realism of computer generated forces.
    -- (U) general investigation of applied Human Factors in the design of interactive information management and interactive display technology to support user/task centered decision-making.
    -- (U) investigate the side effects induced by utilization of virtual environment trainers on shipboard platforms.
    -- (U) dynamic assessment and feedback on Tactical Decision performance.
    -- (U) distributed debriefing for network centric warfare in an information intense environment.
    -- (U) intelligent tutoring for time-stressed system control/interaction.

- Continue:
  -- (U) development and evaluation of unconventional visual, auditory and haptic cueing techniques to enhance learning of complex perceptual-motor skills.
  -- (U) development of computer-based tools to improve the Navy's force management capabilities.
  -- (U) feasibility evaluation of continuous speech recognition technology for the development of a virtual instructor for training complex team skills.
  -- (U) development of a Response Planner and Manager (RPM) authoring tools; develop the Human Computer Interface (HCI) and user dialogue.
  -- (U) development of design guidelines for a Combat Supervisory Support System that provides for reduced shipboard manning and increased automation, and supports the use of reconfigurable, collaborative task teams.

- Complete:
  -- (U) laboratory evaluation of candidate instructional strategies and measurement techniques for aircrew situational awareness.
  -- (U) demonstration and evaluation of large flat panel displays for use in aviation mission planning, mission rehearsal and training systems.
  -- (U) development of measures and models to improve the Navy's ability to predict fleet readiness based on training and manpower resources expended.
  -- (U) development and transition of a prototype tactical decision support system to the Joint Maritime Command Information System (JMCIS).

(U) ($9,859) MEDICAL TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UP - $2,000 SMART AIRCREW INTEGRATED LIFE SUPPORT SYSTEM):

- Continue:
  -- (U) research and development of supportive resuscitation fluids that minimize tissue damage and facilitate stabilization of hemorrhagic and burn casualties

-- (U) research and development of therapeutic regimens/modalities that prevent reperfusion injuries subsequent to combat trauma and hemorrhage.
-- (U) development of immune modulators for prevention of multiple organ failure.
-- (U) development of neuromodulators for therapy of non-freezing cold injury.
-- (U) research to extend the diving operational envelope by permitting faster decompression and/or longer bottom times through novel biochemical based decompression or other means of increasing survivability of Disabled Submarine (DISSUB) personnel and enhancing special warfare operations.
-- (U) undersea medicine programs that lead to preventive and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios and special warfare operations.
-- (U) investigate operational durability of G-tolerance due to pilot down time.
-- (U) investigation of pharmaceutical rescue of noise induced hearing loss.
-- (U) mechanism research to prevent performance decrements during military operations in extreme environments implementing biomedical and pharmacologic interventions.
-- (U) research in chronic or high pulse exposure to induced body currents from radio frequency radiation and develop techniques to ameliorate adverse human health effects through physical and/or biological protections.
-- (U) research to identify biomarkers of cardiac sensitization associated with exposure to refrigerants and fire suppression materials and to develop preventive measures; determine applicability of heart rate variability analysis to identifying adverse impact of toxicants.

-Complete:
-- (U) system for biofeedback control of aircrew physiologic state and integrate with Vehicle Management System. Transition to Advanced Technology Crew Station Program (PE 0603216N).
-- (U) second phase of testing of oral interleukin-6 for prevention of intestinal ischemia following hemorrhage.
-- (U) evaluation of interleukin-11 for preservation of intestinal barrier function following hemorrhage
-- (U) optimization of trans-crocetinate delivery following hemorrhage

- (U) ($1,165) NSAP:
  - -- (U) continue support to the operational Commands in C4ISR for deployed assets.
  - -- (U) provide support to the Fleet/Force in high life cycle cost maintenance areas through application of innovative technologies to reduce maintenance frequency, manpower intensiveness, and incorporation of 'in the field' retro-fixes as applicable.
  - -- (U) address Fleet/Force operational readiness issues amenable by demonstration and application of COTs technology solutions.

- (U) ($317) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($21,102) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Initiate:
    - -- (U) test and evaluation of models designed to enhance the realism of computer generated forces.
    - -- (U) develop and evaluate Perspective View Technology (PVT) prototype.
    - -- (U) demonstrate, test and evaluate After Action Review (AAR) principles in Joint Service exercises.
    - -- (U) evaluation of an advanced processor for speech recognition.
  - Continue:
    - -- (U) development and evaluation of unconventional visual, auditory and haptic cueing techniques to enhance learning of complex perceptual-motor skills.
    - -- (U) demonstrate the efficacy of the framework that specifies how different types of knowledge are presented to decision makers to foster development of appropriate knowledge structures.

-- (U) general investigation of applied Human Factors in the design of interactive information management and interactive display technology to support decision-making.
-- (U) dynamic assessment and feedback on Tactical Decision performance.
-- (U) distributed debriefing for network centric warfare in an information intense environment.
-- (U) intelligent tutoring for time-stressed system control/interaction

- Complete:
-- (U) development of the RPM authoring tools, conduct fleet demonstration.
-- (U) planning, design, development and conduct of experiments to systematically investigate the human performance benefit of various perspective view technology feature.
-- (U) complete mockup and final experiments for a Combat Supervisory Support System that provides for reduced shipboard manning and increased automation, and supports the use of reconfigurable, collaborative task teams.
-- (U) experiments for continuous shipboard learning, develop on the job training (OJT) guidelines, and demonstrate transitions to shipboard environment.
-- (U) development of a testbed facility to enhance the realism of computer generated forces.
-- (U) feasibility evaluation of continuous speech recognition technology for the development of a virtual instructor for training complex team skills.
-- (U) investigate the side effects induced by utilization of virtual environment trainers on shipboard platforms.

• (U) ($8,260) MEDICAL TECHNOLOGY:

- - Continue:
-- (U) research and development of supportive resuscitation fluids that minimize tissue damage and facilitate stabilization of hemorrhagic and burn casualties
-- (U) research and development of therapeutic regimens/modalities that prevent reperfusion injuries

subsequent to combat trauma and hemorrhage.
-- (U) development of immune modulators for prevention of multiple organ failure.
-- (U) development of neuromodulators for therapy of non-freezing cold injury.
-- (U) development of mission preparation and body protection countermeasure techniques to minimize effects of pulsed radiowave energy.
-- (U) effects research durability of G-tolerance due to pilot down time.
-- (U) investigation of pharmaceutical rescue of noise-induced hearing loss.
-- (U) research to extend the diving operational envelope by permitting faster decompression and/or longer bottom times through novel decompression or other means of increasing survivability of DISSUB personnel and enhancing special warfare operations.
-- (U) undersea medicine programs that lead to preventative and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios and special warfare operations.
-- (U) mechanism research to prevent performance decrements during sustained operations in extreme environments implementing biomedical and pharmacologic interventions.
-- (U) research to identify biomarkers of cardiac sensitization associated with exposure to refrigerants and fire suppression materials and to develop preventive measures; determine applicability of heart rate variability analysis to identifying adverse impact of toxicants.

- Complete:
-- (U) industrial transition of trans-crocetinate as additive for resuscitation fluid
-- (U) complete development of interleukins as therapeutics for hemorrhage
-- (U) complete testing of nerve growth factors in non-freezing cold injury.
-- (U) complete testing of guanidine derivative for preservation of mitochondrial function in uncontrolled hemorrhage.

• (U) ($1,224) NSAP:
- Complete:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

-- (U) continue support to the operational Commands in C4ISR for deployed assets.
-- (U) provide support to the Fleet/Force in high life cycle cost maintenance areas through application of innovative technologies to reduce maintenance frequency, manpower intensiveness, and incorporation of 'in the field' retro-fixes as applicable.
-- (U) address Fleet/Force operational readiness issues amenable by demonstration and application of COTs technology solutions.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget Submit:	38,079	29,722	30,915
(U) Appropriated Value:	-	31,722	-
(U) Adjustments from FY 1999 PRESBUDG:	+2,326	+1,704	-329
(U) FY 2000 OSD/OMB Submission:	40,405	31,426	30,586

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 increase is due to the FY98 Small Business Innovative Research funding (-276), Actual Update adjustment (+2,622) and Federal Technology Transfer (-20). The FY 1999 increase is due to Revised Economic assumption (-73), Civilian Personnel Underexecution (-16), Congressional Add for Smart Aircrew (+2,000) and Contract Advisory and Assistance (-207). FY 2000 decrease is due to Outsourcing Adjustment (-73), Navy Working Capital Fund adjustment (+120), Civilian Pay Rates (+66) and Non Pay Inflation (-442).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:
- (U) PE 0601152N (In-House Independent Laboratory Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602232N (Communications, Command and Control Technology)

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PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Readiness, Training and Environmental Quality Technologies

(U) PE 0603706N (Medical Development (Advanced))
(U) PE 0603707N (Manpower, Personnel and Training Advanced Technology Development)
(U) PE 0603712N (Environmental Quality and Logistics Advanced Technology)
(U) PE 0602202F (Human Systems Technology)
(U) PE 0602205F (Personnel, Training and Simulation)
(U) PE 0602716A (Human Factors Engineering Technology)
(U) PE 0602727A (Non-System Training Device Technology)
(U) PE 0602785A (Manpower, Personnel and Training Technology)
(U) PE 0602787A (Medical Technology)

This PE adheres to Tri-Service Reliance Agreements on Human Systems Technology, Medical, and CBD Technology. Oversight is provided by the Joint Directors of Laboratories, Training and Personnel Systems Science and Technology Evaluation Management and Armed Services Biomedical Research Evaluation and Management.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

(U) COST: (Dollars in Thousands)

PROJECT NUMBER &	FY 1998 ACTUAL	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
Materials, Electronics, and Computer Technology	76,194	87,698	77,957	82,631	83,951	86,481	86,246	87,802	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) provides Applied Research to support all Navy advanced weapon and platform system concepts and needs in the areas of materials, electronics, and computer technology. Developmental tasks address significant improvements in terms of affordability; performance; reliability; high assurance computing; data; information and image processing; distributed collaborative network concepts; real-time computing; environmental impact; and advanced distributed manufacturing to effect transition of advanced technology to the Navy fleet. Development efforts are part of an integrated Department of Navy Science and Technology process managed by the Office of Naval Research.

(U) This PE develops enabling technologies to support most Joint Mission Areas, including:

- (U) Strike: advanced thermal management materials for most platforms to reduce weight and cost.
- (U) Littoral Warfare: acoustic signature reducing materials, torpedo warhead materials, vacuum electronics, solid state low noise amplifiers, network centric software, and high assurance computing, image and information processing and human computer interfaces.
- (U) Joint Surveillance: real-time targeting, connectivity, counter-jamming and deception, infrared sensors, broadband control components, fiber optics technology, high assurance computing, and network centric software.
- (U) Space and Electronics Warfare/Intelligence (SEW/I): lightweight and radiation-hard satellite materials, radio frequency (RF) solid state devices, high assurance computing, network centric software image and information processing and distributed collaborative groupware.
- (U) Strategic Deterrence: advanced ballistic missile launcher materials, RF solid-state devices for secure communications.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Forward Presence issues: high temperature pavements for advanced aircraft, materials for condition based maintenance, RF solid state devices for secure communications, high power transmitters for precision strike, high assurance computing, and network centric software and decision aids.
- (U) Strategic Mobility: development of advanced distributed manufacturing capabilities and advanced long-life materials for repair of aircraft at sea, ultralight materials.
- (U) Land Attack Warfare: Common Tactical Picture (CTP), information exploitation and distribution, Fire Support Planning and Coordination, Weapon-Target Pairing, air and ground deconfliction and seamless Force coordination across C2 Command echelons and Warfare Commander's Forces who operate in both non-real-time and real-time regimes.

(U) In addition, this PE directly underpins the Readiness Joint Support Area and Support and Infrastructure Joint Support Area especially in the domains of affordability, environmental quality, and logistics. Programs include environmentally acceptable coatings for both aircraft and ships and the maintenance of the Navy pier and wharf infrastructure for surge capacity. This PE also contributes to lower system life-cycle costs through development of technologies that realize more compact, lighter weight electronic components, and reduction of cost, schedule and operational manpower in computer-centric systems.

(U) This PE supports the Office of the Secretary of Defense (OSD) Science and Technology (S&T) Investment Strategy in the following Future Joint Warfighting Capabilities: Real-Time Knowledge of the Enemy, Prompt Engagement of Regional Forces on Global Basis, Lower-End Actions, Space Control, and Countering Threat of Weapons of Mass Destruction; materials projects support affordable performance increases in radomes, infrared windows, advanced engines, and platform signature reduction to allow achievement of military objectives with minimum casualties and collateral damage; materials programs directly support lightweight, survivable satellite and spacecraft thermal control materials to positively affect the U.S. ability to control space usage. The PE is an integral part of the following Department of Defense (DoD) Technology Areas: Materials and Processes, Electronics, and Information Systems Technology. As a foundation technology area it has impact in most other DoD technology areas as well.

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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

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

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications towards solution of specific Naval problems, short of a major developmental effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($988) SHORE FACILITIES MATERIALS. Shore Facilities Materials provides technology for the structure of piers, wharves, Naval/Marine Air Station runways, and other facilities required by naval logistics and operations, such as magazines and tank farms. The work is focused on demonstrating affordable materials to increase the life and reduce maintenance costs of such facilities.
  - (U) Two corrosion demonstration test articles have been fabricated and installed for evaluation. A half-scale deck specimen utilizing two layers of corrosion resistant dual-phase steel was installed at Port Hueneme, California. A prototype cathodic protection system, prepared by an impressed current flame sprayed titanium process, was installed on a 900 square foot section of reinforced concrete at SUBASE San Diego pier 5002 for experimental evaluation. These innovations have the potential to substantially increase the time between repairs and reduce costs.
  - (U) Major structural-composite specimens were obtained and are being subjected to accelerate aging tests, which will produce the effects of two decades exposure in two years. This new procedure will permit the rapid convergence to new long life cost effective materials.

- (U) ($10,049) AIRBORNE MATERIALS. (Includes Congressional plus-up, for Second Source Carbon Fibers and Resin Transfer Molding) Airborne Materials provides technology for naval aircraft, including airframes, propulsion, and air weaponry. It is focused on those material issues associated with carrier landings, corrosion and affordability.
  - (U) Demonstrated single crystal/powder metal insertable bladed disk system materials for 1200° F compressors and 1450° F turbines. Subscale components such as a disk were successfully fabricated.

- (U) Demonstrated a process for low volatile organic (340 gram/liter) high solids self-priming topcoats for aircraft ground support equipment and identified procedures for reducing carbon dioxide generation. This development helps the Navy to respond to Environmental Protection Agency (EPA) restrictions on volatile organic compound content of paints.
- (U) Quantified the benefits of cyanate ester adhesives for rapid curing aircraft repairs. This reduces maintenance costs.
- (U) Designed sensor systems for condition-based maintenance monitoring of aircraft corrosion and health of corrosion preventive coatings. This provides needed technology for Navy implementation of condition based maintenance.
- (U) Demonstrated casting technology for large gamma-titanium aluminide structures with 150°F creep capability for first generation materials. This will lead to increased thrust-to-weight in Naval gas turbine engines.
- (U) Novel low thermal conductivity thermal barrier materials were demonstrated and directions for further development identified. The materials will result in enhanced life-times and performance for Naval gas turbine engines.

• (U) ($13,186) SEABORNE MATERIALS. (Includes Congressional plus-ups for Advanced Intelligent Materials Processing (Center, Titanium Powder Processing, Composite Submarine Shelter). Seaborne Materials provides technology for all ship, submarine, and related materials needs, including hull materials, machinery materials, coatings of all types, and seaborne weapons materials. This work provides the enabling capabilities for reduced cost and maintenance, improved performance, and reliable operations.
- (U) Reformulated both silicone-alkyd and acrylic-latex Infrared (IR) reflective coatings using alternative pigments to BASF black pigment which has seen a ten-fold increase in price being charged to the Navy.
- (U) Developed spray forming procedure for making 50%Cr-50% Ni alloy for incinerator applications to reduce the cost of alloy liners for VORTEX shipboard waste incinerators by $14,000 per liner.
- (U) Designed new MIL-100S welding wire to minimize costly preheat and eliminate hydrogen cracking for more affordable and reliable ship and submarine construction with advanced high strength steels.
- (U) Explored strength, fracture, and weldability characteristics of non-magnetic alloys for ship hull structures with reduced signature.
- (U) Determined ballistic resistance of glass reinforced polyurethane as candidate lightweight, non-magnetic material for construction of ships with reduced signature.
- (U) Explored advanced composites for submarine storage capsule applications.

- (U) Investigated self-canning of powder components via selective laser sintering of the surface.
- (U) Continued development and exploration of the plasma quench process to produce low cost titanium powder.

- (U) ($2,022) MISSILE/SPACE MATERIALS. Missile/Space Materials provides technology for tactical ballistic missile needs, including thermal management materials for power generation and protection, and spacecraft thermal straps and doublers. While this effort focuses on problems associated with naval systems, it is jointly planned and coordinated with Army, Air Force and Defense Advance Research Project Agency (DARPA) efforts.
  - (U) Feasibility of two alternative heat shield materials with ablation and insulation performance equivalent to state-of-the art rayon-base materials using blends of low cost carbon fibers was demonstrated. These are potential replacements for out-of-production heat shield materials.
  - (U) Developed cost effective fabrication processes for ceramic composites based on hafnium and/or tantalum materials. This will lead to better engine performance and reduced cost in Naval missile systems.
  - (U) Demonstrated the benefits of heat shield replacement materials that emphasize lower cost tape wrapped fabrication techniques. This offers low-cost replacement candidate for out-of-production heat shield materials.
  - (U) Developed low cost fabrication methods for ceramic materials for applications such as rocket nozzles.
  - (U) A processing technique for imparting high temperature strength to sapphire IR transparencies while maintaining excellent optical quality was demonstrated. Diamond and enhanced sapphire domes and windows will increase the attainable velocity of air to air and Theater Air Defense (THAD) missiles, which will result in improved lethality and survivability.

- (U) ($8,661) MULTI-MISSION MATERIALS. (Includes Congressional plus-ups for photomagnetic materials and Terfenol-D). Multi-mission materials provides developing technologies for promising naval applications such as biomolecular materials for antifouling coatings on ships. It also supports materials technologies for naval systems across a broad spectrum, such as laser eye and sensor protection as well as sensor/transducer materials for sonar and condition based maintenance applications.
  - (U) Tubule-based materials for controlled release-coating applications were developed and transitioned to industry. Such materials have the potential to control ship fouling and thus reduce fuel costs.
  - (U) Demonstrated high temperature composites based on fluorinated and non-fluorinated phthalonitrile polymers for high temperature application to multiple platforms. These materials were shown to meet fire specifications for shipboard use and thus permit new ship topside stealthy designs.

- (U) Evaluated metal-plated microtubules for electro-active coatings in antenna systems and demonstrated that they meet antenna isolation requirements. These materials were shown to be more cost effective and are scheduled for testing for fleet insertion on the EAGER.
- (U) Nanostructured WC/Co, YSZ, and oxide composite hard coatings were successfully fabricated by thermal spray on steel and aluminum substrates with significantly enhanced adhesion, toughness, and wear resistance. Nanostructured coatings will significantly reduce the cost of maintenance for ships, aircraft and land vehicles.
- (U) Equipment was purchased and installed in order to synthesize, for the first time, new photomagnetic materials and measure their properties.
- (U) Injection molding of 2-D acoustic receiver piezoelectric materials in arrays were demonstrated in diver hand held sonar devices. Such devices are critical to mine detection and removal.

• (U) ($7,665) RF SOLID STATE DEVICES AND CONTROL COMPONENTS. Provides for the generation, radiation, reception, control and processing of Ultra High Frequency (UHF), Very High Frequency (VHF), Microwave (MW), and Millimeter Wave (MMW) power for Navy all-weather radar, surveillance, reconnaissance, electronic warfare (EW), communications, and smart weapons systems. The technology developed cannot be obtained through Commercial Off the Shelf (COTS) as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size. Beginning in fiscal year 1998 the Microelectronics thrust has been merged with RF Solid State and Control Components to highlight the increasing digital RF emphasis of Microelectronics.
- (U) Demonstrated low power W-band duplexer components for Navy's 94 GHz radar program.
- (U) Developed design for highly compact, high Q, tunable bandpass filters and oscillators for transmit/receive (T/R) module applications.
- (U) Demonstrated InP-based heterojunction bipolar transistors for application to pulsed Ka-band phased arrays for dual mode electronic counter measures (ECM) resistant strike weapon conformal aperture.
- (U) Demonstrated the device technology for low power, low voltage sub 500nm - 250nm Complementary Metal Oxide Silicon (CMOS)/silicon germanium (SiGe) devices in 50nm thick Thin Film Silicon-on-Sapphire (TFSOS) for high performance A/D converters for smart sensors/weapons, space/missile/airborne electronics, advanced stand-off weapons and EW applications.
- (U) Continued development of the technology for low power, low voltage sub 250nm - 100nm CMOS/silicon germanium (SiGe) devices with T-gate structures in 50nm - 30nm thick Thin-Silicon-on-Sapphire (TPSOS) to achieve Ft, Fmax in the range of >70 GHz - 100 GHz. These devices will allow the development of 16 - 18 bit, 2 - 50

kilosamples/sec, <1 mw A/D converter for unattended deployable remotely controlled sensor systems for sonar and shallow water ASW applications.
- (U) Demonstrated the components of a 4-bit, 10 GSPS A/D based on 100nm minimum feature size CMOS TFSOS for EW and radar applications.
- (U) Continued development of analog very large-scale integrated (VLSI) continuous wavelet transform circuit for RF emitter identification
- (U) Continued to develop a 25 channel Continuous Wavelet Transform circuit for EW signal identification.
- (U) Continued to develop p-type doping of GaN grown by Orgono-Metallic Vapor Phase Epitaxy (OMVPE). This task will enable device programs that rely on the use of p-n junctions.
- (U) Continued to optimize the interface structure in resonant tunneling diodes grown in 6.1 Angstrom (A) materials in order to improve the peak-to-valley ratios and increase current densities.

- (U) ($11,000) VACUUM ELECTRONICS. Provides for the generation and reception of MW, MMW, and sub-millimeter wave power. The technology being developed is not available through COTS because of the power and size requirements.
- (U) Demonstrated elements of an advanced design tool set for an electron gun/collector and helix Traveling Wave Tubes (TWTs) implementation.
- (U) Demonstrated a high-power, moderate bandwidth gyro-klystron for the Navy's 94-GHz radar program.
- (U) Continued development of a high-duty, wideband gyro-twystron to meet the requirements of MMW radar applications.
- (U) Evaluated noise reduction techniques for a coupled cavity TWT for ship-based illuminator applications.

- (U) ($3,575) E/O TECHNOLOGY. Provides for the development of IR focal plane arrays to detect targets against various backgrounds; RF photonics technology to increase the bandwidth and reduce the size/weight of phased arrays; and IR transmitting fibers for EW applications. The technology being developed is not available through COTS, which is primarily focused at 1.3-1.55um whereas Navy requires electro-optic devices and components in the threat bands of 2.0-2.5, 3.5-5, and 8-12um.
- (U) Continued to develop mid IR fibers to reduce impurity loss < 0.05 dB/m and total loss< 0.3 dB/m in the 3- 5um region with emphasis on ruggedized one-meter lengths of cabled fibers; demonstrate IR fibers for 8-12μm region with loss < 2 dB/m.

- (U) Continued to develop 256 x 256 dual band Infrared Focal Plane Array (IRFPA) with one midwave and one longwave band for the detection of targets in clutter.
- (U) Continued to develop a 256 x 256 adaptive IRFPA with high dynamic range on-chip electronics to implement on-chip nonuniformity correction to handle challenging imaging conditions such as an aerodynamically heated dome, both hot desert and cold sky, and shadows.
- (U) Continued to develop a 128 x 128 color discriminating IRFPA with two midwave bands for the detection of missiles against ground clutter.
- (U) Continued development of broadband, amplified photoreceiver for 6-20 GHz links for ECM and Electronic Support Measures (ESM) applications.

- (U) ($9,500) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY. With the advances that are currently being made in electronics there exists a strong opportunity to realize multifunctional systems that integrate the functions of radar, EW, and communications into a pair of transmit and receive apertures over a broad bandwidth. It should be noted that this program is in contrast to the Air Force (AF) and Joint Strike Fighter (JSF) programs in that it treats both the transmit and receive functions in separate apertures. This approach avoids the need for time allocation of different RF functions and therefore offers the opportunity for more massive integration of RF functions into the pair of apertures. As a result, this integrated thrust has been formed and the current program enhanced to capitalize upon ongoing and planned applied research to develop RF solid state and photonic devices. This program is coordinated with JSF and the AF and has an oversight group with representatives from Space and Warfare Systems Command (SPAWAR), Naval Air Systems Command (NAVAIR), Program Executive Office (PEO)DD-21, PEO Theater Air Defense/Surface Combatant (TAD/SC), Common Support Aircraft (CSA), N86 and N6. Specific efforts within this thrust include:
  - (U) Demonstrated a UHF high power circulator.
  - (U) Continued to develop Twystrode/klystrode-compatible field emitter arrays to reduce size of Microwave Power Module (MPM) for radar and EW applications.
  - (U) Evaluated several concepts for multifunctional operation of fiber optic beamformer with one and two-dimensional array.
  - (U) Demonstrated feasibility of achieving a structurally embedded antenna array that is optically controlled over multi-octaves of frequency and capable of being fed by a MW modulated optical fiber for use in next generation wide area surveillance systems.

- (U) Demonstrated the feasibility of a superconducting 10 MHz bandwidth Analog-to-Digital (A/D) converter operating with 14 bits of dynamic range for use in next generation wide area surveillance systems.
- (U) Developed the concept for a RF transmit and receive beamforming network capable of RF frequency independent beam steering over ± 60 degrees from boresight using photonic technology to control an antenna array. Characterize the performance of photonic technology components optimized for various beamforming architectures.
- (U) Designed 100 GHz logic-derived microwave synthesizer with integral beam former.
- (U) Designed low parasitic heterojunction bipolar microwave power transistor with 100 GHz Fmax and 50-200 volt breakdown voltage.

• (U) ($2,255) HIGH PERFORMANCE COMPUTING (HPC). This areas supports development of software processing in embedded, real-time, systems such as detection of targets in clutter for missiles or the extraction of unknown signals from background. Functional areas include all-weather non-cooperative target recognition, including Identify Friend or Foe (IFF), adaptive beam forming and control, advance discrimination, sensor data fusion, and image compression (10x improvement).
- (U) Demonstrated a cross-platform architecture for three dimensional (3D) Virtual Reality Environment that interacts with multiple displays.
- (U) Demonstrated a robust embedded algorithm which enables Regionally Partitioned Lossy/Lossless Image Compression, including a Feature Based Compression scheme, enabling region of interest target identification" for automatic target cueing.
- (U) Modified the COTS software package, Private Eye to enable multichannel segmentation (including: two spatial, two spatial and time, ladar range and intensity) to allow fusing of information across multispectral IR bands with applications in the area of motion analysis and image registration.
- (U) Demonstrated version 1 of the Systems of Systems development software which includes compression and automatic processing for possible retargeting applications.
- (U) Demonstrated a robust software application suitable for preventing network traffic analysis attacks on Navy SIPRNET and commercial Internet communications.

• (U) ($2,708) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION (AI/HCI). This area supports the development of generic technologies for a large number of application and mission areas that require reasoning under uncertainty (incomplete information, erroneous information, etc), sometimes in unprecedented situations. These are extremely

critical to decision making, training, diagnostics, human-computer interaction, and robot control applications and functions.
- (U) Demonstrated a Java-based case-based reasoning tool for solving interactive decision aids tasks. Integrated the Java-based case-based reasoning tool with another tool, PARKA, to support dialogue inferencing; modified the tool to solve crisis response tasks and applied the tool to a United States Marine Corps (USMC) recruiter training task.

- (U) ($4,585) ENGINEERING OF COMPLEX SYSTEMS (ECS). This area supports the development of a set of tools that will support the evaluation and assessment of large, complex systems including (1) an integrated measurement and instrumentation framework for reliability, metrics identification and validation, and performance modeling at the component and system level, and (2) a consistent framework for requirements specification, design capture, design optimization and system specification and assessment.
  - (U) Demonstrated the Engineering of Complex Systems toolset and transitioned to the DD-21 Program Office (PMS-500). These tools will be used to define the set of requirements for the DD-21 acquisition program.
  - (U) Demonstrated a Portable Common Interface Set prototype (Version 2) [PCIS2], emphasizing the use of COTS components and standards, as a US-France wide-area network software development system. This software provides for requirements traceability, configuration management, software process support, and the low-cost production of Defense Information Infrastructure Common Operating Environment compliant software. This will be used to develop coalition warfare software.
  - (U) Demonstrated a software tool that a developer can use to specify both timing and functional behavior in requirements specifications and applied the tool to the Operational Flight Program (OFP) of a Navy attack aircraft.
  - (U) Completed an empirical study showing the effectiveness of three formal techniques--term rewriting, Binary Decision Diagrams, and a constraint solver--that automatically detect serious errors (such as missing cases and instances of ambiguity) in software specifications containing numbers and arithmetic. Used one of the techniques to automatically detect over 100 instance of ambiguity in the requirements specification of an Operational Flight Program of a Navy attack aircraft.
  - (U) Devised several concepts for remote measurement of ocean wave slope. Slope information is necessary for accurately aiming the gun on the Rapid Airborne Mine Clearance System (RAMICS) anti-mine system.

2. (U) FY 1999 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) ($891) SHORE FACILITIES MATERIALS.
  - (U) Determine the durability of composite materials through characterization and material studies for waterfront upgrades of reinforced concrete structures to reduce the maintenance costs and increase the lifetime of these Naval facilities.
  - (U) Design test protocols and conduct tests to characterize mechanical characteristics of prestressed carbon tendons and to quantify effects of material parameters on durability of modular hybrid composite/concrete structural systems for long applications in long life piers.

- (U) ($7,966) AIRBORNE MATERIALS.
  - (U) Explore the benefits of beryllium-aluminum and berylium-titanium alloys for aircraft applications.
  - (U) Demonstrate fabrication technology for compressor outer vane/diffuser using cast gamma titanium aluminides. This will result in increased performance and decreased cost in Naval aircraft engines.
  - (U) Complete demonstration of 1500°F Ni-turbine disk alloy. This will lead to increased performance (thrust-to-weight) for Naval gas turbine engines.
  - (U) Continue development of low volatile organic (340 gram/liter) self-priming topcoat for aircraft ground support equipment using new procedures for compliance with EPA air quality regulations.
  - (U) Explore cost effective processing routes for high strength diamond material for applications such as infrared missile domes and windows.
  - (U) Investigate applique technology for aircraft corrosion prevention to reduce hazardous waste enerated by paint removal.
  - (U) Evaluate corrosion sensor systems for condition based maintenance implementation on operational aircraft.

- (U) ($18,115) SEABORNE MATERIALS. (Includes Congressional Plus-ups for Advanced Intelligent Materials Processing Center, High Temperature Superconductors for Propulsion, and Micronization of Materials (coal)).
  - (U) Explore improved anticorrosive coatings for non-magnetic ship hulls required for stealth and mine countermeasures.
  - (U) Explore corrosion sensors for ship ballast tanks for implementation of condition based maintenance.
  - (U) Identify materials upgrades for long life seawater valves for life cycle cost reduction.
  - (U) Explore guided wave ultrasonics for detecting corrosion/erosion in shipboard piping without removing insulation for implementation of condition based maintenance.

- (U) Demonstrate self-canning of powder components via selective laser sintering of the surface.
- (U) Explore the dynamic strength and fracture resistance of very low interstitial titanium alloys for ship and submarine application to enhance survivability.
- (U) Evaluate strength, fracture, and weldability characteristics of non-magnetic stainless steel for ship hull structures for signature reduction.
- (U) Design, fabricate and test improved fender system using fiber reinforced urethane composites.
- (U) Investigate fire resistance and low velocity impact damage of carbon reinforced polyurethane as candidate lightweight, non-magnetic material for construction of ships for signature reduction.
- (U) Demonstrate new MIL-100S welding wire designed to enable more affordable and reliable welding of high strength steels in ship and submarine construction through reduction of preheat and elimination of hydrogen cracking for construction and maintenance cost reduction.
- (U) Develop improved models of deformation and fracture of hull materials, for incorporation into computer codes to simulate response of ship and submarine structural materials to underwater explosion, in cooperative program between U.S. and Germany.
- (U) Explore advanced hydrogen management techniques in regard to overall enhancement of cracking resistance in next generation high strength steel welds for ship and submarine construction for maintenance cost reduction.

• (U) ($2,763) MISSILE/SPACE MATERIALS. (Includes Congressional Plus-up for Carbon-Carbon Materials for Reentry Vehicles).

- (U) Demonstrate fabrication technology for affordable and reliable low cost hybrid materials for reentry vehicle heatshield applications. This will result in lower cost replacements for no-longer produced heat shield materials.
- (U) Demonstrate the benefits of ceramic materials for protection of propulsion components and other high temperature impingement applications in terms of predictive models and material screening test development. This will result in reduced cost and improved engine performance for Naval missiles.
- (U) Evaluate advanced ceramic materials in rocket environment. This will result in higher operating temperatures and greater reliability for Naval missiles.

• (U) ($8,908) MULTI-MISSION MATERIALS. (Includes Congressional Plus-ups for High Thermal Conductivity Fibers for Thermal Management Materials).

- (U) Develop phase one computer program to model non-linear optical materials in optical limiting devices for laser eye protection. Such materials have the potential for frequency agile protection for Marine Corps.
- (U) Demonstrate a system and controlling software for a reliable ultrasonic tomography that alleviates the problem of refraction to increase the ability to rapidly inspect aging platforms.
- (U) Demonstrate improved processing technology to reduce the cost of microtubule materials and composites for advance shipboard applications.
- (U) Identify critical Navy applications in weapons guidance devices for new single crystal high strain piezoelectric crystals for mine detection and removal.
- (U) The use of nanostructured tungsten carbide cobalt (WC/Co) coatings will be demonstrated by fabrication and testing of selected prototype components. Development of techniques for fabrication of nanostructured ceramic and aluminum matrix composite coatings will be carried out. Production of nanostructured feedstock materials will be scaled up to pilot plant capacity. This will result in maintenance cost reduction due to repair versus replacement for ship and submarine machinery components.

• (U) ($12,737) RF SOLID STATE DEVICE AND CONTROL COMPONENTS. (Includes Congressional Plus-ups for Superconducting Waveform Generator and Silicon Carbide Semiconductor Materials).
- (U) Demonstrate 80 kW W-band duplexer for Navy's 94 GHz radar program.
- (U) Develop design parameters for heterojunction varactor to be used in highly compact, high Q, tunable bandpass filters and oscillators for T/R module applications.
- (U) Develop InGaP/GaAs heterojunction bipolar transistors for application in pulsed Ka-band phased arrays for dual mode, ECM resistant hyper-velocity strike weapon conformal aperture.
- (U) Demonstrate the device technology for low power, low voltage sub 500nm - 250nm CMOS/SiGe with T-gate structures in 50nm thick TFSOS. These devices, which have frequency performance (Ft, Fmax) in excess of 50 GHz, allow the development of RF analog front end receivers, 16-bit, 125 megasamples/sec and 10-bit, 2.6 gigasamples/sec A/D converters, for digital receivers (X-band)/EW/Communication/signal intelligence.
- (U) Demonstrate the analog portion of the very low power (<0.4 mw) high-resolution (16 - 18 bit) 2 - 5 kilosamples/sec A/D converter for sonar, shallow water Anti Submarine Wafare (ASW) applications.
- (U) Demonstrate components of 16 bit, 125 megasample/sec A/D converter for application to wide bandwidth digital ASW receiver to meet Navy multi-channel acoustic system requirements.
- (U) Develop a 25 channel Continuous Wavelet Transform circuit for EW signal identification
- (U) Develop 6.1 Angstrom (A) materials for high frequency applications.

- (U) Develop 25 watt Gallium Nitride (GaN) X-band amplifier for high power transmitter applications
- (U) Develop gallium nitride heterojunction field effect power transistor for 6 - 18 GHz operation for next generation E/M power amplifiers.

- (U) ($10,000) VACUUM ELECTRONICS.
  - (U) Develop a high average power, moderate bandwidth gyro-klystron for the Navy 94-GHz radar program.
  - (U) Develop a 2D/3D electron gun and collector design code for vacuum devices.
  - (U) Develop an ultra-wide band vacuum power booster for EW applications.
  - (U) Develop a high-duty, wideband gyro-twystron to support radar and EW applications at millimeter-wavelengths.

- (U) ($5,511) E/O TECHNOLOGY.
  - (U) Develop a 256 x 256 adaptive IRFPA
  - (U) Develop optical microwave link with 50 mw output using <2.0V Vpi external lithium niobate modulators at 20 GHz.
  - (U) Develop 3 band IR detector to enhance performance against countermeasures and stealthy targets.
  - (U) Develop mid-IR fibers with loss < 0.2 dB/m in the 2 - 5 μm region and improve fiber fabrication techniques to achieve high tensile strength fibers. Reduce fiber defects and optimize fiber preparation to achieve power damage threshold > 1.2 GW/cm^2. Develop broadband, high damage threshold AR coatings for 2 - 5 μm region. Develop cabling techniques for ruggedized, thermally tolerant one-meter cables.
  - (U) Evaluate InAs/InGaSb growth techniques and transfer the techniques to industry and device technology programs.

- (U) ($10,500) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY.
  - (U) Develop CW ultra broadband (1 - 18 GHz), ultra linear (cross modulation products 28 dbm below fundamental signal) compact amplifiers suitable for use in next generation wide area surveillance systems.
  - (U) Develop a superconducting A/D capable of 19 bits of dynamic range over a 20 MHz spectrum for use in reducing background clutter in littoral warfare surveillance operations.
  - (U) Develop a RF transmit and receive beamforming network for the generation of simultaneously multiple frequency independent RF beams capable of beamsteering over ± 60 degrees from boresight on transmit and receive with control structure that preserves a 500 MHz instantaneous RF bandwidth for each beam.
  - (U) Implement concept for 100 GHz logic-derived microwave synthesizer and design integral phase and frequency modulator for synthesizer for 1 - 5 GHz output signals.

- (U) Fabricate from wide bandgap semiconductors and begin testing of low parasitic bipolar microwave power amplifier.

- (U) ($9,129) COMMAND AND CONTROL AND COMBAT SYSTEMS. Beginning in FY99, the HPC, the AI/HCI, and the ECS programs will be restructured into an integrated program entitled Command and Control and Combat Systems. This consolidation reflects a change in programmatic emphasis towards the direct support of Network Centric Warfare. Scientific domains of interest include (1) dependable and high assurance computing; (2) image processing and information exploitation; (3) visualization of the Common Operational Picture (COP)/Common Tactical Picture (CTP) including virtual reality environments; (4) decision support and collaboration; and (5) networked engagement and operations. The focus is on high assurance requirements specification and requirements testing, image compression and feature recognition, 3D virtual displays, architectures to merge Command and Control and Combat Systems, and distributed software development to support Defense Information Infrasturcture Common Operating Environment (DII-COE) systems such as the Global Command and Control System (GCCS).
  - (U) Incorporate intelligent agents into 3D virtual reality architecture to control interactions and data flow between entities.
  - (U) Develop collaborative software for combat system applications with allied and coalition countries leading towards interoperable systems.
  - (U) Demonstrate the ability to fuse image and defense terrain elevation data to produce improved maps supporting targeting and mission planning. Apply techniques to produce image mosaics with variable spatial resolution.
  - (U) Demonstrate the feasibility of using ocean wave slope measurement by remote wave sensing in the littoral region (shallow water) towards improving the RAMICS anti-mine system. Devise, implement, and test a methodology for removal of capillary wave distortions in airborne lidar images of underwater mines.
  - (U) Demonstrate version 2 of the "System of Systems" software and evaluate the joint effects of compression and noise upon data link performance. Modularize the compression algorithms, template design algorithms, and communications channel models and perform Monte Carlo simulations to analyze the effects of compression on the quality of the templates generated.
  - (U) Demonstrate a case-based reasoning toolset and integrate it with Stanford's INCA planner/scheduler for hazard materials spills; Develop automated methods for a case authoring task within the toolset and integrate with other systems to support interactive Command, Control, Communications, Computer, and Intelligence (C4I) plan authoring and monitoring.
  - (U) Design and test a prototype software tool which uses three formal techniques (term rewriting, Binary Decision Diagrams, and a constraint solver) to automatically detect errors in software requirements specifications containing

variables of different types (real, integer, Boolean, and enumerated); analysis of such specifications is not feasible with current technology.
- (U) Demonstrate flexible techniques to significantly reduce vulnerability of Navy Internet traffic to traffic flow analysis, making it difficult for commercial Internet routers to determine which Navy facilities are communicating with other Navy facilities via the commercial Internet infrastructure.
- (U) Develop an technical architecture that can provide the needed interfaces for achieving distributed force coordination between the command and control information grid (non real-time) and the Combat System (real-time) grid in support of network centric speed of command and force synchronization.
- (U) Develop a scaleable architecture for a consistent COP/CTP that portrays a coherent visualization of the battlespace among distributed decision makers from CINC to unit level.

- (U) ($1,178) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. FY 2000 Plan:

- (U) ($1,000) SHORE FACILITIES MATERIALS.
- (U) Characterize long-term time dependent system behavior and stress rupture response under sustained stress for modular hybrid composite/concrete structural systems for long life-low maintenance shore facilities.
- (U) Develop concepts for application of non-destructive evaluation (NDE) technologies to modular hybrid composite/concrete systems to enable cost effective approaches to repair.

- (U) ($8,976) AIRBORNE MATERIALS.
- (U) Explore turbine case fabrication technology for orthorhombic Ti alloys. This will result in improved performance and lighterweight in Naval aircraft engines.
- (U) Explore feasibility of oxidation resistant Mo-Alloy w/2500°F capability. This will result in revolutionary performance improvements in Naval aircraft engines.
- (U) Continue evaluation of corrosion sensors in operational aircraft for implementation of condition based maintenance.

- (U) Evaluate corrosion prevention applique technology in operational carrier environments to reduce hazardous material disposal costs.
- (U) Identify chromate and cadmium replacement technologies for aircraft to conform with EPA regulations.

- (U) ($10,555) SEABORNE MATERIALS.
  - (U) Integrate composite and multifunctional technologies for reduced signature and weight in ship topside design.
  - (U) Develop innovative, more affordable processes for improved welding/joining of non-magnetic ship hull materials to reduce signature and provide mine countermeasures.
  - (U) Investigate non-magnetic alloys in regard to strength, fracture behavior, fabrication, and corrosion protection for ship hull application to reduce signature.
  - (U) Develop improved fire-resistant, low-cost composite material systems to enhance fire-fighting capability.
  - (U) Develop prediction capability for (UNDEX) loaded hull structural material with rupture to improve warfighting ability.
  - (U) Continue evaluation of coatings technology for non-magnetic ship hull applications to reduce signature.
  - (U) Evaluate corrosion sensors in ballast tanks of operational ships to enable implementation of condition based maintenance.
  - (U) Evaluate upgraded seawater valves in operational ship systems to reduce life cycle costs.
  - (U) Transition guided wave ultrasonics corrosion/erosion detection technology to fleet to enable implementation of condition based maintenance.

- (U) ($1,432) MISSILE/SPACE MATERIALS.
  - (U) Investigate Refractory metal (Hf, Ta) spraying process for fabrication of low-cost metal nozzles which will increase performance and reduce cost in missile engines.
  - (U) Develop oxidation models for ceramic systems of interest (HfC, HfW, HfB2) which will result in improved performance and reduce development costs for missile propulsion systems.

- (U) ($7,368) MULTI-MISSION MATERIALS.
  - (U) Explore new formulations of phthalocyanines that do not show performance degradation at high fluences (energy/area) for advanced laser eye and device protective devices.

- (U) Establish industrial fabrication processes for tubules and formulated composites for transition to fleet applications.
- (U) Demonstrate the performance of single crystal piezoelectrics (high sensitivity-2 Octave Bandwidth) in high frequency ultrasonic imaging transducers for torpedo guidance and mine detection.
- (U) Use of nanostructured oxide ceramic coatings will be demonstrated by fabrication and testing of selected components. Techniques for fabrication of nanostructured Ni-based alloy coatings will be developed for multi-mission applications.

- (U) ($9,789) RF SOLID STATE DEVICE AND CONTROL COMPONENTS.
  - (U) Demonstrate highly compact, high Q, tunable notch filter for T/R module applications.
  - (U) Demonstrate gallium nitride heterojunction field effect power transistor for 6 - 18 GHz operation for next generation E/M power amplifiers.
  - (U) Continue the development of gallium nitride based heterojunction bipolar transistor in the 1 - 18 GHz spectrum and connected as class B, push-pull for maximum efficiency and linearity for ultra wideband MPM applications.
  - (U) Demonstrate compact varactor tuned filter for T/R module applications.
  - (U) Demonstrate 25 watt GaN X-band amplifier for high power transmitter applications.
  - (U) Develop a programmable time delay hybrid circuit for improving co-site interference canceller accuracy over VHF operation bandwidth.
  - (U) Demonstrate SiGe T-Gate structures with Ft, Fmax > 100 GHz and equal p/n channel MOSFET mobilities to minimize CMOS circuit area.
  - (U) Apply and transition the technology of CMOS low voltage, low power sub 250nm - 100nm SiGe with T-gate structure in 50nm - 30nm TFSOS for the implementation (design, fabrication and demonstration) of K-band (40 GHz) low noise analog front-end receiver functions and 4 bit, 20 gigasamples/sec A/D converters using two time-interleaved 4 bit, 10 GSPS A/D converters.
  - (U) Demonstrate a 25 channel Continuous Wavelet Transform circuit for EW signal identification.

- (U) ($10,000) VACUUM ELECTRONICS.
  - (U) Develop an ultra-wideband MPM for EW applications.
  - (U) Develop a vacuum power booster for a 2-D array MPM for phased array applications.

- (U) Develop an airborne compatible gyroklyston with gridded electron gun for high pulse repetition frequency (PRF) radar to provide unambigous doppler at W band.
- (U) Develop high speed design codes for coupled cavity TWTs to provide for reduced noise in Navy shipboard illuminator applications.
- (U) Develop high brightness scandate cathode in high perveance TWT to increase reliability through lower operating temperature.

• (U) ($5,867) E/O TECHNOLOGY.
- (U) Demonstrate an adaptive two color IRFPA for increased clutter and background rejection
- (U) Demonstrate a three color IR detector to enable discrimination against advanced countermeasures.
- (U) Develop a small pixel color discriminating IRFPA for wide field of view shipboard IRST and theatre missile defense interceptor applications.
- (U) Optimize fiber fabrication techniques to achieve goal of 0.1 dB/m loss in 2 - 5 μm region and proof-test fibers to goal of 50,000 psi for EW applications. Reduce AR coatings reflectance to 2% in 2 - 5 μm region. Improve optical power damage threshold to achieve goal of 1.5 GW/cm2 in AR coated fibers. Develop cabling techniques for 10 m length cables which are ruggedized and meet system environmental specifications.
- (U) Select final approach (e.g. lateral epitaxial overgrowth or compliant substrate) for the synthesis of low defect materials for reducing the cost of infrared materials and improving their performance.

• (U) ($12,613) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY. With the advances that are currently being made in electronics there exists a strong opportunity to realize multifunctional systems that integrate the functions of radar, EW, and communications into a pair of transmit and receive apertures over a broad bandwidth. It should be noted that this program is in contrast to the Air Force (AF) and Joint Strike Fighter (JSF) programs in that it treats both the transmit and receive functions in separate apertures. This approach avoids the need for time allocation of different RF functions and therefore offers the opportunity for more massive integration of RF functions into the pair of apertures. As a result, this integrated thrust has been formed and the current program enhanced to capitalize upon ongoing and planned applied research to develop RF solid state and photonic devices. This program is coordinated with JSF and the AF and has an oversight group with representatives from Space and Warfare Systems Command (SPAWAR), Naval Air Systems Command (NAVAIR), Program Executive Office (PEO)DD-21, PEO

Theater Air Defense/Surface Combatant (TAD/SC), Common Support Aircraft (CSA), N86 and N6. Specific efforts within this thrust include:
- (U) Demonstrate moderate power continuous wave (CW) ultra broadband (1 - 18 GHz), ultra linear (cross modulation products 28dbm below fundamental signal) compact amplifiers suitable for use in next generation multifunctional wide area surveillance systems and also suitable for use as drivers in microwave power modules.
- (U) Develop low parasitic bipolar microwave power amplifier for the 1 - 5 GHz spectrum.
- (U) Demonstrate a 100 GHz logic-derived microwave synthesizer for 1 - 5 GHz output (sans modulator)
- (U) Select final approach to A/D converter with real time adjustment of resolution vs bandwidth and suitable for use with advanced multifunctional RF systems.
- (U) Continue the development of a multicomponent model for antenna isolation and coupling to assess options for minimizing interference and self-jaming of multifunciton apertures.

- (U) ($10,357) COMMAND AND CONTROL AND COMBAT SYSTEMS.
  - (U) Demonstrate distributed software that will enable users at remote locations to collaborate for effective planning using 3D, interactive virtual reality displays with objects having physical realism.
  - (U) Precisely quantify image spatial domain error propagation and further study the problem of feature detection in wavelet space.
  - (U) Integrate the Software Requirements Specification tool that combines the three decision procedures (term rewriting, Reduced Ordered Binary Decision Diagrams, and a constraint solver) into the existing toolset. Evaluate the prototype tool as well as the TAME tool (which uses a mechanical prover to analyze properties of time automata models) for detecting violations of application properties in timed requirement specifications.
  - (U) Under the 'System of Systems' program, demonstrate chip out technology and develop/understand transmitting the targeting template through additional compression stages in the presence of channel noise. Introduce techniques to optimize joint channel source encoding to maximize performance and adapt the system.
  - (U) Demonstrate a distributed software infrastructure prototype development for use in integrating COTS tools (PCIS2) by incorporating Software Process, Configuration Management, and wide-area traceability capabilities.
  - (U) Continue development of interface specification and architecture merging command and control functions and platform battle management in a secure distributed network combining non-real-time and real-time databases and operations.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	70,174	77,617	81,026
(U) Appropriated Value:		88,117	
(U) Adjustments from FY 1999 PRESBUDG:	+6,020	+10,081	-3,069
(U) FY 2000 PRESBUDG Submission:	76,194	87,698	77,957

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 adjustment reflects actual update adjustments (+3,245), Small Business Innovation Research reduction (-225) and Terfenol-D Line Item Veto Override (+3,000). FY 1999 adjustment reflects the following Congressional additions: Materials Micronization (+4,000), Advanced Materials Intelligent Processing Center (+3,000), High Temperature Superconductors for Propulsion (+2,000), Carbon-Carbon Materials for Reentry Vehicles (+1,500), High Thermal Conductivity Fibers for Thermal Management Materials (+2,500), Superconducting Waveform Generator (+1,000) and Silicon Carbide Semiconductor Materials (+3,500), Congressional Undistributed reductions (-419), and Congressional General reduction (-7,000). FY 2000 adjustment reflects Program adjustments (-2,817), Navy Working Capital Fund (NWCF) rate adjustment (+602), Civilian Pay Rates (+274), and Non Pay Inflation (-1,128).

(U) Schedule: The reductions in FY 2000 as noted above, preclude certain aspects of expansion, risk reduction and early transition in the following thrust areas: Airborne Materials, Shore Facilities, and Multi-mission Materials, RF Solid State Devices and Control Components, and Command, Control and Combat Systems. Specific areas affected include: research in the area of integration of electrically switchable radome materials into airborne systems; engineered lumber for pilings; new composite concrete; transitioning high performance A/D power converters to military systems; verification and validation of software supporting Network-Centric Warfare; multi-level security software for Navy Systems; and integration of real and non real-time Navy information systems.

(U) Technical: The thrust areas of Airborne Materials, Shore Facilities, RF Solid State Devices and Control Components, and Command and Control and Combat Systems will see an overall decrease that will increase the

technical and transition risk for front frame technology for aircraft engines, especially F414 in the F/A-18E/F; increase the technical risk for transition of engineered lumber for pilings; increase the technical risk for transition of laser protective materials; increase the technical risk and development time of A/D converters that can be used for all sensor systems; increase vulnerability to intrusion and computer security threats for Navy COTS based Information Systems, as well as increase the system acquisition certification and maintenance costs for Network-Centric Warfare Systems.

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

(U) RELATED RDT&E:
- (U) PEs 0601102A, 0601102F, 0601153N (Defense Research Sciences)
- (U) PEs 0602105A, 0602102F (Materials Technology)
- (U) PEs 0602705A, 0602709A, 0602204F, 0602702F (Electronic Devices Technology)
- (U) PEs 0602783A, 0602783A, 0602202F, 0602702F, 0603728F, 0602301E, 0603226E (Computer Technology)
- (U) PE 0602303A (Missile Technology)
- (U) PE 0602601A (Combat Vehicle and Automotive Technology)
- (U) PEs 0602702F, 0602232N (Command, Control and Communications)
- (U) PE 0602786A (Logistics Technology)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602121N (Ship, Submarine and Logistics Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602323N (Submarine Technology)
- (U) PE 0602270N (Electronic Warfare Technology)

(U) This PE adheres to Defense Technology Area Plan (DTAP) and Defense Technology Objective (DTO) Agreements on Advanced Materials, Electronics and Computer Technology with oversight provided by the Joint Directors of Laboratories and Joint Engineers. This PE is integrated with the 6.1 and 6.2 PE's shown above and is fully coordinated with efforts in DoD through Joint Director of Laboratories and Defense Task Area Plans activities.

D. (U) FUNDING PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
Electronic Warfare Technology	16,982	22,743	24,659	25,462	27,049	27,777	28,469	29,195	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Navy Electronic Warfare (EW) Science and Technology (S&T) Program addresses identified technology requirements for EW in cooperation with the other Services, placing special emphasis on Naval EW roles in Information Warfare (IW). This program develops technologies which support the effective utilization of Naval force capabilities in the conduct of the Navy's Joint Mission Areas defined by Office of the Chief of Naval Operations (OPNAV) (i.e., Strike, Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Command, Control, Communications, and Computers (C4) and Information Warfare, and Nuclear Deterrence/Counterproliferation of Weapons of Mass Destruction). It is also vitally associated with future joint warfighting capabilities of "maintaining near perfect real-time knowledge of the enemy and to counter the threat of cruise missiles to the Continental United States and deployed forces". The program is planned jointly in accordance with Defense S&T Reliance agreements that allocate various EW disciplines and their attendant technology development responsibilities between the Army, Air Force and the Navy. As part of the Integrated S&T EW Program, efforts are subject to review and execution oversight by the Director of Defense Research and Engineering (DDR&E) Technology Panel for Electronic Warfare (TPEW).

(U) The emergence of a polycentric strategic environment, the evolving and diversified nature of the threat, and the proliferation of arms and technology have contributed to shifting the focus of conflict to regional and littoral areas. Concurrently, the global arms industry continues to supply increasingly sophisticated sensors and weapons to the world-wide arms market. The heterogeneous combination of military and commercial systems dictates the need to develop more advanced EW technologies that will be able to adequately exploit and counter the use of new threats.

(U) The structure and balance of this program are responsive to OPNAV guidance and identified System Command warfighting requirements and needs. The program features the integration of 6.1 and 6.2 programs with 6.3 EW core programs and Advanced Technology Demonstrations (ATDs) which can produce prototypes suitable for naval force

deployments and demonstrations. Program integration is achieved through the transition and implementation of program products. The program continues to support the Navy's highest priority need, Ship Self-Defense. It develops EW technologies to counter a range of threats (including multi-spectral/multi-modal sensors and seekers) and spans the entire electromagnetic spectrum by improving threat detection, identification, and location in the battle space. The program transitions new technologies to tactical aircraft (TACAIR), low observable aircraft, surface EW platforms, and Pre-Planned Product Improvement (P3I) programs through developmental upgrades and direct technology insertions.

(U) Due to the sheer volume of efforts included in this Program Element (PE), the programs described in the Accomplishments and Plans section are representative selections of the work included in this PE.

(U) The Navy Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH budget activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: FY 1998 funding reflected an enhanced program to address stand-off jamming (SOJ) technology for next generation support jamming. Work continued on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance continued.

   • (U) ($3,218) THREAT WARNING - The objective is to develop small and inexpensive radio frequency (RF) receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive electro-optical/infrared (EO/IR) technologies to provide early warning of hostile action, either surveillance or attack, to United States military platforms and to assist in identifying and countering the threat.
     - (U) Coordinated development and packaging of a 12-bit analog-to-digital converter to provide a 24 decibel increase in dynamic range for the extraction of signals and of processing hardware for use in a miniature Specific Emitter Identification (SEI) system for tactical aircraft, Unmanned Air Vehicles (UAVs), and portable

systems and making it attractive for application in weapons systems such as High Speed Anti-Radiation Missile (HARM).
- (U) Field tested the double delta direction finding system to provide a passive high precision direction finder comparable to multi-channel phase interferometers for air and surface platforms.
- (U) Improved de-interleaver algorithms and designed a prototype system which extracts SEI information from modern tactical military radars possessing more stable, near flat, RF sources focusing on the tactical application of SEI to the commander in the field, onboard ship, or in the air.
- (U) Developed an airborne counterfire system which detects mortar, artillery, and other large caliber weapon firings, and, via a satellite or radio link, communicates their location to counterfire units.
- (U) Developed an improved signal processing concept providing capability for detecting frequency modulated, continuous wave (FMCW) signal with a signal-to-noise ratio of zero decibels to address the Advanced Integrated Electronic Warfare System (AIEWS) program requirement of detecting and identifying certain FMCW signals to provide early warning and cueing of ship self-defense weapons systems.

• (U) ($7,628) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard EW systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and Space and Electronic Warfare (SEW) Intelligence. The entire radar RF frequency band from high frequency (HF) to millimeter wave (MMW) is covered under this project. It also includes the protection of U.S. Naval platforms against EO/IR guided weapons by the development of new infrared (IR) materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
- (U) Evaluated robustness of jamming techniques and smart jam codes and timelines for causing optical breaklock for the integrated onboard/offboard countermeasures (CM) solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
- (U) Tested waveforms to determine timeline effectiveness of directional infrared countermeasures (IRCM) against Anti-Ship Cruise Missile (ASCM) threats and use optical augmentation and Moving Target Indicator sensors to determine which smart waveforms seduce missiles and minimize chance of reacquisition after initiating directional lock transfer to enhance capability of the AIEWS system against advanced IR guided anti-ship threats.
- (U) Added and tested a floating component to the Multi-cloud decoy which will increase the lifetime of the device thus enhancing ship self-defense against IR guided anti-ship threats.
- (U) Concluded Kinematic Special Material Decoy effort with a final report and transfer of concept design and technologies to programs in Navy 6.3 Electronic Warfare Advanced Technology program and Air Force 6.2 EW program that are developing thrusted infrared countermeasure decoys.

- (U) Improved antenna isolation model to represent antennas mounted on flat surfaces coated with Radar Absorbing Material for any decoy platform and implemented interference cancellation techniques to achieve higher decoy effective radiated power through improved antenna isolation.
- (U) Demonstrated final integration and flight-tested the AN/ALQ-167 pod mounted Mini-URANUS system (a modular, fully coherent jammer capable of jamming multiple simultaneous threats) for standoff and self-protection of aircraft, helicopters, and potentially UAVs, as part of the next generation electronic attack function.
- (U) Integrated electronic attack (EA) subsystems with electronic support (ES) subsystem and performed lab test of the Small Ship Jammer developed for physically small surface patrol craft that have no active onboard EA self-protection capability (e.g., the PC-1 and MK V Special Operation Craft) and are currently involved in fleet littoral warfare operations.
- (U) Performed susceptibility analysis and developed final cooperative IRCM techniques to focal plane arrays (FPAs) on selected foreign and domestic FPAs as part of a tri-service planned and funded program to assess the susceptibility of imaging seeker components for the development of CM against advanced imaging IR missiles.

• (U) ($6,136) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual system/platform through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids that fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, electronic countermeasures (ECM) and other mission-support aircraft to improve situation awareness, to provide dependable combat identification and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.

- (U) Selected design configuration, and built and tested a baseline model of a Micro Air Vehicle capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman, for discreet Navy missions.
- (U) Evaluated tri-service field tests of countermeasures against modern cellular radio communication systems and transition countermeasure techniques into the EA-6B jamming system.
- (U) Integrated the use of the real-time software bridge in next generation, dynamic information fusion systems as part of a visually rich command and control warfare simulator capable of synthesizing realistic operations found in modern combat missions for assessing Naval operational situations, planning future operations, and evaluating system effectiveness.

- (U) Conducted validation of heat transfer, sea clutter, and surface reflectance sub-models and incorporated these into the IR ship target and scene model for the Cruise Missile (CM) EW simulation to address the shortcomings of previous IR ship predictive codes.
- (U) Implemented modifications to the Little Monopulse Information Signal Processing Element (LMISPE) system and tested those against surrogate cellular communication test sets to develop a system capable of fingerprinting modern cellular radio communication systems from airborne platforms.

2. (U) FY 1999 PLAN: Work continues on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance will continue. The development of micro and unmanned air vehicle designs for small radar cross section platforms and the IRCM development and stand-off jamming work continue to be of importance.

• (U) ($3,902) THREAT WARNING - The objective is to develop small and inexpensive RF receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive EO/IR technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying and countering the threat.

- (U) Demonstrate the ability of the miniaturized SEI system to perform within the confines of a platform such as a small UAV, providing specific target homing and discrimination capabilities for tactical aircraft, UAVs, and portable systems and making it attractive for application in weapons systems such as HARM.
- (U) Design and fully demonstrate prototype unit which extracts SEI information from modern tactical military radars possessing more stable, near flat, RF sources focusing on the tactical application of SEI to the commander in the field, onboard ship, or in the air.
- (U) Develop a counterfire system based on microbolometer camera technology which is carried by the individual infantryman to detect and mark in space the location of small arms fire in real time and at ranges greater than or equal to the lethal range of the enemy weapon.
- (U) Evaluate digital signal processing using wavelets, optical processing, and electrical micro-circuit realization of the wavelet filter bank, selecting the most promising approach for demonstrating an improved signal processing capability for detecting FMCW signals with a signal-to-noise ratio of zero decibels to address the AIEWS program requirement of detecting and identifying certain FMCW signals to provide early warning and cueing of ship self-defense weapons systems.

• (U) ($10,749) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard EW systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and SEW Intelligence. The entire radar RF

frequency band from HF to MMW is covered under this project. It also includes the protection of U.S. Naval platforms against IR/EO guided weapons by the development of new IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.

- (U) Conduct preliminary designs of onboard laser guided weapons detection/protection systems and field test prototype developmental systems for the integrated onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
- (U) Determine most efficient jam codes against steering array sensors and transition selected robust seductive waveforms to enhance capability of the AIEWS system against advanced IR guided anti-ship threats.
- (U) Improve antenna isolation model to represent antennas mounted on random access memory coated curved surfaces for any decoy platform and finalize isolation improvement techniques and document analysis methods to achieve higher decoy effective radiated power through improved antenna isolation.
- (U) Perform field and at-sea tests of the Small Ship Jammer developed for physically small surface patrol crafts that have no active onboard EA self-protection capability (e.g., the PC-1 and MK V Special Operations Craft) and are currently involved in fleet littoral warfare operations.

• (U) ($8,050) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual system/platform through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids which fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, ECM and other mission-support aircraft to improve situation awareness, to provide dependable combat ID and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.

- (U) Demonstrate a partial payload of a Micro Air Vehicle capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman, for discreet Navy missions.
- (U) Develop a visually rich command and control simulator capable of synthesizing realistic operations found in modern combat missions for assessing Naval operational situations, planning future operations, and evaluating system effectiveness.
- (U) Validate the IR ship target and scene model for the CM EW simulation to address the shortcomings of previous IR ship predictive codes.
- (U) Plan and conduct tri-service field demonstration of the modified LMISPE system capable of fingerprinting modern cellular radio communication systems from airborne platforms.

- (U) ($42) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN: Work continues on shipboard sensor and weapons response involved in operations in littoral regions. Programs concerning combat identification, precision strike and information dominance will continue. The development of micro and unmanned air vehicle designs for small radar cross section platforms and the IRCM development and SOJ work continue to be of importance.

- (U) ($5,533) THREAT WARNING - The objective is to develop small and inexpensive RF receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive EO/IR technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying and countering the threat.
  - (U) Demonstrate and verify, in an operational test, specific target homing and discrimination capabilities with the use of extremely miniature components (Analog-to-Digital Converter, the pulse processor Application Specific Integrated Circuit (ASIC) and the Digital Signal Processor) packaged in sizes suitable for tactical aircraft, UAVs, and portable systems and making it attractive for application in weapons systems such as HARM.
  - (U) Optimize wavelet filterbank parameters and digital signal processing algorithms which extract SEI information from modern tactical military radars possessing more stable, near flat, RF sources focusing on the tactical application of SEI to the commander in the field, onboard ship, or in the air. Transition to the AIEWS program.
  - (U) Develop and demonstrate technology building blocks to provide small, inexpensive integrated sensors to allow micro air vehicles (MAV) to detect and identify RF emitters, locate and navigate towards these emitters and deliver a sensor or countermeasure micro-payload for battlefield intelligence and situational awareness.
  - (U) Demonstrate an improved signal processing capability for detecting FMCW signals with a signal-to-noise ratio of less than zero decibels to address the AIEWS program requirement of detecting and identifying certain signals to provide early warning and cueing of ship self-defense weapons systems. Transition to the AIEWS program.
  - (U) Complete design and integration of an ES system capable of being deployed on presently available remotely piloted vehicles to provide high quality threat information for strategic and tactical surveillance and reconnaissance missions.
  - (U) Develop and incorporate variable fidelity electromagnetic propagation models into the simulation providing a littoral capable force-on-force level simulator which establishes a common operating picture for the EW commander.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

• (U) ($10,528) SELF PROTECTION - The objective is to provide a fundamental technology base, from components to systems, to support the prototype development of future onboard and offboard EW systems, to enhance Naval success in Littoral Warfare, Strike, Sealift/Protection, Strategic Deterrence, and SEW Intelligence. The entire radar frequency band from HF to MMW is covered under this project. It also includes the protection of U.S. Naval platforms against IR/EO guided weapons by the development of new IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.

- (U) Complete integration and evaluation of the onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
- (U) Improve the spectral performance of the IR Special Materials and incorporate with the vehicle autopilot and sensor control for the development of a containerized vertically launched decoy to counter the advanced Imaging Infrared ASCM seekers.
- (U) Incorporate a new mid-infrared solid state laser into the Multi-Band Anti-Ship Cruise Missile Defense Tactical Electronic Warfare System (MATES) testbed and investigate use of a compact IR countermeasures system for small shipboard platforms to provide an integrated multi-function, multi-band laser based countermeasures system for ship defense.

• (U) ($8,598) MISSION SUPPORT - The objective is focused on improving the ability to assess EW performance ranging from individual system/platform through operations in Joint Mission and Support Areas such as training and the research infrastructure. A major goal of this research area is to explore development of Battle Management decision aids that fit within the established Navy command and control system deployed throughout the fleet. The focus is also on advanced surveillance techniques and jamming and deception of command and control systems and data links and the development of capabilities for strike, surveillance, ECM and other mission-support aircraft to improve situation awareness, to provide dependable combat ID and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.

- (U) Develop the final jamming payload and integrate it with the final Micro Air Vehicle design capable of carrying avionics and a radar jamming payload, but light enough to be carried by an individual infantryman for discreet Navy missions.
- (U) Develop digital signal processing (DSP) hardware and algorithms to integrate with receiver/transmitter models for development of building block technologies needed for a small, lightweight, programmable Anti-Ship Missile (ASM) seeker simulator for packaging on a recoverable target drone to perform realistic at-sea threat engagement scenarios.
- (U) Based on results of the STARCROSS studies, develop and test a high speed analog-to-digital and DSP intercept system to establish jamming requirements against mobile radio communications systems potentially employed by enemy forces.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (U) Conduct an overall system level design (including Electronic Attack, Information Warfare and Artificial Intelligence) and model a coordinated Force-on-Force level engagement for deployment of distributed EW assets that can be used collaboratively in a synchronized fashion in real time.
- (U) Develop prototype set-up and control software models and establish parallelization efforts to reduce per-run execution time, simulation setup time, and post-run analysis time of the CM high-fidelity EW simulation model.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	21,164	23,849	25,460
(U) Appropriated Value		22,849	
(U) Adjustments from FY 1999 PRESBUDG	-4,182	-1,106	-801
(U) FY 2000 PRESBUDG Submission	16,982	22,743	24,659

(U) Funding: The FY 1998 adjustment reflects a Small Business Innovation Research reduction (-76), and Actual Update adjustment (-4,106). FY 1999 adjustment reflects a program reduction (Fiscal Constraints) (-1,000), Undistributed reductions (-106). FY 2000 reflects Program Re-balancing (-1,074), Navy Working Capital Fund adjustments (+480), Civilian Pay Rates (+149), and Non Pay Inflation (-356).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) RELATED RDT&E PROGRAMS:

This PE adheres to Defense S&T Reliance Agreements on EW with oversight and coordination provided by the DDR&E and is associated with efforts that are being pursued under the following Army and Air Force PEs:

(U) PE 0602204F (Aerospace Avionics)
(U) PE 0603270F (Advanced Electronic Warfare Technology)
(U) PE 0602270A (Electronic Warfare Technology)
(U) PE 0603270A (Advanced Electronic Warfare Technology)
(U) PE 0605604A (Survivability and Lethality Analysis)

This program is also closely associated with the following Navy PEs:

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602232N (Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)
(U) PE 0602111N (Air and Surface Launched Weapons Technology)
(U) PE 0603270N (Advanced Electronic Warfare Technology)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604270N (EW Development)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602315N
PROGRAM ELEMENT TITLE: Mine Countermeasures, Mining and Special Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	T
00000	35,221	45,496	45,022	51,008	52,104	53,285	54,542	55,837	CONT.	C

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Navy program element (PE) provides technologies for naval Mine Countermeasures (MCM), U.S. Naval sea mines, Naval Special Warfare, and Department of Defense (DOD) Explosive Ordnance Disposal (EOD). It is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capabilities through the development of technologies to achieve military objectives (Power Projection from the Sea) with minimal casualties and collateral damage. The PE supports the Joint Littoral Warfare Mission Area by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. The MCM component concentrates on the development of technologies for clandestine minefield surveillance and reconnaissance, organic self-protection, organic minehunting, neutralization/breaching and clearance; the sea Mining component emphasizes offensive sea mining capabilities. The Naval Special Warfare and EOD technology components concentrate on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as explosive ordnance disposal.

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

(U) MCM Technology: Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littoral battlespace. "Desert Storm" demonstrated the U.S. Navy's needs to counter the projected third-world mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water to the beach. This task has two major thrusts: (1) Mine/obstacle detection and (2) mine/obstacle neutralization. The detection thrust includes: remote sensing techniques to survey threat mining activities and mine/obstacle field locations; advanced acoustic/non-acoustic sensors and processing technologies for rapid minefield reconnaissance and determination of the location of individual mines and obstacles. The majority of these sensors and techniques were demonstrated in FY 1997 and FY 1998 as part of the Joint Countermine Advanced Concepts Technology Demonstration (ACTD). The neutralization thrust includes influence sweeping technologies for influence minefield clearance, explosive and non-explosive technologies for surf zone (SZ) mine/obstacle field breaching, and advanced technologies to rapidly neutralize shallow water (SW) sea mines.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602315N
PROGRAM ELEMENT TITLE: Mine Countermeasures, Mining and Special Warfare Technology

(U) Mine Technology: The requirements for improved sea mine technologies has changed due to the reduced threat of the traditional modern submarines and surface ships. The elevated threats today are the third-world submarines and surface ships which may be encountered in the littoral waters of regional conflicts. Despite the diminished sophisticated threat, it is imperative that the US Navy maintain a broad-based and robust sea mining capability through advanced mine sensors, environmental characterization, and systems performance analysis technologies. Emphasis will be placed on potentially high payoff advanced sensors for target detection and discrimination and on low cost, wide area sea mine system concepts, including positive command/control mechanisms, with expanded weapon effectiveness for regional warfare.

(U) Special Warfare Technology: Naval Special Warfare (NSW) missions primarily support covert naval operations. The goal is to develop technology required to increase the combat range and effectiveness of Special Warfare units. A major current focus is to develop technologies to enhance the Sea-Air-Land (SEAL) mission of pre-invasion detection for clearance/avoidance of mines and obstacles in the very shallow water (VSW) and SZ approaches to the amphibious landing areas. Improvements to mission support equipment are needed to increase the probability of mission success, endurance and SEAL swimmer survivability.

(U) EOD Technology: Technology development for EOD needs addresses the DOD Joint Service and interagency responsibilities in EOD, including that required to counter and neutralize Weapons of Mass Destruction (WMD). The technologies developed are required for locating, rendering safe and disposing of Unexploded Explosive Ordnance (UXO). These operations typically occur in deep, poor-visibility water, in areas of high background noise, and in strategic operating areas contaminated by a variety of UXO. Advanced technologies are needed for gaining access to areas contaminated by sophisticated area-denial sensors and/or booby traps and for contending with WMD. These technologies are expected to transition to the Joint Service EOD Program, the Naval EOD Program or the DOD Technical Response Group.

(U) The Navy Science and Technology program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($18,756) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Completed integration of Toroidal Volume Search Sonar (TVSS) and Synthetic Aperture Sonar (SAS) acoustic minehunting sensor modules into remote underwater sensor platform for Joint Countermine (JCM)

ACTD demonstration of sea mine detection, classification, and identification. Conducted at-sea testing of TVSS and SAS integrated sensor modules. Demonstrated acoustic sensors during the JCM ACTD as part of MARCOT98/Unified Spirit (combined Canadian/NATO exercise). Continued development of advanced SAS and Side Looking Sonar beamforming techniques focusing on phase compensation for motion and environmentally induced errors.

- (U) Electro-Optic Sensors: Completed sensor performance prediction model for optical mine identification system that included the spectral characteristics of mine-like targets. Completed integration of Laser Line Scan mine identification sensor into Remote underwater platform for demonstration during the Joint Countermine ACTD. Successfully deployed laser line scan and synthetic aperture sonar sensors during SwissAir crash site investigation, providing identification of sonar contacts of interest. Continued development of fluorescence imaging for mine identification focusing on the characterization of target/background spectral content.
- (U) Electro-Magnetic Sensors: Completed development of thin film, single channel Low Temperature Critical(Tc) superconducting gradiometer test article. Completed investigation of motion-induced noise and radio frequency immunity. Continued to develop thin film, High Tc superconducting gradiometer fabrication technology to a level of maturity comparable to the thin film, Low Tc counterpart.
- (U) Image Processing and Classification Algorithms: Developed improved multi-sensor data fusion and compression techniques to provide real-time processing and data transmission from the remote underwater sensor platform to the "mother ship" for information assimilation and display. Completed integration of real-time processing algorithms on embedded processor and demonstrated as part of the JCM ACTD, real-time mine detection, classification, and identification.

• (U) ($6,180) MINE/OBSTACLE NEUTRALIZATION:
  - (U) SW Mine Neutralization: Transitioned anti-mine projectile for the Rapid Airborne Mine Clearance System concept to an Advanced Technology Transition Project (PE 0603792N).
  - (U) SZ Mine Neutralization: Established through precise tests and measurements the importance of relative flow between sand and mine-like targets on shock transmission and mine kill predictions in the SZ environment. Continued expanding database of mine neutralization criteria (pressure, impulse, energy) for threat mines through testing and analysis.
  - (U) Obstacle Breaching: Developed an analytical model from parametric studies with the finite concrete model which will allow tradeoffs of warhead size, shape, and standoff required to defeat various target shapes and configurations. Improved obstacle clearance models by incorporating results of simultaneous and sequential detonation testing. Initiated development of technologies required for precise standoff bomb delivery for mine and obstacle clearance.

• (U) ($2,860) SEA MINING:

- (U) Intelligent Mine Network: Developed Distributed Autonomous Deployed System (DADS) mobile shallow water mine (DADS-weapon) concept. Develop covert deployment concept based upon Submarine Launched Mobile Mine. Developed concepts for "restart" of deployed mobile mine for target attack, communications with DADS during target attack mode, and terminal guidance.
- (U) Sea Mine Sensors: Initiated development of guidance sensors and signal processing for DADS mobile shallow water mines.
- (U) Minefield Command and Control: Initiated development of concept for command and control of DADS weapons. Conducted assessment of minefield command and control incorporating prior year developments of Indication Friend or Foe and Remote Control into DADS. Initiated development of concept for intra-field guidance of DADS weapon after launch using node and weapon sensors.

• (U) ($7,425) SPECIAL WARFARE/Explosive Ordnance Disposal (EOD):
- (U) Mission Mobility Technology: Completed development of components of low signature diver propulsion system; integrated, tested and evaluated prototype. Transitioned technology for incorporating micro Phase Change Materials into dive suits for passive, thermal protection. Developed NSW life support equipment technologies. Options for life support equipment technologies include passive in-water chemical detectors, advanced Carbon Dioxide scrubbing technology, diver internal monitoring/biofeedback, field oxygen supply technologies.
- (U) Mission Support Technology: Fabricated, evaluated and demonstrated prototype of passive multispectral optical parametric amplification laser imager. Conducted field tests of sensors for use in a diver-portable multi-sensor buried minehunter; developed algorithms to process and display signals. Transitioned clandestine ultra-short range gate laser technology for underwater obstacle localization/identification.
- (U) Clearance of UXO: Demonstrated a capability to determine the status of electronic safe and armed fuses from a standoff distance due to unintentional or stimulated emissions from the firing train components. Demonstrated a small, autonomous, untethered underwater vehicle controls and sensors for identification of naval threats hosted on a composite vehicle built by Lockheed-Martin under Independent Research & Development funding.

2. (U) FY 1999 PLAN:

• (U) ($21,486) MINE/OBSTACLE DETECTION:
- (U) Acoustic Sensors: Complete analysis of performance and effectiveness of TVSS and SAS, demonstrated during JCM ACTD, for detection and classification of sea mines. Initiate development of broadband sonar transmitter for SAS application to enhance detection/classification probabilities, area search rate, and environmental adaptability.
- (U) Electro-Optic Sensors: Initiate development of scene classification algorithms based on target optical properties. Begin feasibility studies to define the characteristics of an advanced electro-optic identification sensor that measures the spectral properties of mine-like objects and the surrounding scene.

- (U) Electro-Magnetic Sensors: Complete development of thin film, High Tc superconducting gradiometer for field demonstration to investigate motion induced noise characteristics.
- (U) Image Processing and Classification Algorithms: Assess effectiveness of multi-sensor data fusion techniques demonstrated during JCM ACTD and initiate development of improvements indicated by the assessment. Initiate development of broadband acoustic signal processing algorithms and techniques for SAS application to provide increased coverage rate, increased target image resolution, and extended sonar range. Initiate environmentally adaptive processing techniques to maintain high detection/classification probabilities under varying and adverse environmental conditions.

• (U) ($7,548) MINE/OBSTACLE NEUTRALIZATION:
- (U) SW Mine Neutralization: Initiate effort to develop technology to sweep pressure influence mines by focusing on the characterization of pressure signatures of surface ships in ocean swell.
- (U) SZ Mine Neutralization: Expand mine vulnerability data base to include neutralization criteria for recently developed threat mines with potential for use in the SZ and beach environments. Investigate innovative concepts for energetic neutralization of SZ mines.
- (U) Obstacle Breaching: Determine effects of directed energy warheads against light/medium obstacles in water and air. Investigate innovative concepts for clearance or burial of SZ obstacles.

• (U) ($2,975) SEA MINING:
- (U) Intelligent Mine Network: Develop hardware/software to demonstrate feasibility of DADS-weapon concept.
- (U) Sea Mine Sensors: Test guidance sensors and signal processing for DADS-weapon in the laboratory.
- (U) Minefield Command and Control: Test concept for command and control of DADS weapon through simulation.
- (U) SW Bottom Mines: Assess application of sensors and command and control concepts developed in prior years to SW bottom mines.

• (U) ($12,854) SPECIAL WARFARE/EOD:
- (U) Mission Mobility Technology: Transition low signature diver propulsion technology. Develop NSW signature reduction technologies. Continue development of NSW life support equipment technologies.
- (U) Mission Support Technology: Integrate sensors into a diver-portable multi-sensor buried minehunter prototype and evaluate/demonstrate under realistic field conditions. Transition multispectral optical parametric amplification laser imaging technology. Develop advanced portable real-time intelligence/sensor/marker technologies. Options for intelligence/sensor technology developments include passive millimeter wave sensor, infrared polarimetry, sonar classification using echo back scatter, sensor fusion/processing, etc.
- (U) Clearance of UXO: Investigate the use of broad band transmissions to jam or neutralize the electronic components of electronic safe and armed fuses. Expand the inverse scattering sensing capability of time domain

electro-magnetic induction sensors to allow identification of individual buried UXO. Demonstrate a 10,000 element acoustic array that provides a 1 centimeter resolution image of an underwater target at 20 frames per second.

- (U) Response to WMD incidents: Perform testing of a catalyst/sensor array technique for the detection and localization of a WMD in a marine environment.
- (U) Extending the Littoral Battlespace (ELB):
Initiate development of modeling and simulation of ELB component technologies. Develop ELB Measures of Effectiveness and Measures of Performance supporting military utility assessment. Conduct and assess integrated feasibility demonstrations.

• (U) ($633) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN

•(U) ($21,107) MINE/OBSTACLE DETECTION:
- (U) Acoustic Sensors: Complete development of broadband sonar projector for synthetic aperture sonar to enhance detection/classification probabilities, area search rate and environmental adaptability. Integrate broadband source on existing SAS testbed for field testing. Begin field test of broadband synthetic aperature technology. Begin development of small acoustic sensors for integration on small autonomous vehicles.
- (U) Electro-optic Sensors: Continue development of scene classification algorithms based on target optical properties. Complete feasibility studies defining characteristics of advanced, multi-spectral mine identification sensor. Initiate development of advanced electro-optic mine identification sensor.
- (U) Electro-magnetic Sensors: Initiate field testing of thin film, high temperature superconducting gradiometer focusing on motion induced noise characterization.
- (U) Image Processing, Classification Algorithms, and Data Fusion: Continue development of broad band processing techniques/algorithm development efforts. Continue development of environmentally adaptive processing techniques to extend detection/classification range of existing and emerging sensor systems. Initiate data fusion effort focusing on fusion of multi-platform, multi-sensor data (with initial emphasis on fusion of in-service and developmental organic sensors).

•(U) ($7,650) MINE/OBSTACLE NEUTRALIZATION:
- (U) SZ Mine Neutralization: Continue development and evaluation of HELP (High Energy Low Pressure) explosive technology to promote pressure-impulse characteristics of explosives for more efficient coupling into tilt-rod mines. Transition completed mine kill criteria for new threat mines to PMS-407 in support of Distributed

Explosive Technology/Shallow Water Breaching (DET/SABRE) programs. Initiate nondeterministic modeling of mine vulnerability. Initial efforts will be development of a nondeterministic model for a single mine.

- (U) Obstacle Breaching: Initiate development of linear shaped charge array anti-obstacle technology for breaching of obstacles on the beach and in the surf. Continue development and evaluation of small unmanned bottom robotic platforms to provide reconnaissance and targeting data for mine and obstacle clearance systems. Continue developing data base for damage characteristics of obstacles on land and in the water when subjected to simultaneous and sequenced multiple bomb detonations.

•(U) ($3,000) SEA MINING:

- (U) Intelligent Mine Network: Complete development of hardware/software to demonstrate feasibility of DADS-weapon concept. Begin demonstration of mine network concept.
- (U) Sea Mine Sensors: Initiate field tests of guidance sensors and signal processing for DADS-weapon.
- (U) Minefield Command and Control: Initiate development of command and control hardware/software for feasibility demonstration of minefield command and control.

•(U) ($13,265) SPECIAL WARFARE/EOD

- (U) Mission Mobility: Continue development of life-support equipment technologies. Major focus will be thermal protection for extremities. Initiate effort to increase Stirling engine performance from 500 to 2000 watts. Investigate materials and methodologies to enable non-magnetic valve and actuator systems on NSW diver propulsion vehicle systems.
- (U) Mission Support: Continue development of unmanned underwater vehicle (UUV) technologies to support VSW reconnaissance missions. Initiate development of broadband sonar technology for diver and UUV deployment. Initiate development of scannerless range imaging system for underwater applications. Continue development of underwater adhesive technologies. Initiate development of deployable virtual environment based training aid and tactical decision aid for NSW missions.
- (U) Clearance of UXO: Initiate underwater vehicle coordination task to provide enabling technologies for heterogeneous systems of small UUVs to provide detection, classification, and identification of underwater explosive ordnance. Initiate development of robotic actuators and manipulators based on artificial muscle materials. Investigate and implement neural techniques for visual image processing and object recognition.
- (U) Response to WMD Incidents: Evaluate concepts for detecting radiation interaction with water as a means of detecting the primary source of radiation.
- (U) ELB:
- Conduct and assess integrated feasibility demonstrations of ELB technologies. Develop enhancements to battlespace network to enable real-time, seamless sensor to shooter functions. Initiate development of technologies to support near real-time operations/intelligence integration.

B. (U) PROGRAM CHANGE SUMMARY:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602315N
PROGRAM ELEMENT TITLE: Mine Countermeasures, Mining and Special Warfare Technology

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	41,451	45,928	45,264
(U) Appropriated Value:		45,928	
(U) Adjustments from FY 1999 PRESBUDG:	-6230	- 432	- 242
(U) FY 2000 President's Submission:	35,221	45,496	45,022

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 reduction consists of Small Business Innovation Research (-1,415), and Actual Execution Update(-4,815). The FY 1999 reduction consists of Revised Economic Assumptions (-106), Civilian Personnel Underexecution (-51), Contract Advisory and Assistance (-221),and FFRDC Distribution (-54). The FY 2000 reflects NWCF Adjustment of (+265), CIVPERS (+144) and Non Pay Inflation (-651).
(U) Schedule: Not applicable.
(U) Technical: Not Applicable.

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

(U) RELATED RDT&E:
(U) This program has strong ties to the PE's listed below:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602131M (Marine Corps Landing Force Technology)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0602633N (Undersea Warfare Weapons Technology)
(U) PE 0603502N (Undersea Warfare and MCM Development)
(U) PE 0603555N (Sea Control and Littoral Warfare Technology Demonstration)
(U) PE 0603654N (Joint Service EOD Development)
(U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
(U) PE 0604654N (Joint Service EOD Development)
(U) PE 1160401BB (Special Operation Technology Development)
(U) PE 1160402BB (Special Operation Advanced Technology Development)
(U) This program adheres to Tri-Service Reliance Agreements on EOD with coordination provided by the Joint Directors of Laboratories.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602315N
PROGRAM ELEMENT TITLE: Mine Countermeasures, Mining and Special Warfare Technology

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

(U) COST (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
N/A Oceanographic and Atmospheric Technology										
	74,767	68,726	60,334	62,084	63,046	64,313	65,624	66,989	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) provides the fundamental programmatic instrument by which basic research on the natural environment is transformed into technology developments that provide new or enhanced warfare capabilities. This PE also provides technologies that form the natural-environment technical base on which all systems development and advanced technology depend. This PE contains the National Oceanographic Partnership Program (Title II, subtitle E, of Public Law 104-201) enacted into law for FY 1997.

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

(U) This PE provides for ocean and atmospheric technology developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff. Major efforts of this PE are devoted to (1) gaining real-time knowledge of the battlefield's natural environment, (2) determining the natural-environment needs of regional warfare, (3) providing the on-scene commander the capability to exploit the environment to tactical advantage, and (4) developing atmospheric research related to detection of sea-skimming missiles and strike warfare.

(U) This PE provides natural-environment applied research for all fleet operations and for current or emerging systems. This PE supports virtually all the Joint Mission Areas/Support Areas with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare. Specifically:

(U) Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Programs include ocean and atmospheric prediction for real-time description of the operational environment, shallow water (SW) acoustics and multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on mine countermeasure (MCM) systems.

(U) Joint Strike Warfare efforts address issues in air battlespace dominance. Programs include influences of the natural environment on electromagnetic (EM)/electro-optic (EO) systems used in the targeting and detection of missile weapon systems as well as improvements in tactical information management about the natural environment.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

(U) These efforts support the Joint Warfare Strategy "Forward...From the Sea." This program fully supports the Director of Defense Research and Engineering's Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this PE is related to and fully coordinated with efforts in accordance with the ongoing Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the Battlespace Environment categories of Lower Atmosphere, Ocean Environments, Space & Upper Atmosphere, and TerrestrialEnvironments.

(U) The Navy program includes projects that focus on, or have attributes that enhance, the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the APPLIED RESEARCH Budget Activity because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($10,857) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS (INCLUDES CONGRESSIONAL EARMARK $1,941 - ARCTIC OCEAN CLIMATE OBSERVATIONS):
  - (U) Continued to advance the capabilities of active acoustic techniques for undersea surveillance in shallow water regions through developments in clutter characterization and control as well as in performance characterization and modeling.
  - (U) Conducted test of influence of internal waves in shallow water on tactical frequency acoustic propagation, surface duct leakage, and vertical/horizontal coherence in shallow water.
  - (U) Developed techniques for acoustic/nonacoustic fusion performance prediction for nonstationary noise fields in shallow water as a means of improving undersea surveillance detection capabilities.
  - (U) Extended full-spectrum noise models to high frequencies (>15 kHz) and assessed impact of full-spectrum noise on the performance of existing broadband detection/classification algorithms using both measured and modeled noise clutter statistics; developed new algorithms that exploit the full-spectrum noise characteristics to reduce the false-alarm/classification-error probabilities.
  - (U) Initiated the development and demonstration of natural-environment enhanced, volumetric, acoustic surveillance arrays for locating and tracking quiet threats in shallow water environments.
  - (U) Initiated the development of geo-acoustical inversion algorithms to improve the performance of natural-environment enhanced signal processing algorithms for undersea surveillance.

- (U) Participated in international program to conduct high-frequency acoustic measurements in shallow water off Australia; the aim was to characterize effects of the natural environment on detection, classification and localization of small, quiet submarines.
- (U) Participated with PE 0603792N in development of underwater acoustic communications to establish communications capability between submarine/submarine and other platforms.
- (U) Continued the Arctic Ocean Climate Observations program aimed at utilizing underwater acoustics to determine and monitor ocean "climate" in a large ocean basis.

• (U) ($32,948) NATURAL-ENVIRONMENT INFLUENCES ON MINECOUNTERMEASURE SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY(INCLUDES CONGRESSIONAL PLUS-UP $9,703 - AUTONOMOUS UNDERWATER VEHICLE AND SONAR DEVELOPMENT, PLUS-UP $2,660 - NAVAL SURFACE WEAPONS CENTERS (NSWC) SOUTH FLORIDA TEST FACILITY):

- (U) Continued development of autonomous ocean vehicle technology (and related natural-environment sensor technology) with selective field work aimed at demonstrating level of capability achieved.
- (U) Developed the utility of the NSWC Test Facility in conjunction with allied universities and government agencies to provide for monitoring and measurement of the ocean environment that will contribute to marine vehicle research, especially in the context of mine countermeasures.
- (U) Based on the lateral variability observed in acoustic bottom-related properties from the seaside Panama City site, designed and conducted a second towed body experiment at a second site to test hypotheses developed by the initial data set and the semi-empirical formulations.
- (U) Using satellite-based data developed performance estimates of optical MCM systems in a foreign coastal area. Validated these using in-site measurements.
- (U) Initiated work on algorithms for hyperspectral remote sensing data by which detailed resolution can be achieved of littoral ocean characteristics important for naval warfare; this work, in collaboration with developments in PE 0602232N and PE 0603794N, supports the Naval Earth Map Observer (NEMO) satellite planned for launch in FY 00 with products aimed for the Warfighter Support Center at Naval Oceanographic Office (NAVOCEANO) and the Marine Corps Intelligence Agency.
- (U) Conducted field experiment to test data extraction algorithms (bathymetry, sediment type, bottom backscatter, sound velocity and volume reverberation) from mine-hunting sonars.
- (U) Continued development of techniques for fusing multiple data types to achieve gains in MCM.
- (U) Tested performance of the toroidal volume sonar system (TVSS) and the side-looking sonar (SLS) using real time natural-environment data for performance prediction.
- (U) Began task of describing distribution as well as bulk percent gas in marine sediments for shock wave method of neutralizing mines.
- (U) Completed micro-scale modeling of fluid-gas flow in marine sediments in support of improved shock wave models.
- (U) Initiated tests of predictive quality of geoacoustic database algorithms for "type" geologic regions.

- (U) Developed a predictive model of mine migration/burial within the surf zone based upon the previous year's field study. Initiation of a study of morphological stability assessing the stationarity of sandbar structures; this work will facilitate prediction of the probability of burial for large (stationary) anti-landing mines in 3-6 feet of water. Additionally, this work is useful for the assessment of the meaningfulness of previously obtained bathymetry, based on the predicted stationarity of the sandbar.
- (U) Continued assessments of techniques for optical characterization of natural environments to serve MCM, especially in terms of the variety of natural environments.
- (U) Analyzed data and reported results of FY 97 experiment on shallow water, high-frequency acoustics bubble effects, especially as they impact MCM systems.
- (U) Applied interim bubble/acoustics models to FY 97 shallow water data and helped define a FY 99 experiment.
- (U) Incorporated spatial/temporal coherence results from the Mediterranean site into the Synthetic Aperture Sonar (SAS) performance prediction model and made predictions/hypotheses for an additional very-shallow water site; conducted a major acoustic clutter experiment in a high-clutter environment.
- (U) Developed composite mission/tactics analysis model which uses physics-based predictions with realistic descriptions of the natural environment.
- (U) Made investment strategy suggestions relating to accuracies and space/time resolutions required for ocean descriptions based on known Korean and Persian Gulf natural environments.
- (U) Developed fully-coupled nonlinear wave/tide model with data assimilation and incorporated into system performance models.

• (U) ($10,259) OCEAN AND ATMOSPHERIC PREDICTION:
- (U) Adapted the recent, conservative form of semi-Lagrangian schemes to an ocean model.
- (U) Tested ocean models incorporating new advection schemes with coastal ocean data and with deep water data, the aim being to achieve greater capabilities and improved performance of Navy numerical ocean models.
- (U) Delivered a fourth-order advective sigma-coordinate model.
- (U) Delivered a fourth-order advective layer model with topography.
- (U) Advanced shipboard ocean forecast capability through inclusion of relocatable ocean circulation component and nesting with shore-based boundary conditions, transitioned to 6.4.
- (U) Completed Sea of Japan/Yellow Sea SW Assimilation/Forecast System (SWAFS) development. Began combination of Sea of Japan/Yellow Sea/South China Sea (Asian Seas) SWAFS development as a contribution to oceanography of Navy-priority coastal seas.
- (U) Conducted critical evaluation of new predictive schemes with the aim of determining their effectiveness against current schemes.

- (U) Explored the ability of the SPY-1 operational tactical radar to detect clear air turbulent features in the marine atmosphere using advanced processing techniques for coded waveforms with at-sea demonstration of SPY-1 tactical radar capability.
- (U) Transitioned a variational assimilation capability for incorporating satellite radiance observations directly into the operational atmospheric prediction system.
- (U) Demonstrated and transitioned a shipboard tactical scale atmospheric prediction capability, incorporating local observations and interfaces to tactical decision aids.

• (U) ($4,069) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS (INCLUDES CONGRESSIONAL PLUS-UP $728 - PM-10):
- (U) Based on EO Propagation through the Atmosphere and Coastal Environment data, developed a coastal aerosol model for use in EO propagation effects assessment, including near ocean surface effects which are critical in defense against sea-skimmer missiles.
- (U) Developed improved periscope detection assessment capability with an EM propagation model incorporating an improved surface clutter model.
- (U) Continued PM-10 evaluation of particulate matter in southern California with consideration extended to particles of less than 2.5 microns diameter (the so-called PM 2.5 content).

• (U) ($16,634) NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM (NOPP) (INCLUDES CONGRESSIONAL PLUS-UP $11,644):
- (U) Continued efforts in "virtual" ocean data and remote sensing centers/facilities to capitalize on existing centers by developing broad community access/exchange of Navy, National Oceanic and Atmospheric Administration (NOAA), and other data bases together with data display and assimilation techniques.
- (U) Continued efforts aimed at a National Littoral "Laboratory" with the long-term aim of "portable" coastal ocean/atmosphere forecasting capabilities.
- (U) Used Broad Agency Announcement to solicit proposals that develop and/or demonstrate Coastal and Open Ocean Observational Techniques for continuous, high-resolution measurements of ocean processes; major themes of emphasis were: Observational Systems; Sensors and Sensing; and Modeling/Data Assimilation.
- (U) Initiated partnership efforts to develop and exploit Regional Scale Coastal and Open Prediction Systems that integrate existing military and civil observing and prediction systems including networked sensing systems, and capitalize on existing and planned satellite open ocean and coastal remote sensing systems; the goal was to develop cutting edge 4-D nowcast and forecast systems for the open and coastal ocean to address civil and military requirements.
- (U) Continued partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences and education focusing upon ocean observing technologies.

2. (U) FY 1999 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) ($10,621) NATURAL-ENVIRONMENT ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:
  - (U) Demonstrate techniques for adapting to the natural environment for in-site, near-real-time reverberation assessment and clutter control, optimizing sonar operation in complex, shallow water natural environments so as to further advance active techniques for detection of the quiet submarine threat.
  - (U) Analyze FY 98 test data to address potential exploitation of internal waves in shallow water under surface-duct conditions for mid-water surveillance by hull-mounted sonar.
  - (U) Develop predictive capability for optimum placement and fusion of acoustic/nonacoustic sensors in strongly range-dependent natural environments such as straits and gulfs.
  - (U) Complete validation of high frequency underwater acoustic noise models and conduct experimental evaluations of the false-alarm/classification-error performance of newly developed noise exploitation algorithms.
  - (U) Demonstrate performance improvements of natural-environment enhanced signal processing algorithms using geo-acoustical inversion techniques.
  - (U) Perform detailed analyses of high-frequency acoustic data obtained in several shallow water locales with the purpose of creating a unified basis for undersea weapon performance prediction in shallow water.
  - (U) Continue participation with PE 0603792N in development of underwater acoustic communications to establish communications capability between submarine/submarine and other platforms.

- (U) ($31,595) NATURAL-ENVIRONMENT INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY (INCLUDES CONGRESSIONAL PLUS-UP $10,000 - AUTONOMOUS UNDERWATER VEHICLE AND SENSOR DEVELOPMENT; PLUS-UP $2000 - NAVAL SURFACE WEAPONS CENTER (NSWC) SOUTH FLORIDA TEST FACILITY):
  - (U) Continue development of autonomous ocean vehicle technology (and related natural-environment sensor technology) with selective field work aimed at demonstrating increasing levels of capability in this technology area which offers great promise for virtually all naval missions in the littoral zone.
  - (U) Continue development of the NSWC Test Facility in conjunction with allied universities and government agencies to provide for monitoring and measurement of the ocean environment to contribute to marine vehicle research, especially in the context of mine countermeasures.
  - (U) Continue efforts in hyperspectral remote sensing technology to build a capability for detailed resolution of littoral ocean characteristics; this work, in collaboration with developments in PE 0602232N and PE 0603794N, supports the Naval Earth Map Observer (NEMO) satellite planned for launch in FY 00 with products aimed for the Warfighter Support Center at NAVOCEANO and the Marine Corps Intelligence Agency.
  - (U) Provide an initial spatial variability model (low-grazing angle bottom reverberation backscattering, bottom penetration/sediment scattering) and data bases to NSWC, Coastal Systems Station (NSWC-CSS) for MCM system development.

- (U) Process Sea-Viewing-Wide-Field-of-View Sensor data and other satellite data in near real time using new algorithms to extract coastal optical absorption and scattering. Utilize these new algorithms to create a regional data base for forward strategic area.
- (U) Initiate efforts on ocean color algorithms and ocean process models to develop the capability for inferring aspects of ocean vertical structure from remotely-sensed ocean color, especially in the littoral ocean where this technology will impact use of optical devices in MCM and aid in the resolution of complex ocean processes that affect other warfare missions.
- (U) Transition algorithms for extracting real-time seafloor data from TVSS and SLS sonars to NSWC-CSS.
- (U) Conduct final test for algorithms for extracting real-time sound speed and surface reverberation data from TVSS sonar.
- (U) Test data fusion algorithms.
- (U) Initiate development of algorithms to extract real-time data on the natural environment in denied areas using SAS and Laser Line Scanner System (LLS).
- (U) Integrate micro-scale modeling of fluid/gas flow into data base predictive model incorporating oceanographic forcing functions.
- (U) Initiate effort to extend geoacoustic data base algorithms to geotechnical data base algorithms.
- (U) Conduct a field study of mine migration and burial behavior in low energy/muddy beach natural environments.
- (U) Evaluate the Predictive Visibility Model in terms of performance in various natural environments and determine the feasibility of improvements to the model to provide the natural-environment basis for optical MCM systems.
- (U) Conduct final and comprehensive experiment on influence of bubbles in shallow water on sonar performance, especially in terms of MCM systems.
- (U) Begin applying and validating final models of bubble distributions and high-frequency acoustic propagation in a shallow-water bubbly medium.
- (U) Plan and conduct a full-band spatial/temporal coherence measurement in a very-shallow water site and utilize these data to test predictions/hypotheses regarding the oceanographic factors which affect the phase stability of the waterborne paths involved in real aperture and SAS systems for MCM; analyze data from the high-clutter natural environment to provide an upper bound for the statistical characterization of bottom clutter which will be utilized in the clutter model.
- (U) Biosensor technology for MCM will be developed, especially in terms of a bioluminescence sensor for the Navy Special Warfare forces to provide vulnerability assessment to detection through "bioluminescence trails."

• (U) ($11,176) OCEAN AND ATMOSPHERIC PREDICTION:

- (U) Continue testing other high-order advection schemes. Compare with older schemes and test in the California Current region.
- (U) Investigate the effect of higher-order schemes on passive tracer dispersion.
- (U) Deliver Very High Resolution (VHR) Coastal Model with improved advection.
- (U) Deliver Global Layered Model with improved advection and subduction/ventilation capability.
- (U) Initiate eddy-resolving global ocean model development including data assimilation.
- (U) Develop and transition to 6.4 a shipboard tactical ocean nowcast/forecast model that allows for VHR (to 100 m).
- (U) Transition Asian Seas SWAFS including data assimilation to 6.4. Develop relocatable baroclinic tide model.
- (U) Continue efforts in critical evaluation of new predictive schemes as a means of achieving more effective models.
- (U) Demonstrate the over-water clear-air weather detection capability of the operational system SPY-1 at a coastal test site.
- (U) Transition a nested air-sea coupled prediction system for operational implementation incorporating coupled data assimilation.
- (U) Develop a complete nonhydrostatic tactical scale prediction system for shipboard use in forecasting weather effects for operational planning and "what-if" scenario rehearsal, incorporating the targeting of relocatable weather observation capabilities.

• (U) ($4,607) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS (INCLUDES CONGRESSIONAL PLUS-UP $500 - PM-10):
- (U) Interface the coastal aerosol model with the EO Tactical Decision Aid and with the coastal aerosol data assimilation system to provide a more complete basis for EO systems, especially those used in detection of sea-skimmer missiles.
- (U) Transition improved EM propagation effects decision aids incorporating terrain, surface clutter, airborne platforms, etc, thus expanding the capability to assess effects of the natural environment on radar systems.
- (U) Transition to Naval Sea Systems Command and Space and Naval Warfare Systems Command a small Global Positioning System (GPS)-receiver based system for measuring atmospheric refractivity structure.
- (U) Continue efforts in characterizing PM-10 in the atmosphere of southern California, especially as it relates to operations and testing at naval bases in the area.

• (U) ($10,000) NOPP:
- (U) Use a Broad Agency Announcement to solicit new ideas and efforts in Data Assimilation and Modeling as well as in Ocean Observation Capabilities: in Data Assimilation and Modeling, recent workshops indicated the need for a new structural paradigm under which a community-wide effort would build a linked system of

resources and collaborations leading to new scientific insight and sysnthesis of new results with broad utility for the ocean community; in Ocean Observation the focus is on establishing the the means for continuous, high resolution of oceanic processes.

- (U) Continue evolution of efforts in "virtual" ocean data and remote sensing centers/facilities to capitalize on existing centers by developing broad community access/exchange of Navy, NOAA, and other data bases together with data display and assimilation techniques.
- (U) Continue evolution of efforts aimed at a National Littoral "Laboratory" with the long-term aim of "portable" coastal ocean/atmosphere forecasting capabilities.
- (U) Continue partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences focused upon ocean observing technologies.
- (U) Continue with selected aspects of efforts that develop and/or demonstrate Coastal and Open Ocean Observational Techniques; Observational Systems; Sensors and Sensing; and Modeling/Data Assimilation.
- (U) Utilize Secretary of the Navy/Chief of Naval Operations (SECNAV/CNO) Oceanographic Research chairs to further promote the collaboration of distinguished university scientists with Navy/Marine Corps activities; a primary aim is to achieve a synthesis of results and understanding in key oceanographic areas important to Navy/Marine Corps operations.

• (U) ($727) SBIR

- (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN

• (U) ($11,258) NATURAL-ENVIRONMENT ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:

- (U) Earlier work on low frequency active acoustics successfully demonstrated capabilities to discriminate against clutter from environmental features in a deep ocean setting (algorithms have transitioned and been implemented in the Low Frequency Active Fleet System); further development will continue in active acoustics to provide capabilities for detection of the "quiet" submarine with special emphasis on shallow water regions; acoustic field measurements, modeling, and data analysis will be employed as well as joint efforts with fleet activities, The Technical Cooperation Program, and the North Atlantic Treaty Organization Supreme Allied Commander Atlantic (NATO SACLANT) Centre; validation and refinement of mid-frequency bistatic bottom, surface, and volume scattering models will be a main focus.
- (U) Continue developments in shallow water acoustics to advance capabilities to exploit the natural environment for optimal submarine detection, especially in the littoral zone where oceanographic conditions can be highly variable both spatially and temporally; advances will come from theoretical modeling to describe sound interaction with the ocean surface, the ocean bottom, and with variable ocean processes (ocean fronts and internal waves); further quantification will be found for the result that acoustic propagation in shallow water regions can be greatly influenced by the presence of internal solitary waves.

- (U) Continue developments in undersea noise characterization to enable acoustic detection/processor systems (distributed systems; focused and adaptive beamforming; matched-field processing) to reject false alarms; coupled hydrodynamic-acoustic noise source models from propeller cavitation and surf-generated breaking wave noise will be the focus of effort; noise properties are of major importance to efforts in PE 0602314N.
- (U) Continue developments in natural-environment enhanced signal processing, including methods for estimating characteristics of the natural environment from acoustic measurements; develop techniques that exploit key qualitative features of acoustic signals and thus offer near real-time localization.
- (U) Use a science/technology team to ensure application of the latest developments in oceanography and acoustics in the planning and assessment of fleet Ship Anti Surface Warfare Readiness Effectiveness and Measuring Program (SHAREM) exercises; apply computer simulation/warfare effectiveness tools to SHAREM; aim is to reveal how oceanographic/acoustic properties affect system performance and help focus future basic/applied research.
- (U) Continue development of high-frequency acoustics, including underwater acoustics communications, based on assessment of the area as of FY 99.

• (U) ($22,515) NATURAL-ENVIRONMENT INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY:
- (U) Continue development of the technologies that will contribute toward the long-term goals of determining influences of the natural environment on MCM systems and tactics and enabling real-time characteristics of the natural environment to be known to the on-scene commander; this goal will be achieved through developments in several technologies (coastal ocean prediction, with waves and currents; ocean sampling; remote sensing; acoustics; optics; magnetics; hydrodynamics; chemistry; geology/sediment dynamics; biosensor technology; etc.) and the "network-centric" approach by which the component technologies will be applied for use by the on-scene commander.
- (U) Develop high-resolution littoral ocean models, including waves and currents, for use in predicting oceanographic characteristics in the littoral zone significant to MCM operations; the aim is to transition the capability to NAVOCEANO; indirect use of wave properties to infer bottom bathymetry will also be developed.
- (U) Autonomous Ocean Sampling Network technology for MCM will continue development, primarily using commercial-off-the-shelf technology; a series of field experiments featuring increasing levels of difficulty; the revolutionary nature of this ocean technology will continue to be demonstrated through collaboration with NAVOCEANO and other participants.
- (U) Continue development of remote sensing techniques to gain information about the littoral ocean, especially ocean bathymetry which has a significant impact on mine countermeasure operations as well as amphibious operations; the aim is to provide NAVOCEANO with a worldwide capability for inferring bottom depths and other characteristics of the littoral ocean; Precise Time/Time Interval technology will be developed for precise position capability, especially critical for Mine Warfare and MCM operations.

- (U) Continue development, in collaboration with developments in PE 0602232N and PE 0603794N, of algorithms to employ with the NEMO satellite planned for launch in FY 00 with products aimed for the Warfighter Support Center at NAVOCEANO and the Marine Corps Intelligence Agency.
- (U) Place increasing emphasis on the development of physics-based littoral ocean color models to enable remotely-sensed hyperspectral data to infer physical processes in the ocean; these models will enable the most effective exploitation of hyperspectral satellite imagery, which promises to be a major advance in the ability to probe the littoral ocean vertical structure for the purposes of littoral warfare; algorithms will transition to NAVOCEANO.
- (U) Continue development of impact of the natural environment on high-frequency acoustics in terms of synthetic aperture sonar and other high-resolution acoustic methods of mine detection/classification; results in this area are important to developments underway in PE 0602315N.
- (U) Continue development in characterization of gas content of wet sands as a critical aspect of the natural environment that affects the effectiveness of explosive neutralization techniques for mine clearance.
- (U) Continue development of hydrodynamic interactions with mines, including hydro-sedimentological aspects, to gain more accurate ability to predict the behavior of mines in shallow water, such as their possible movement and burial; this capability will provide the mine warfare community significant aid in terms of types of operations needed to clear an area.
- (U) Continue development of bioluminescence sensor aimed for transition to Navy Special Warfare Forces; this work will enable the Navy Special Warfare Forces to assess vulnerability of their operations to detection via "bioluminescence trails," which is a high priority with Commander, Navy Special Warfare Command.
- (U) Computer simulation/sensitivity analyses of operations in the littoral zone will continue development for the evaluation of optimum tactical effectiveness, given the variable characteristics of the natural environment.

• (U) ($11,838) OCEAN AND ATMOSPHERIC PREDICTION:
- (U) Continue to develop ocean model nowcast/forecast capabilities at a variety of scales (global and basin, regional and semi-enclosed seas, and local), including relocateable and nested models, with the aim of providing for transition through PE 0603207N to fleet operational users.
- (U) Continue development efforts for advanced on-board oceanographic models that utilize real-time data; aim is to ultimately merge several models to enable the on-board model to provide a full suite (oceanographic, acoustic, biologic, optical, visibility, etc.) of predictive capabilities for the on-scene user in the FY 05 timeframe.
- (U) Perform ocean data assimilation, model intercomparisons, testing and validation with oceanographic models under development.

- (U) Continue developments in the area of coupled ocean/atmosphere models to achieve more accurate incorporation of the effects of interactions between the two media.
- (U) Continue development of atmospheric models with the goal of providing Fleet Numerical Meterological and Oceanographic Command (FNMOC) with global prediction capabilities that use a nested procedure to go from global to regional to local descriptions; adaptation of models to massive parallel computers will continue as a means of achieving greater speed and efficiencies.
- (U) On-scene weather prediction capability has been under development and has demonstrated some degree of maturity; a preliminary capability has been established in Bahrain at the request of U. S. Central Command to provide real-time, on-scene weather prediction for operations in the Persian Gulf.
- (U) With the advent of more capable prediction procedures data assimilation techniques for the atmospheric models will receive increased attention; in particular, the SPY-1 operational tactical radar will undergo continued testing for use of the radar returns to infer detailed local atmospheric conditions, which in turn may be used to remove weather "clutter" from the radar display.
- (U) The remarkable accomplishment of deriving vector wind fields from satellite data dramatically increased the number of weather stations (by orders of magnitude) and led to a substantial increase in daily wind observations; this achievement lays the basis for further developments in satellite applications to meteorology; application of wind-derived information to tropical cyclone structure, to severe storms, and to rain-rate will be developed; artificial intelligence procedures will continue to be developed for automated inference of significant atmospheric characteristics.
- (U) Build on the past work on aerosols and transport models to start the process of constructing an end-to-end observation, analysis, and prediction system for use at FNMOC and with on-scene forecast systems; continue field work on coastal aerosols and dust.

• (U) ($4,723) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS:
- (U) As a consequence of previous work on EM propagation in the atmosphere, much knowledge has been gained on the nature and magnitude of variability in EM propagation caused by the natural environment; developments will yield models that more thoroughly incorporate atmospheric effects of refraction, extinction, turbulence, and rough boundaries; models are made available to the entire EM user community through transition to NAVOCEANO; a specific focus for airborne and ship platforms will be the Advanced Propagation Model that combines previous component models for terrain and range-dependence.
- (U) Continue field measurements to quantify atmospheric effects on EM propagation; an experiment in the summer of FY 00 is to focus on a "rough" evaporation duct and the anomalous properties that result.
- (U) Continue development of tactical decision aids to enable the fleet user of EM systems to more fully exploit system capabilities and/or anomalous conditions of propagation in the atmosphere which are often of significant magnitude in terms of range and altitude modifications.

- (U) EO sensors are important in surface warfare and strike warfare, as demonstrated in the Persian Gulf conflict; improvements in EO propagation models will be developed in terms of atmospheric effects such as background radiance, transmittance, refractivity, aerosols, and clouds; the Advanced Navy Aerosol Model (incorporating near surface effects over the open ocean important for detection of sea-skimming missiles) is expected to be completed in this timeframe; models are made available to the entire EO user community through transition to NAVOCEANO.
- (U) Continue the international program Electro-Optical Propagation Assessment and Coastal Environment (EOPACE) as an effective means of gathering field measurements to test and verify atmospheric effects on electro-optic propagation, especially in coastal environments.
- (U) Continue efforts toward making the Electro-Optical Tactical Decision Aid and Electro-Magnetic Tactical Decision Aid (EOTDA/EMTDA) more inclusive of atmospheric effects and more useful to the fleet operators.
- (U) Continue efforts in characterizing PM-10 in the atmosphere of southern California, especially as to operations and testing at naval bases in the area; field studies and emission studies will be the focus of the efforts.

• (U) ($10,000) NOPP:
- (U) Continue evolution of efforts in "virtual" ocean data and remote sensing centers/facilities to capitalize on existing centers by developing broad community access/exchange of Navy, NOAA, and other data bases together with data display and assimilation techniques.
- (U) Continue evolution of efforts aimed at a National Littoral "Laboratory" with the long-term aim of "portable" coastal ocean/atmosphere forecasting capabilities.
- (U) Continue partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences focused upon ocean observing technologies.
- (U) Continue with selected aspects of efforts that develop and/or demonstrate Coastal and Open Ocean Observational Techniques; Observational Systems; Sensors and/Sensing; and Modeling/Data Assimilation.
- (U) Utilize SECNAV/CNO Oceanographic Research Chairs to further promote the collaboration of distinguished university scientists with Navy/Marine Corps activities; a primary aim is to achieve a synthesis of results and understanding in key oceanographic areas important to Navy/Marine Corps operations.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	71,491	56,722	59,974
(U) Appropriated Value:		69,222	
(U) Adjustments from FY 1999 PRESBUDG:	3,276	12,004	360

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

(U) FY 2000 President's Submission	74,767	68,726	60,334

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 adjustment of 3,276 reflects a Small Business Innovation Research reduction (-686), and Actual Update through June (+3,962). The FY 1999 adjustment of 12,004 reflects a Revised Economic Adjustment (-159), Civilian Personnel Underexecution (-101), Congressional Add South Florida Test Facility (+2000), Congressional Add PM-10 (+500), Congressional Add Autonomous Underwater Vehicle (+10,000), and a Contract Advisory and Assistance reduction (-236). FY 2000 adjustment of 360 reflects adjustments for Navy Working Capital Fund (NWCF) Pricing adjustment (+943), Civilian Pay Rates (+289), and Non Pay Inflation adjustment (-872).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602101F (Geophysics)
- (U) PE 0602232N (SEW Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
- (U) PE 0602633N (Undersea Warfare Weapons Technology)
- (U) PE 0602601F (Phillips Lab Exploratory Development)
- (U) PE 0602784A (Military Engineering Technology)
- (U) PE 0603207N (Air/Ocean Tactical Applications)
- (U) PE 0603410F (Space Systems Environmental Interactions Technology)
- (U) PE 0603707F (Weather Systems Technology)
- (U) PE 0603785N (Combat Systems Oceanographic Performance Assessment)
- (U) PE 0603792N (Advanced Technology Transition)
- (U) PE 0603794N (C3 Advanced Technology)
- (U) PE 0604218N (TESS ENG)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
Dual Use Science and Technology Program	22,100*	9,977	18,390	18,126	18,222	18,304	18,692	19,091	CONT.	CONT.

* This program was allocated to Defense Advanced Research Projects Agency (DARPA) under Program Element 0603805E in FY 1997 and FY 1998. In FY 1999 the funding was transferred from DARPA and allocated equally among the three Services.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of the Dual Use Science and Technology Program (DUS&T) is to prototype and demonstrate new approaches for leveraging commercial research, technology, products, and processes for military benefit. These new approaches to working with industry, many of which were prototyped at DARPA, must become common throughout the Navy in order to take full advantage of the technological dynamism of the commercial sector. While acquisition reform has helped clear the path, and experience has shown leveraging can work, it has also shown that leveraging is still unfamiliar and not widely adopted. The challenge is to spread leveraging of the commercial sector into the Navy and make it a normal way of doing business throughout the entire acquisition spectrum. Specifically, DUS&T encourages the Navy to leverage commercial research and development to improve the performance, cost and/or readiness of military systems. Under this effort, the Navy solicits, evaluates, ranks, and nominates dual use S&T projects for Dual Use S&T funds. Each project is 50% cost shared with industry. 25% is cost shared with the Navy project funds and Dual Use S&T provides the remaining 25%. All projects are awarded using either Cooperative Agreements or Other Transactions. This is essentially a learning by doing approach to Dual Use S&T in the Navy, with Dual Use S&T funds providing an incentive.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is funded under APPLIED RESEARCH because it investigates technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

- ($22,100) This program was allocated to DARPA under Program Element 0603805E in FY 1998:

  (U) Hyperspectral Remote Sensing Technology in Space - Provide dual-use, space based system for collecting broad-area Hyperspectral Imagery to characterize land and sea environments for Naval forces and commercial users.

  (U) Sensor Technology - Develop the sensor hardware, software, and system architecture needed to meet the needs and lower cost of Naval and commercial systems. Sensor technologies included are acoustic sensor arrays, electric/magnetic field sensors, seismic sensors, radiowave frequency sensors, electro-optic/infrared sensors, laser radars, sensor fusion, and location/navigation sensors.

  (U) Sustainment - Develop robust and reliable designs, parts obsolescence decision tools and simulation models, and advanced industrial sustainment practices capable of fully supporting Naval weapon and commercial system life cycle requirements. These requirements include low-cost, low volume manufacturing, shorter time to low risk production and cost-effective support; rapid quality repair and remanufacturing throughput; and increased readiness support.

  (U) Distributed Mission Training - Develop commercially available authoring tools for developing interactive, advanced distributed training which offer intelligent tutoring capabilities.

  (U) Fuel Efficiency and Advanced Propulsion Technology - Develop a modeling and simulation tool for electrical power systems, and other dynamic load characteristic power systems and to develop a monitoring and control system for distributed power systems.

  (U) Information Systems & Technology - Develop information technologies that improve the capability of both Navy command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.

  (U) Medical Technologies - Develop, design and construct a small, portable ultrasound imaging device for advanced trauma care.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

2. (U) FY 1999 PLAN:

- (U) ($9,735) ONR issued a call to Navy activities for topics to be included in a single Joint Army, Navy, and Air Force solicitation to industry for dual use S&T proposals. Topic areas selected for FY 1999 include:

  (U) Affordable Sensor Technology - Develop the sensor hardware, software, and system architecture needed to meet the needs and lower cost of Naval and commercial systems. Sensor technologies included are acoustic sensor arrays, electric/magnetic field sensors, seismic sensors, radiowave frequency sensors, electro-optic/infrared sensors, laser radars, sensor fusion, and location/navigation sensors.

  (U) Sustainment - Develop robust and reliable designs, parts obsolescence decision tools and simulation models, and advanced industrial sustainment practices capable of fully supporting Naval weapon and commercial system life cycle requirements. These requirements include low-cost, low volume manufacturing, shorter time to low risk production and cost-effective support; rapid quality repair and remanufacturing throughput; and increased readiness support.

  (U) Distributed Mission Training - Develop network of training assets, including live, simulated and computer-generation, which allows multiple players at multiple sites to engage in complex, scalable and tailorable synthetic training environments that mirror the real, modern battlefield. Including Interconnection technology, Information technology, Representation technology, and Pervasive technologies.

  (U) Fuel Efficiency and Advanced Propulsion Technology - Develop technologies for the total propulsion system for increased and efficient speed and thrust, reduced amounts of fuel and power requited and reduced emissions. Aspects include power electronic building blocks.

  (U) Advanced High Speed Vessels and Structural Systems for Large Sea-Based Structures - This focus area addresses those requirements needed by the Navy and commercial sector to build high performance and yet affordable platforms over the life cycle. Technologies of particular interest include: high speed and excellent seakeeping vessels, structural health monitoring systems for large sea-based structures, control of large structural systems, and reliability of composite structures.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

(U) Information Systems & Technology - Develop information technologies that improve the capability of both Navy command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.

- (U) ($242) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($18,390) ONR issued a call to Navy activities in November 1998 for FY 2000 and 2001 topics to be included in a single Joint Army, Navy, and Air Force solicitation to industry for dual use S&T proposals. Selected topics will address Navy needs identified in the Science and Technology Requirements Guide and Navy projects will be expected to provide at least 25% of the total proposed effort with industry providing at least 50%. The FY 2000/2001 solicitation will be issued in January 1999. Selections will be made beginning July 1999 and agreements for FY 2000 will be awarded in October 1999. Topic areas include:

  (U) Affordable Sensor Technology - Develop the sensor hardware, software, and system architecture needed to meet the needs and lower cost of Naval and commercial systems. Sensor technologies included are acoustic sensor arrays, electric/magnetic field sensors, seismic sensors, radiowave frequency sensors, electro-optic/infrared sensors, laser radars, sensor fusion, and location/navigation sensors.

  (U) Sustainment - Develop robust and reliable designs, parts obsolescence decision tools and simulation models, and advanced industrial sustainment practices capable of fully supporting Naval weapon and commercial system life cycle requirements. These requirements include low-cost, low volume manufacturing, shorter time to low risk production and cost-effective support; rapid quality repair and remanufacturing throughput; and increased readiness support.

  (U) Distributed Mission Training - Develop network of training assets, including live, simulated and computer-generation, which allows multiple players at multiple sites to engage in complex, scalable and tailorable synthetic training environments that mirror the real, modern battlefield. Including Interconnection technology, Information technology, Representation technology, and Pervasive technologies.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

(U) Fuel Efficiency and Advanced Propulsion Technology - Develop technologies for the total propulsion system for increased and efficient speed and thrust, reduced amounts of fuel and power required and reduced emissions. Aspects include power electronic building blocks, turbine engine propulsion, aircraft power distribution and storage.

(U) High Speed Ships - Conceptualize, analyze, and demonstrate the feasibility of high speed ships for both commercial and military transport. The broad goals at full scale are: speeds in excess of 70 knots, ranges in excess of 6,000 miles, payload (cargo) in excess of 5,000 tons, shallow draft for small port entry, offloading under adverse weather conditions, and reasonable power requirements.

(U) Information Systems & Technology - Develop information technologies that improve the capability of both Navy command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.

(U) Bioengineering and Medical Technologies - Develop technologies to improve areas of Automatic Pattern Recognition-Neural model-based sensor/processor networks for dynamic scene assessment, target detection/classification, and machinery fault diagnosis and Biorobotics-Biomimetic, Autonomous Vehicles and Mobile Robots.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT TITLE: Dual Use Science and Technology Program

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	0	20,000	18,700
(U) Appropriated Value:	0	-	-
(U) Adjustments from FY 1999 PRESBUDG:	0	-10,023	-310
(U) FY 2000 PRESBUDG Submission:	0	9,977	18,390

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: Reductions in FY 1999 due to FY99 Program Decrease (-10,000) and Revised Economic Assumption (-23). FY 2000 adjustments due to Outsourcing Adjustment (-44) and Non Pay Inflation (-266).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:
(U) PE 0602805A (Dual Use Applications Program)
(U) PE 0602805F (Dual Use Applications Program)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL ESTIMATE
R0446 Advanced Avionics Subsystems (formerly Maritime Avionics & Subsystems Technology (MAST)	6,625	3,434	3,449	3,507	3,564	3,623	3,700	3,780	CONT.	CONT.
R0447 Weapons Advanced Technology	19,412	23,693	21,439	23,802	24,960	25,671	26,345	27,039	CONT.	CONT.
R2264 Air Systems Affordability	5,930	5,728	5,511	2,988	2,140	2,323	183	322	CONT.	CONT.
R2327 Integrated High Payoff Rocket Propulsion Technology (IHPRPT)	944	0	0	0	0	0	0	0	0	1,904
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	5,171	7,559	7,211	7,180	7,903	7,377	7,543	7,712	CONT.	CONT.
R2455 Vectoring Extremely Short Take-off and Landing (ESTOL) Control Tailless Operation Research (VECTOR)	0	4,989	4,436	492	0	0	0	0	0	9,917
R2487 DP-2 Thrust Vectoring System Proof of concept demonstration	0	1,995	0	0	0	0	0	0	0	1,995
TOTAL	38,082	47,398	42,046	37,969	38,567	38,994	37,771	38,853	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) demonstrates concepts for future air platforms and surface/air weapons employed in Naval Warfare. The demonstrated concepts support the Joint Warfare Strategy Forward...from the Sea" and relate to the Joint Mission Areas of Strike, Littoral Warfare, and Intelligence Surveillance and Reconnaissance. Projects in this PE are jointly planned in the Defense Science and Technology Reliance process with the Air Force and Army through panels of the Director Defense Research and Engineering.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

(U) Strike technology issues relevant to this PE include surgical lethality, platform survivability, affordability and increased Naval gunfire range and accuracy. Littoral Warfare technology issues relevant to this PE include air battlespace dominance, expeditionary forces air support, ship self-defense and increased Naval gunfire range and accuracy. Intelligence Surveillance and Reconnaissance technology issues relevant to this PE include platform mission endurance and survivability. Seven projects are executed within the PE:

(U) Advanced Avionics Subsystems (formerly Maritime Avionics and Subsystems Technology (MAST)): Initiated in FY 95 by Congress plus-up as MAST, Advanced Avionics Subsystems is a multi-faceted program maturing integrated modular avionics and software concepts towards providing new functionality, affordable, common avionics to future and legacy aircraft. Focused on advanced visualization and data fusion functionality through scalable, open, fault tolerant and common avionics architecture, advanced emulation and virtual prototyping, along with multifunction sensors and antennas. Program thrusts address either Navy-specific applications or technological areas where Tri-Services have agreed on a Navy lead. This becomes a core effort in FY 99.

(U) Weapons Advanced Technology: Demonstrates emerging sub-system/component level weapons concepts which promise affordable and significant performance improvements to both existing and next generation Naval Air and Surface launched weapons. These efforts in this area will demonstrate the achievement of the time-phased Air and Surface Weapons Technology (ASWT) goals, which will maintain and increase the Naval Air and Surface Weapons capability edge through the 21st century. In FY98 the Extending the Littoral Battlefield (ELB) Advanced Concept Technical Demonstration (ACTD) was added to this project. In FY99 this task was transferred to PE 0603238N, Project R2145.

(U) Integrated High Payoff Rocket Propulsion Technology (IHPRPT): This project supports the achievement of the IHPRPT program time-phased goals by conducting integrated component demonstrations of rocket propulsion technology developed under PE 0602111N. In FY99, this task was transferred to PE 0603217N, Project R0447.

(U) Integrated High Performance Turbine Engine Technology (IHPTET): Provides experimental engine testing of new gas turbine engine technologies to demonstrate readiness and reduce technical risk for entering engineering development. IHPTET is a Tri-Service program in which each Service contributes established shares of 6.2 and 6.3 funding and laboratory resources to meet specified goals of doubling thrust-to-weight ratio, halving fuel consumption by the year 2003 (relative to

a 1987 baseline) and reducing acquisition and maintenance costs. Additional emphasis has been incorporated to address High Cycle Fatigue issues, which may be associated with propulsion system design system deficiencies.

(U) Air Systems Affordability: Multi-faceted phased program to focus on improving the affordability of future major acquisition programs. This project will focus affordability research to support the delivered accuracy of future stand-off weapons and support the development of multi-function, analog-to-digital conversion and signal processing electronic modules.

(U) Vectoring ESTOL Control Tailless Operation Research (VECTOR) Program: A follow-on to a previous X-31 thrust vectoring demonstration with Germany. This international flight demonstration effort adds Sweden to the US/Germany Team to utilize the X-31 aircraft to develop and demonstrate thrust vectoring technologies using a multi-axis axisymmetric thrust vectoring nozzle with a fully integrated flight/engine/nozzle control system. The VECTOR effort will demonstrate, in flight, the concepts of: Extremely Short Takeoff and Landing (ESTOL) to allow short-field operations, reduced catapult/arresting gear requirements, increased payload and bring-back, reduced aircraft catapult and arresting loads, and, an Advanced Air Data System (AADS) that will provide the required air data accuracy at very high angles of attack. It will provide engineering analyses for reduced tail/reduced directional stability to validate directional control capabilities using with thrust vectoring. The program will also provide data with which to determine valuable operating efficiencies inherent with such a nozzle configuration. These efficiencies include reduced aerodynamic (induced) trim drag, increased engine exhaust recovery, and reduced aircraft weight.

(U) The DP2 Thrust Vectoring System: Initiated in FY 99 by Congressional plus-up, this program is a demonstration of a proof-of-concept of a reduced-scale flight test vehicle. The vehicle concept is a short take-off/vertical landing (STOVL) aircraft of advanced composite construction, utilizing thrust vector control. This air vehicle is envisioned as a vertical take-off transport for ship-to-shore operation and for ship/shore-based reconnaissance.

(U) The Navy Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity because it encompasses design, development, simulation, experimental testing or prototype hardware. It is also necessary to

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

validate technological feasibility and concept of operations to reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

B. (U) PROGRAM CHANGE SUMMARY FOR TOTAL P.E.:

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	34,562	48,143	40,034
Appropriated Value		48,143	0
Adjustments from FY 1999 PRESBUDG	3,520	-745	2,012
FY 2000 President's Budget	38,082	47,398	42,046

(U) CHANGE SUMMARY EXPLANIATION:

(U) Funding: FY 1998 adjustments reflect Actual adjustment updates (+3,805); and small business Innovation Research adjustment (-$285). FY 1999 adjustments reflect Congressional Undistributed reductions (-$239); Congressional Directed reduction (-$2,000); Congressional Plus-up DP-2 Thrust Vectoring (+$2,000); and Minor adjustment (-$506). FY 2000 adjustments reflect Non Pay Inflation adjustment (-$611); Navy Working Capital Fund (-$85); Civilian Pay rate adjustment (+$208); and Realignment of Vector funding (+$2,500).

(U) Schedule: Not Applicable.

(U) Technical: Not Applicable.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: September 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R0446 Advanced Avionics Subsystems (AAS) (formerly Maritime Avionics Subsystems & Technology (MAST))	6,625	3,434	3,449	3,507	3,564	3,623	3,700	3,780	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project has been supported by Congressional Plus-ups since FY 1995 and became a Navy budget effort beginning in FY 1999. This project demonstrates commercial-off-the-shelf (COTS) and non-development item (CANDI) technology that will facilitate the introduction of new functionality (e.g., 3 dimensional (3-D) perspective scene visualization, crew workload reduction, on/off-board sensor data fusion, telepresence to the battlespace, etc.) into existing Navy aircraft and future platforms in a cost-effective manner. The project includes elements responsive to the original Congressional guidance: (a) visualization and data fusion software; (b) scalable open architecture project (SOAP); (c) advanced interconnect technology; (d) avionics packaging and cooling technology; and (e) low cost sensors and connectivity. Individual performers and tasks are selected to maximize the probability of transfer of successful results to Navy and other systems. This project addresses the Joint Vision 2010, Navy Science and Technology (S&T) Requirements Guidance, ...Forward From The Sea, and the outyear plans of several naval aviation programs (e.g., F/A-18, Air Combat Electronics, Tactical Aircraft Mission Planning, AV-8B, Joint Strike Fighter (JSF) and others). Key objectives include providing better technology transparency, reducing software costs, opening currently closed avionics architectures, enabling earlier use of CANDI technologies, protocol-independent high-speed/high-bandwidth databases, and ability to introduce new functionality for effective joint warfighting.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics Subsystems (AAS)

A. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: ($7,132) includes $3,461 FY 97 funding released in FY 98

- (U) ($2,070) Advanced Visualization and Data Fusion Software (AVDFS)

(U) Initiated:
- (U) AVDFS software integration with version 6.2 of Tactical Aircraft Mission Planning System (TAMPS) for integrated mission planning and rehearsal capability.
- (U) Demonstration of bringing off-board imagery from commercial source into a military cockpit by creating commercial imagery archive browser and retrieval software

(U) Continued:
- (U) Mosaicing of off-board and on-board information into geospecific 3-D imagery. Includes ability to mosaic and fuse (overlay) camera video streams onto a 3-D scene rendered from the combination of archival Digital Terrain Elevation Data (DTED) and imagery.
- (U) Refining image generation software for portability to multiple commercial-off-the-shelf (COTS) graphics engines. Migration of AVDFS to multiple platforms including the entire Silicon Graphics Inc. (SGI) product line and Windows New Technology (NT) INTEL-based processors.

(U) Completed:
- (U) PowerScene Integration with TAMPS for integrated mission planning and rehearsal capability and application at Naval Air Station, Fallon, NV.
- (U) F/A-18 integrated 2 dimensional (2-D) cockpit demonstration at Boeing's Advanced Avionics Center in St.Louis, MO.

Highlighted the tactical utility of AVDFS for several avionics scenarios.
- (U) Demonstration of ability to import National Imagery and Mapping Agency (NIMA) standard format data for direct use in a geocentric representation with worldwide coverage.

- (U) ($3,840) Scalable Open Architecture

(U) Initiated:

- (U) Integration of signal processing node and high speed multiprocessor node into the SOAP architectureed on COTS technology.
- (U) Implementation of 3-D perspective scene generation into embedded hardware. Initial investigation of using processing resources on the Optical Backplane Interconnect System (OBIS) backplane as the embedded resource for visualization algorithms.
- (U) Incorporation of Real-time Database Management System.
- (U) Fault tolerant/dynamic reconfiguration in a Real-time Common Object Request Broker Architecture (CORBA) environment.
- (U) Performance modeling process development to be used throughout project life.

(U) Continued:

- (U) Preliminary off-board interface definition.
- (U) Performance analysis and development of common object request broker architecture in a real-time deterministic system.
- (U) Definition of network requirements and capabilities for an information intensive unified system.

(U) Completed:

- (U) Implementation and integration of 2-D capability on embedded processing hardware.
- (U) Initial design and virtual prototype of COTS-based single thread processor emulator chip capable of running existing code on a clock-cycle accurate basis.

• (U) ($850) Advanced Avionics Interconnect Technology

(U) Initiated:

- (U) Development of extremely high speed and high bandwidth protocol independent optical data network based on COTS technologies and techniques. Technology leverages fiber optic technologies developed by the commercial telecommunications industry. This effort seeks to multiplex multiple signals using various protocols over a single optical fiber to replace current MIL-STD-1553 bus technology. The goals of this effort seek to increase data transfer rates by a factor of 1000X (1MB vs. 1GB or more); demonstrate reduced Electromagnetic Interference (EMI) and Electromagnetic Vulnerability (EMV); and reduced life cycle and development costs for F/A-18, JSF, Close Air Support (CSA) and other advanced air vehicles.

- Joint Dual-Use program with Naval Sea Systems Command (NAVSEA) and Defense Advanced Resource Project Agency (DARPA) to establish commercial sources for military fiber optic systems applications Exploiting Commercial Sources and Technical Advantages to Insure Competitiveness (ECSTATIC Project).
Continued:
- (U) Optical Network effort discussed above to begin demonstration of critical components.
- (U) Optical backplane integration into SOAP architecture with multiprocessor real-time operating system.

- (U) ($262) Low Cost Sensors and Connectivity
(U) Continued:
- (U) Evaluation of technology and concepts for real-time connectivity of on-board data bases and subsystems with off-board sources of data or information.

- (U) ($110) Advanced Packaging
(U) Continued:
- (U) Evaluation of COTS packaging technology in naval avionics applications.

2. (U) FY 1999 PLAN: ($6,388 includes $2,954 FY 98 funding released in FY 99)

- (U) ($1,775) Advanced Graphics and Data Fusion
(U) Initiate:
- (U) Development and demonstration of a portable 3-D rendering capability which can be executed in non-real-time on a scalable open architecture system prototype.
- (U) Preliminary investigation of calligraphic light sources and a range of atmospheric effects in the AVDFS to enhance realism in the avionics environment.

(U) Continue:
- (U) Development and demonstration of interoperability with operational avionics hardware through simulation and proposed flight-worthy hardware.
- (U) To develop the capability to execute 3-D perspective scene generation software in real-time on embedded avionics hardware. The development methodology will involve the iterative use of software simulation techniques in conjunction with the progressive use of proposed scalable open architecture avionics hardware.

- (U) Geo-registered image mosaicing techniques and data compression technology required to fuse imagery from multiple sources and bring in information from off-board.

(U) Complete:

- (U) Initial demo of bringing off-board imagery from commercial source into a military cockpit by creating commercial imagery archive browser and retrieval software.
- (U) Integration of AVDFS with TAMPS 6.2 mission planning software.
- (U) Migration of AVDFS software to Windows NT processors.

• (U) ($3,155) Scalable Open Architecture

(U) Continue:

- (U) Realtime common object request broker architecture evaluation.
- (U) Evaluation of dynamic reconfiguration in a realtime CORBA environment.
- (U) Demonstration of 3-D visualization in embedded hardware.

(U) Complete:

- (U) Realtime Database Management System.
- (U) Backplane and network protocol evaluations.
- (U) Demonstration of off-board interfaces.
- (U) Renewal of legacy software systems processor emulator prototype chip which is capable of emulating the AN/AYK-14 mission computer processor.

• (U) ($858) Advanced Interconnect Technology

(U) Continue:

- (U) Evaluation of optical interconnect components for ships and aircraft under joint NAVSEA/Naval Air Systems Command (NAVAIR) Dual-Use S&T project agreement.
- (U) Integration of key components for High Speed Optical Networks.

• (U) ($515) Low Cost Sensors and Connectivity

(U) Continue:

- (U) Millimeter-wave (MMW) antenna concept analysis.

• (U) ($85) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

• (U) ($1,200) Advanced Visualization and Data Fusion Software
(U) Continue:
-(U) Development of controllable time-of-day effects in AVDFS-rendered 3-D scene.
-(U) Development of extended graphical annotation and editing techniques.
-(U) AVDFS man/machine interface analysis in airborne environment.
(U) Complete:
-(U) Ground-based demo showing mosaicing and fusion of off-board Unmanned Aerial Vehicle (UAV) video streams with AVDFS and render resulting 3-D product on an embedded open system architecture in near real-time.

• (U) ($1,299) Scalable Open Architecture
(U) Initiate:
-(U) On-board/off-board/archival database information fusion.
(U) Continue:
-(U) Demonstration of distributed real-time application integrated with actual F-18 Mission Software.
(U) Complete:
- (U) Final demonstration of dynamic reconfiguration in a Real-time CORBA environment.
- (U) Completion of 3-D visualization in embedded hardware.

• (U) ($950) Advanced Interconnect Technology
(U) Continue:
-(U) Development of Fiber-optic Avionics SubCarrier Modulation (SCM) Transfer (FAST) Network.
(U) Complete:
-(U) Dual-use ECSTATIC hardware demonstrations.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

PROJECT NUMBER: R0446
PROJECT TITLE: Advanced Avionics Subsystems (AAS)

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

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

(U) RELATED RDT&E: This program adheres to Defense Reliance Agreements for Sensors, Electronics and Battlespace Environment (Integrated Platform Electronics).

(U) Work in this Program Element (PE) is related to and fully coordinated with efforts in the following PEs:

- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602202F (Human Systems Technology)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602234N (Materials, Electronic, and Computer Technology)
- (U) PE 0602708E (Cockpit Autonomous Landing)
- (U) PE 0603231F (Crew Systems and Personnel)
- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603792F (Advanced Technology Demonstrations)
- (U) PE 0603800N & 0603800F (Joint Strike Fighter (JSF) DEM/VAL)
- (U) PE 0603253F (Advanced Avionics Integration)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R0447 Weapons Advanced Technology	19,412	23,693	21,439	23,802	24,960	25,671	26,345	27,039	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project will reduce technical risk by performing technology demonstrations in guidance and control, ordnance, Guns and Launchers, fire control air breathing propulsion and airframe aeromechanics sub-system/component concepts. It builds on the foundation of research emerging from Navy and Industry Applied Research projects funded by PE 0602111N programs which promise affordable performance improvements to existing and next generation Naval air and surface launched weapons. In FY98 the scope of this project was expanded to include the Extending the Littoral Battlespace (ELB) Advanced Concept Technical Demonstration (ACTD) which will demonstrate/exploit emerging technologies (commercial and government) for use in theater-wide, real time management of expeditionary forces operating within the littoral. In FY 99 ELB was funded in PE 0633238N and PE 0602315N. The elements of the project addresses Joint Mission Area (JMA) requirements for increased capabilities in surgical lethality of weaponry (Strike JMA), increased ship self defense capabilities (Littoral Warfare JMA) and increased accuracy and range for Naval Surface Fire Support (Strike and Littoral JMAS).

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: R0447
PROJECT TITLE: Weapons Advanced Technology

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($3,523) Cruise Missile Real Time Retargeting Demonstration:
  -(U) Produced Build 1 seeker.
  -(U) Established ground testing capability for Build 1 solid state Laser Detecting and Ranging Seeker (LADAR) in North Range Towers.
  -(U) Began flight testing of Build 1 solid state LADAR on T-39 aircraft.
  -(U) Modified the T-39 test aircraft to accept the Build 1 LADAR sensor. This task includes designing and fabricating the mechanical/electrical interface assemblies, wiring harnesses, and interface boards in Hardware in the Loop (HITL) lab.
  -(U) Produced Build 2 solid state LADAR components. Phase 3 will finalize the designs for the Tomahawk (Navy) and Small Smart Bomb (Air Force) tasks.
  -(U) Produced mission planning procedures and software for strike planning, targeting, and neural network training.
  -(U) Developed fixed target Autonomous Target Recognition Software.

- (U) ($3,850) Surgical Strike Adaptive Weapon Control Video and Data Communication System:
  This task develops and demonstrates advanced video compression and radio frequency (RF) modulation/coding technology for a podless digital weapon control data link system for use in joint strike operations.

  -(U) Designed, integrated, and lab tested RF modules, modem modules, network control processor modules, and central processor modules.
  -(U) Refined system level performance requirements.
  -(U) Performed prediction analysis of weapon control data link system.
  -(U) Designed, developed, and fabricated of RF, modem, network control, processor, and central processor submodules.
  -(U) Developed platform integration approach/design.

-(U) Defined electrical and mechanical terminal interfaces.
-(U) Produced antenna design.

- (U) ($1,200) Concentric Canister Launcher (CCL):
  (U) This task will demonstrate a universal munitions launcher for Tomahawk, SM-2 Block IV, and Evolved Sea Sparrow Missile (ESSM). The technologies to be demonstrated involve missile fly out from a full scale launcher tube; validation, verification, computational design tools; and will demonstrate a distributed launch control system capable of simultaneous and coordinated launch of multiple missile types. This program is focused upon Affordability and will address reduced Life Cycle Costs through reducing manning, automated construction, and by utilizing a modular design.
  -(U) Designed and fabricated canister interface electronics unit.
  -(U) Developed fiber optic Local Area Network (LAN) architecture.
  -(U) Demonstrated all up distributed control system.
  -(U) Designed hardware for planned outyear SM2 Blk IV restrained firing tests.

- (U) ($3,052) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:
  -(U) Completed integrated CE seeker development and environmental demonstration.
  -(U) Finished Mechanical/electrical hardware design.
  -(U) Conducted CE seeker demonstration.
  -(U) Performed Ground, rooftop, HITL. Fabrication and flight clearance test preparation.
  -(U) Continued CE seeker integration and test.

- (U) ($1,362) Shared Aperture:
  (U) This task enables the development and demonstration of wideband multifunction RF systems with shared apertures and electronics to perform the functions currently performed by multiple RF systems, in particular radar, communications and electronic warfare systems.
  -(U) Constructed test prototype.
  -(U) Continued final design for open architecture multifunction RF system capable of meeting Navy requirements or a set of radar, communications and Electronic Warfare (EW) functions,

-(U) Finished system requirements and performance specification.

- (U) ($6,425) ELB:
  -(U) Continued fires and targeting definition for ELB ACTD system design.
  -(U) Conducted Exercises and feasibility demonstration definition.
  -(U) Performed ACTD systems engineering, development and integration.
  -(U) Completed design and initial outfitting of afloat testbed interface with Navy fires and targeting systems.

2. (U) FY 1999 PLAN:

- (U) ($5,102) Cruise Missile Real Time Retargeting Demonstration:
  -(U) Demonstrate the Build 1 LADAR in the lab which includes the adaptive strike planning and fixed/mobile target automatic target recognition software, and Tomahawk 6 DOF simulation.
  -(U) Finish modification of the T-39 test aircraft to accept the Build 1 LADAR sensor. This task included design and fabrication of the mechanical/electrical interface assemblies, wiring harnesses, and interface boards to the lab.
  -(U) Conduct Flight testing of the Build 1 solid state LADAR on the T-39 aircraft.
  -(U) Fabricate Build 2 sensor for delivery in FY 2000.
  -(U) Modify the T-39 test aircraft to accept the Build 2 LADAR sensor. This task includes designing and fabricating the mechanical/electrical interface assemblies, wiring harnesses, and interface boards to the lab.

- (U) ($3,204) Surgical Strike Adaptive Video Control and Data Communication System:
  (U) This task develops and demonstrates advanced video compression and RF modulation/coding technology for a podless digital weapon control data link system for use in joint strike operations
  -(U) Start flight test planning for FY 2000 system verification and testing.
  -(U) Integrate terminals into ground test platforms.
  -(U) Ground test multiple terminals.

-(U) Integrate terminals into flight test platforms.
-(U) Refine system level performance requirements.
-(U) Continue Performance prediction analysis of weapon control data link system.
-(U) Perform laboratory integration testing of terminals.
-(U) Finish design, development, and fabrication of RF, modem, network control, processor, and central processor submodules.
-(U) Complete platform integration approach/design.
-(U) Define electrical and mechanical terminal interfaces.

- (U) ($5,370) CCL:
  -(U) Continue Tomahawk Computational Fluid Dynamics (CFD) model validation.
  -(U) Proceed with hatch design and fabrication.
  -(U) Maintain efforts for fabrication of prototype launch system hardware.
  -(U) Continue Design and fabrication of canister interface electronics unit.
  -(U) Complete demonstration of all up distributed control system.
  -(U) Development of fiber optical LAN architecture.
  -(U) Conduct SM2 Blk IV restrained firing.

- (U) ($4,300) CE Ball-Joint Gimbal for Joint Strike Weapon:
  -(U) Start CE seeker flight tests and demonstration.
  -(U) Conduct CE seeker integration and test, ground, rooftop, HITL tests.
  -(U) Finish integration of CE gimbal hardware and flight test pod.
  -(U) Complete ground, rooftop, HITL, flight tests, and program documentation.

- (U) ($1,160) Shared Aperture:
  (U) This task enables the development and demonstration of wideband multifunction RF systems with shared apertures and electronics to perform the functions currently performed by multiple RF systems, in particular radar, communications and EW systems.
  - (U) Construct test prototype.

- (U) Finish final design for open architecture multifunction RF system.

- (U) ($1,560) High Speed Missile Technology (Formerly Hypersonic):
  This task will demonstrate airframe propulsion guidance & control and ordnance technologies of the dual combustion ramjet for potential next generation Navy high speed strike missiles.
  -(U) Begin initial design of dual combustion ramjet test vehicle.
  -(U) Develop test plan for free jet testing of the ramjet.
  -(U) Develop preliminary design of the test stand.

- (U) ($1,465) Land Attack and Deep Strike (LADS) Weapon Technology: This task will demonstrate the capability to substantially improve the mission planning and execution times for land attack and deep strike missions for both surface and submarine launched tactical strike weapons such as Tactical Tomahawk, Fasthawk, Navy Tactical Missile System (NTACMS), and the Land Attack Standard Missile (LASM).The demonstration uses the following technology developed in the 6.2 Weapons program (PE 0602111N): Weapon/target pairing, Bomb Damage Identification (BDI) from Syntheic Apeture Radar (SAR) processing, Global Positioning System (GPS)/Inertial Measurement Unit (IMU) attitude accuracy for 3 dimensional (3-D) precision targeting, algorithms for rapid Tomahawk mission planning, and rapid tactical area mapping.
  -(U) Define preliminary operational concept for the LADS weapon demonstration
  -(U) Produce an initial top level architecture for the mission planning system
  -(U) Identify components of the previous 6.2 program products that will be transitioned to the LADS weapon demonstration.
  - (U) Review software and hardware components of the 6.2 the elements (e.g. GPS/IMU, BDI SAR, etc) transitioning to the LADS demonstration. Identify the modifications required to integrate the components into the demonstration.

- (U) ($1,400) IHPRPT:
  (U) This task will demonstrate high kinetic performance air launched rocket motor technologies. These technologies will be integrated into a 5'-8' diameter flight weight rocket motor and demonstrated in ground

tracking. Technologies demonstrated will include aluminized and non-aluminized reduced smoke propellants; light weight, high strength/stiffness component case; high pressure combustion; thrust vector control(TVC)(integrated aero/TVC and aft mounted jet reaction control); and a light weight, low erosion nozzle.
- -(U) Optimize reduced smoke solid propellant grain geometry and burn rate characteristics.
- -(U) Conduct static firing of subscale rocket motors at increasing chamber pressures to verify propellant specific impulse.
- -(U) Analytically evaluates composite case strength.

- (U) ($132) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 Plan:
- (U) ($4,905) Cruise Missile Real Time Retargeting Demonstration:
  - -(U) Complete flight testing of Build 1 LADAR
  - -(U) Finish development of critical mobile target algorithm.
  - -(U) Conduct synthetic scene generation work for hardware in the loop testing.
  - -(U) Demonstrate adaptive strike planner executive allocator.
  - -(U) Conduct ground test of Build 2 LADAR
  - -(U) Begin flight testing of Build 2 LADAR

- (U) ($3,300) Surgical Strike Adaptive Video Control and Data Communication System:
  - -(U) Finish F/A-18 system integration studies.
  - -(U) Complete Flight testing of Surgical Strike system. Demonstrate real time video and high bandwidth capacity in F/A-18 flight test aircraft.

- (U) ($4,235) CCL:
  - -(U) Complete Standard Missile II, Block IV restrained firing test.
  - -(U) Finish CCL conceptual design for ship integration

-(U) Conclude CCL life cycle cost study.
-(U) Produce final report.

- (U) ($3,540) High Speed Missile Technology
  -(U) Perform component and subsystem integration for dual combustion ramjet propulsion system testing
  -(U) Fabricate test stand for free jet testing
  -(U) Conduct subsystem verification testing for dual combustion ramjet free jet testing
  -(U) Develop final design of dual combustion ramjet test vehicle.

- (U) ($2,579) LADS weapon demonstration:
  -(U) Develop a detailed architecture and system design for the mission planning system configuration
  -(U) Define the interface requirements between the software interfaces of the rapid mission planning, tactical area mapping, and weapon/target pairing components.
  -(U) Test the coupled GPS/IMU attitude accuracy for 3-D precision targeting
  -(U) Begin implementation of planning system in testbed.

- (U) ($780) Ship Based Defense Demonstration: This task will demonstrate the technologies for increasing the effectiveness of ship based defense systems in tracking and killing supersonic, maneuvering cruise (U) missiles. The task builds on the following PE 0602111N tasks: interactive adaptation of fire control to the environment, Non-Uniformity Compensated Focal Plane Array (NUCFPA), and clutter processing. Three technology demonstrations will be comprised of two components. The Adaptive weapon control demonstration will demonstrate the feasibility of increasing weapon performance by improving the ability of the weapon to adapt to changing propagation environments. The other component will improve the performance of the weapon warhead against maneuvering targets by implementing alternative warhead concepts.

  -(U) Evaluate and analyze the effectiveness of two alternative warhead designs, the reactive material warhead and the miniature aimed warhead. These warhead designs were developed in the PE 0602111N Air and Surface Weapons Technology (ASWT) program. A down select will be made to select the best alternative for a kill mechanism against a maneuvering threat.

-(U) Conduct weapon system integration study of shipboard electro-Optic (EO) trackers, weapons control systems, and miniature command/link receivers. This will result in a down select between command guidance and command waypoint guidance.

- (U) ($2,100) IHPRPT Technology:
  -(U) Develop high strength, light weight, high pressure composite case rocket motor
  -(U) Develop and test low/no erosion nozzle throat insert materials and test to determine suitability
  -(U) Static test subscale low erosion nozzles at high pressure to determine erosion characteristics

B. (U) PROGRAM CHANGE SUMMARY: See total program chance summary for P.E.

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

(U) RELATED RDT&E:
(U) PE 0601152N (In House Lab Independent Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602111N (Air and Surface Launched Weapons Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronic, and Computer Technology)
(U) PE 0602602F (Conventional Munitions)
(U) PE 0603238N (Precision Strike and Air Defense Technology)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603601F (Advanced Weapons)
(U) PE 0207133F (F-16 Squadrons)
(U) PE 0203730A (Chaparral Missile)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advance Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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
R2264 Air Systems Affordability										
	5,930	5,728	5,511	2,988	2,140	2,323	183	322	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project demonstrates affordability concepts for future air platforms and surface/air weapons employed in Naval Warfare. The demonstrated concepts will support the development and implementation of a phased program to focus a portion of the Science and Technology (S&T) programs on improving the affordability of future major acquisitions programs.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advance Technology
PROJECT NUMBER: R2264
PROJECT TITLE: Air System Affordability

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:
   - (U) ($5,930) Precision Strike Navigator (PSN)
     - -(U) Continue wafer material & structure development and characterization
     - -(U) Continue wafer fabrication.
     - -(U) Begin fabrication of Inertial Measurement Unit (IMU).
     - -(U) Begin test preparation for IMU testing
     - -(U) Complete wafer fabrication process development

2. (U) FY 1999 PLAN:
   - (U) ($5,728) PSN:
     - -(U) Continue test preparation and integration.
     - -(U) Continue IMU fabrication
     - -(U) Complete wafer material & structure development and characterization
     - -(U) Complete wafer fabrication

3. (U) FY 2000 PLAN:
   - (U) ($1,400) PSN:
     - -(U) Complete wafer fabrication
     - -(U) Complete IMU fabrication and testing.
     - -(U) Document results of demonstration

   - (U) ($4,111) Advanced Common Electronic Modules (ACEMs):
     (U) Initiate:
     - -(U) Development of ACEMs that will be smaller, and have less power consumption and higher performance than their analog counterparts, while accomplishing all the requisite acquisition, transmission and digital processing of Raido Frequency (RF) signals over a very wide frequency range (50 MHz to 45 GHz). The family of ACEMs consists of advanced analog-to-digital technology and will be integrated to create systems capable of performing multiple

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advance Technology
PROJECT NUMBER: R2264
PROJECT TITLE: Air System Affordability

functions. This enhances affordability through a 10-fold projected decrease in systems weight and power consumption, a 15-fold increase in systems performance, and substantial Life Cycle Cost savings. This program & technology is scheduled to transition from PE 0602122N by the end of FY99.

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

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

(U) RELATED RDT&E:
- (U) PE 0601152N (In House Lab Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronic, and Computer Technology)
- (U) PE 0602602F (Conventional Munitions)
- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603609N (Conventional Munitions)
- (U) PE 0603601F (Advanced Weapons)
- (U) PE 0207133F (F-16 Squadrons)
- (U) PE 0203730A (Chaparral Missile)

D. SCHEDULE PROFILE: Not applicable.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	5,171	7,559	7,211	7,180	7,903	7,377	7,543	7,712	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project covers the Navy's share of the demonstrator engine efforts under the Department of Defense (DoD)/Naval Aeronautics and Space Administration (NASA) Industry IHPTET program , ensuring that Navy unique design and operational requirements are met. Full scale integrated technology demonstration is essential to validate and transition technologies from applied research through advanced development and into system demonstration/validation, engineering and manufacturing development or product lines. Without technology demonstrators, system acquisition cost/schedule risk would have an unacceptably higher level or programs would have to settle for less operational capability. The lack of technology demonstrator efforts could result in system development schedule increases of five or more years along with the associated increase in cost. The technology sets integrated into and demonstrated in the IHPTET demonstrator engines are closely related to the system requirements for the Joint Strike Fighter (JSF), F-18E/F, Common Support Aircraft (CSA), Multi-mission Maritime Aircraft (MMA), V-22 and SH-60R so that the transition of these high risk and high payback technologies may be effectively accomplished. A strong and viable U.S. propulsion program also provides a dual-use benefit to our country by enhancing our competitiveness in the international commercial engine market. This long term project coordinated through Reliance, will provide for the future needs in air battlespace dominance and expeditionary forces support (Littoral Warfare Joint Mission Area (JMA)), increased platform mission endurance.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Performance Turbine Engine Technology

(Intelligence, Surveillance, and Reconnaissance JMA) and provide technology for increased affordability and platform survivability and increased mission effectiveness (Strike JMA). The program funds three demonstrator engine classes. Each engine class has specific performance goals that are divided into multiple phases. Following from the initial IHPTET goal of doubling the propulsion capability by the year 2003, additional goals were recently approved to address future concepts, i.e., Phase IV (2009). Phase I has been completed and demonstrated for each of the three classes of demonstrators. Phase II is currently progressing to the engine demonstration phase, for all of the advanced component technologies, in the current fiscal year. The Phase III concepts were developed and are currently in the source selection process. The phase goals of each engine class are listed as follows and are referenced to a 1987 baseline (additional affordability goals have been developed for fighter/attack and turboprop/shaft classes):

- (U) Fighter/attack (Joint Technology Demonstrator Engine (JTDE)):
  Phase I - 1993: +30% thrust/weight (Fn/Wt), +100 °F combustor inlet temperature (CIT), +300 °F turbine inlet temperature (TIT), -20% fuel burn.
  Phase II - 1997: +60% Fn/Wt, +200 °F CIT, +600 °F TIT, -20% acquisition cost, -20% maintenance cost, -30% fuel burn.
  Phase III - 2003: +100% Fn/Wt, +400°F CIT, +900°F TIT, -35% acquisition cost, -35% maintenance cost, -40% fuel burn.
- (U) Turboprop/shaft (Joint Turbine Advanced Gas Generator (JTAGG)):
  Phase I - 1993: +40% shaft horsepower/weight (SHP/Wt), -20% specific fuel consumption (SFC), +300 °F TIT.
  Phase II - 1997: +80% SHP/Wt, -30% SFC, +600 °F TIT, -20% acquisition cost, -20% maintenance cost.
  Phase III - 2003: +120% SHP/Wt, -40% SFC, +1000 °F TIT, -35% acquisition cost, -35% maintenance cost.
- (U) Missile/expendable engines (Joint Expendable Turbine Engine Concepts (JETEC)):
  Phase I - 1991: +35% thrust/airflow (Fn/Wa), -20% SFC, +1100 °F CIT, +500 °F TIT, -30% Cost.
  Phase II - 1997: +70% Fn/Wt, -30% SFC, +1200 °F CIT, +900 °F TIT, -45% Cost.
  (U) Phase III - 2003: +100% Fn/Wa. -40% SFC, +1400 °F CIT, +1400 °F TIT, -60% Cost.
  (U) Phase IV - 2009: +140% Fn/Wa, -40% SFC, +1800 °F CIT, +1800 °F TIT, -60% production cost, -30% development cost

(U) Each engine company (Allison Advanced Development Company (IN), AlliedSignal Engines (AZ), General Electric (OH & MA), Pratt & Whitney (CT & FL), Teledyne Ryan Aeronautical (OH) and Williams International (MI)) attempts to utilize at least two engine builds or demonstrator tests within each Phase to demonstrate the performance goals. The JETEC

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Performance Turbine Engine Technology

Phase II goals are divided into demonstrating SFC and Cost for a subsonic demonstrator and Fn/Wa, CIT, TIT and Cost for a supersonic demonstrator.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:
   - (U) ($4,956) Continued:
     - (U) Phase II JTDE: Completed fabrication, assembly and instrumentation of demonstrator engines.
   - (U) ($215) Initiated:
     - (U) Phase III JTDE: Source selection.
     - (U) Phase III JTAGG: Source selection.
     - (U) Phase III JETEC: Source selection.

2. (U) FY 1999 PLAN:
   - (U) ($4,642) Continue:
     - (U) Phase II JTDE: Demonstration of progress to Phase II goals with P&W demonstration engine. Complete fabrication, assembly and instrumentation of General Electric (GE)/ Allison Advanced Development Company (AADC) demonstrator engine. Phase II goals with GE/AADC demonstration engine.
     - (U) Phase II JTAGG: Initial Allied Signal Engines demonstrator engine test. Component optimization and demonstrator engine testing to meet Phase II goals.
     - (U) Phase II JTAGG: Design, component development and fabrication for demonstrator engine and assembly and test of demonstrator engine.
     - (U) Phase II JETEC: Supersonic Phase II demonstrator test of a non-metallic core turbojet meeting Fn/Wa and cost goals.
   - (U) ($2,917) Continue:
     - (U) Phase III JTDE: Contract award and initiate design of Phase III demonstrator engines.
     - (U) Phase III JTAGG: Contract award and initiate design of Phase III demonstrator engines.
     - (U) Phase III JETEC: Contract award and initiate design of Phase III demonstrator engines.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Performance Turbine Engine Technology

3. (U) FY 2000 PLAN:

- (U) ($7,211) Continue:
  - (U) Phase II JTDE: Demonstration of Phase II goals with GE/AADC demonstration engine
  - (U) Phase II JTAGG: Demonstration of Phase II goals with Allied Signal demonstration engine.
  - (U) Phase III JTDE: Fabrication, assembly and instrumentation of demonstrator engines.
  - (U) Phase III JTAGG: Design, component development and fabrication for demonstrator engine and initiate demonstrator engine testing to meet Phase III goals.
  - (U) Phase III JETEC: Design, component development and fabrication of Phase III demonstrator test of a non-metallic core turbojet meeting Fn/Wa and cost goals and an advanced demonstrator to meet SFC goals.

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

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

(U) RELATED RDT&E:
(U) PE 0601152N (In House Lab Independent Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0601102F (Defense Research Sciences)
(U) PE 0601102A (Defense Research Sciences)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronic & Computer Technology)
(U) PE 0602203F (Aerospace Propulsion)
(U) PE 0602211A (Aviation Technology)
(U) PE 0603202F (Aircraft Propulsion Subsystem Integration)
(U) PE 0603216F (Advanced Turbine Engine Gas Generator)
(U) PE 0603003A (Aviation Advanced Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2455 Vectoring Extremely Short Take-off and Landing (ESTOL) Control Tailless Operation Research (VECTOR)										
	0	4,989	4,436	492	0	0	0	0	0	9,917

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Vectoring ESTOL Control Tailless Operation Research (VECTOR) effort is an international cooperative program with Germany and Sweden. This task is a follow-on to a previous X-31 thrust vectoring flight demonstration with Germany as our partner. That effort utilized engine exhaust thrust vectoring vanes (TVV) to produce thrust vectoring and was limited to medium and high altitude fighter maneuvering. ESTOL and Reduced tail/directional control were not addressed. VECTOR will utilize the X-31 aircraft to develop, demonstrate and provide quality metrics and operational concept formulation and validation of ESTOL. The program will also explore reduced tail/directional controls using multiaxis, axisymmetric nozzle thrust vectoring with a first-ever fully integrated flight, engine and nozzle control with the AVEN® multiaxis axisymmetric engine nozzle and an Advanced Air Data System (AADS). Pay-offs for such technologies and concepts include reductions in requirements for runways for expeditionary operations, reductions of catapult and arresting gear and wind-over-the deck requirements, decreased aircraft catapult and arresting loads, and decreased aircraft weight, observability, and maintenance costs. Other benefits include significantly increased performance and decreased operating costs (due to weight and aerodynamic drag reduction), significantly lower take-off and landing energy (which would reduce aircraft fatigue), and increased safety of flight (due to significantly reduced out-of-control flight incidents). VECTOR results will be applicable to tactical aircraft and unmanned aerial vehicles. Foreign candidates include JAS39 GRIPEN (Sweden) and EF2000 (Germany). In addition, applicability to Foreign Military Sales (FMS) F/A-18 could be realized through F-400 series engine upgrades in FMS aircraft and engine rework in foreign depots (e.g., Spain/Integrated Product Team (IPT)).

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control Tailless Operation Research (VECTOR)

1. (U) FY 1998 ACCOMPLISHMENTS: Not applicable.

2. (U) FY 1999 PLAN):

- (U) ($4,866) Initiate:
  - (U) Aircraft reactivation.
  - (U) ESTOL concept and requirements definition.
  - (U) ESTOL modeling and simulation.
  - (U) Wind tunnel testing, supporting concept and requirements definition.
  - (U) Update of ESTOL aerodynamics data set.
  - (U) AVEN® nozzle preliminary design.
  - (U) Flight control law development.
  - (U) System design for installation and integration of X-31 flight controls, engine controls and exhaust nozzle controls.
  - (U) Extensive wind tunnel testing of X-31 integrated systems. This testing will be performed at various sites throughout the U.S. Germany and Sweden.
  - (U) Requirements definition, design and fabrication of a multiaxis axisymmetric exhaust vectoring nozzle.
  - (U) Modifications to X-31 flight control software.
  - (U) Modifications to X-31 exhaust nozzle controls.
  - (U) Modifications to X-31 engine controls.
  - (U) Requirements analysis, design and integration requirements for reduced tail/directional control.
  - (U) Design and fabrication of an Advanced Air Data System (flush port).
  - (U) Ground test and aircraft integration of an Advanced Air Data System.
  - (U) Development of ESTOL and reduced tail concepts and conduct simulation and ground tests, including wind tunnel testing.

- (U) ($123) Small Business Innovation Research. Portion of extramural program reserved for small business Innovation research assessment in accordance with 15 USC 638.

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control Tailless Operation Research (VECTOR)

3. (U) FY 2000 PLAN ($4,436):

(U) Continue: (additional work funded in previous years in PE 0603790N):
-(U) Modifications to X-31 flight control software.
-(U) Modifications to X-31 exhaust nozzle controls.
-(U) Ground and flight test of Advanced Air Data System

(U) Continue:
-(U) System design installation and integration of X-31 flight controls, engine controls and exhaust nozzle controls.
-(U) Design fabrication and testing, of a multiaxis axisymmetric exhaust vectoring nozzle.
-(U) Ground and flight test of ESTOL systems.
-(U) Extensive wind tunnel testing of X-31 integrated systems.
-(U) Requirements analysis, design and integration requirements engineering for reduced tail/directional control.

(U) Complete (additional work funded in previous years in PE 0603790N):
-(U) Design-fabrication, and integration of an Advanced Air Data System (flush port)

(U) Complete:
-(U) Design of multiaxis axisymmetric exhaust vectoring nozzle aircraft modifications requirements.
-(U) Design of multiaxis asymmetric exhaust vectoring nozzle.

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

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

(U) RELATED RDT&E: This program adheres to Defense S&T Reliance Agreements for Air Platforms (Fixed Wing Vehicles).
(U) PE 0601101F (Geophysics)

FY 2000/2001 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: January 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: R2455
PROJECT TITLE: Vectoring ESTOL Control Tailless Operation Research (VECTOR)

(U) PE 0601102F (Materials)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602201F (Aerospace Flight Dynamics)
(U) PE 0602203F (Aerospace Propulsion)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602234N (Materials, Electronic and Computer Technology)
(U) PE 0603112F (Advanced Materials)
(U) PE 0603202F (Aerospace Propulsion Subsystems Integration)
(U) PE 0603205F (Flight Vehicle Technology)
(U) PE 0603211F (Aerospace Structures)
(U) PE 0603216F (Aerospace Propulsion and Power Technology)
(U) PE 0603245F (Advanced Flight Technology Integration)
(U) PE 0603790N (NATO Research and Development)
(U) PE 0603800N & 0603800F (Joint Advanced Strike Technology Program)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance/Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 1998 ACTUAL	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
R2145 Global Surveillance/Precision Strike and Air Defense Technology	38,176	48,179	47,855	62,806	62,795	61,386	62,771	64,196	CONT.	CONT.
R2266 Mobile Offshore Basing (MOB)	4,852	4,989	0	0	0	0	0	0	0	37,321
R0834 Naval Science Assistance Program (NSAP)	2,994	4,326	4,725	4,872	5,008	5,154	5,282	5,414	CONT.	CONT.
R2371 Littoral Airborne Sensor/Hyperspectral (LASH)	11,404	11,972	0	0	0	0	0	0	0	23,376
TOTAL	57,426	69,466	52,580	67,678	67,803	66,540	68,053	69,610	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION
This program focuses science and technology (S&T) resources in the areas of Precision Strike and Air Superiority/Defense in support of the Joint Chiefs of Staff's (JCS's) top five Joint Warfighting Capabilities and the following Joint Mission Areas (JMAs): Strike, Littoral Warfare, Intelligence, Surveillance & Reconnaissance, Nuclear Deterrence, and Sea & Air Superiority. Effective modern warfare in the littorals demands simultaneous execution of these mission areas and requires information transfer and interoperability of multi-mission systems.

(U) Precision Strike is enabled by the integration of Command & Control, surveillance, and targeting capabilities developed in the Global Surveillance Area, and is implemented by high-speed processing and precision weapons for rapid response against high-value, short-dwell targets over extended ranges. The projection of power and Strike elements to defend military and civilian assets ashore using Maritime Forces is a key element for Littoral Warfare. The requirements can only be fulfilled

with: careful correlation of intelligence and other indications and warnings, detection systems which can maintain track of ground targets, methods of identification of targets and hostile intent, command and weapon control systems (to include ability for real-time re-targeting), rapid response and time critical STRIKE weapons, as well as effective and efficient fire support weaponry. This program supports elements of the Fleet and Force Commanders' top Command Capability Issues (CCIs): Flexible Targeting, Battlespace Connectivity and Common Tactical Picture, and Integrated Fire Support.

(U) Extending the Littoral Battlespace (ELB) is an Advanced Concept Technology Demonstration which responds to the top level military need to rapidly deploy a Naval Expeditionary Task Force with an embarked Marine Air Ground Task Force (MAGTF) as part of a larger Joint Task Force to any region of the world's littorals and conduct military operations from a sea base across the spectrum of conflict to implement national military strategy. Forces employed ashore will be light, agile, distributed and disaggregated and capable of optimizing remote fires, to effectively deter aggression, halt attacks and secure critical areas as a precursor to a much larger force. Forces will be empowered by unprecedented situation understanding via a robust information infrastructure that is fully coupled to a decision/planning/execution system on a shared battlespace network (sea/land). The objective of the ACTD is to demonstrate an enhanced integrated command and control/fires and targeting capability to enable rapid employment, maneuver, and fires to support joint dispersed units operating in an extended littoral battlespace. Two Major System Demonstrations (MSDs) is planned for FY99 and FY01. The ELB ACTD was approved by Deputy Under Secretary of Defense (Acquisition and Technology) (DUSD (AT) on 16 January 1997.

(U) Air Defense/Air Superiority for at-sea operations and Littoral Warfare requires the development and demonstration of Detect, Control, Engage capabilities within a fully integrated, Joint Battle Management, Command, Control and Communications architecture. These capabilities must be operational in all weather, day/night, at-sea/over-land, and electronic countermeasure environments. Modern threats (targeted at sea and shore units) which must be detected, identified (accurately), and efficiently engaged include: manned aircraft, cruise missiles (including supersonic sea-skimmers and maneuvering land attack variants), helicopters, unmanned aerial vehicles, and tactical ballistic missiles. Variants of these could be Weapons of Mass Destruction (WMD). All of the above could employ stealth techniques, decoys, and other countermeasures to negate detection and/or engagement.

(U) Cruise Missile Defense (CMD)/Theater Air and Missile Defense (TAMD) is a continuation/evolution of a program initiated in FY 1994. A Joint Mission Assessment (JMA) panel recently (MAY 98) verified the Navy Mission of CMD/TAMD over land as well as at sea. This program consists of the following segments. (1) The CMD Phase I "Mountain Top" ACTD (completed January 1996) demonstrated that an AEGIS ship (or other surface/ ground based missile launch platform), using one or more surrogate airborne sensor partners and Cooperative Engagement Capability (CEC), can provide greatly expanded air defense capability to engage air

targets beyond the surface/ground based radar line of sight. (2) The CMD Phase II program (FY-96 to FY-99) accelerates and aligns the advanced E-2C Airborne Early Warning (AEW) radar system and STANDARD Missile (SM) programs towards a fielded CMD capability. It balances cost, schedule, and risk across multiple technology programs, while initiating advanced missile technology efforts to develop and demonstrate engagement capabilities against next generation cruise missiles and all other air threats. (3) The Phase III program (FY-00 to FY-06) focuses technology associated with the full "system of systems" which will lead to future Naval capability in TAMD. It will optimize the performance of science and technology products to detect, identify, perform fire control, and intercept CM, TBM, and other theater air threats through the use of risk reduction and integrating tools which are compatible with Navy, Joint Service and International TAMD systems.

(U) Mobile Offshore Basing (MOB) concept supports the Nuclear Deterrence and Sea and Air Superiority JMAs. The potential requirement to provide a long-term U.S. presence off shore in support of U.S. interests overseas supports the investigation of advanced mobile bases. Technology issues will be explored associated with both semi-submersible and mono-hull modules connected into platforms between 1000 and 3000 meters in length. Technical challenges include mobility to get on station, sea keeping and stability to support cargo transfer.

(U) Naval Science and Assistance Program (NSAP): This project provides on the spot Science and Technology advisors to Joint, Navy and Marine Corps operational Commands worldwide. It has in the past and will continue to solve high priority Fleet/Force problems rapidly and affordably by evaluation and insertion of mature technologies into operational environments. In addition it provides insight into issues associated with Naval Warfighting Capabilities, thereby influencing long term S&T programs. The program produces a cadre of civilian scientists and engineers fully conversant in operational issues who, upon completion of their NSAP tour, will return to the Naval technical community with enthusiasm and appreciation for the need to develop technologies for transition to the Fleet. Two real products are developed: a compendium of mature technologies, not yet in the acquisition portfolio, for Fleet/Force Commander early evaluation and concurrent development of new tactics and operational concepts; a compendium of Command Capability Issues (CCIs) provided by the Fleet/Force Commanders to the Chief of Naval Research. NSAP is truly a two-way bridge between the warfighter and the scientific/technical community.

(U) Littoral Airborne Sensor/Hyperspectral (LASH) is a modular airborne imagining sensor system with an integrated navigation and control system. Operating in visible and near infrared spectrums, LASH collects hyperspectral imagery using many spectral channels (colors) to exploit subtle color features associated with targets of interest. Developed as a pod-mounted system, LASH can be operated from a P-3C Orion, or other platforms in support of Anti-Submarine Warfare (ASW), mine detection, passive bathymetry, near shore mapping, and land-based detection, discrimination and targeting.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance/Precision Strike and Air Defense Technology

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

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

(U) PROGRAM CHANGE FOR TOTAL P.E.:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	54,319	58,306	49,505
(U) Appropriated Value:		66,406	-
(U) Adjustments from FY 1999 PRESBUDG:	+3,107	+11,160	+3,075
(U) FY 2000 PRESBUDG Submission:	57,426	69,466	52,580

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect Actual Update adjustments (+$3,346); and Small Business Innovation Research adjustment (-$239). FY 1999 adjustments reflect Congressional Undistributed Reductions (-$641); Congressional Plus-up Mobile Offshore Basing (+$5,000), Congressional Plus-up Littoral airborne Sensor/Hyperspectral (+$12,000); Direct Congressional Reduction (-$8,900); and Actual Execution Updates (+$3,701). FY 2000 adjustments reflect Program Adjustment (+3,500); Navy Working Capital Fund (NWCF) Rate adjustment (+198); Civilian Pay Rate adjustment (+$137); and Non Pay Inflation adjustment (-$760).

(U) Schedule: Not applicable

(U) Technical: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance/Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 1998 ACTUAL	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
R2145 Global Surveillance/Precision Strike and Air Defense Technology	38,176	48,179	47,855	62,806	62,795	61,386	62,771	64,196	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Effective modern warfare in the littorals demands simultaneous execution of Surveillance, Strike and Air Defense Mission areas and requires information transfer and interoperability of multi-mission systems.

(U) The Precision Strike and Air Superiority projects develop and demonstrate all/weather, day/night capability to support forces ashore through the use of ground surveillance, Strike warfare command and decision systems, advanced propulsion and weapon technology, and fire support technology.

The projection of power and STRIKE elements to defend military and civilian assets ashore using Maritime Forces is a key element for Littoral Warfare. The requirements can only be fulfilled with: careful correlation of intelligence and other indications and warnings, detection systems which can maintain track of ground targets, methods of identification of targets and hostile intent, command and weapon control systems (to include ability for real-time re-targeting), rapid response and time critical STRIKE weapons, as well as effective and efficient fire support weaponry. This project supports the JCS top five Joint Warfighting Capabilities. In addition, six Fleet and Force Commanders included elements of this as part of their Top Ten Command Capability Issues (CCIs): Flexible Targeting, Battlespace Connectivity and Common Tactical Picture, and Integrated Fire Support.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

PROJECT NUMBER: R2145 PROJECT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

(U) The Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) effort responds to the top level military need to rapidly deploy a Naval Expeditionary Task Force with an embarked Marine Air Ground Task Force (MAGTF) as part of a larger Joint Task Force to any region of the world's littorals and conduct military operations from a sea base across the spectrum of conflict to implement national military strategy. Forces employed ashore will be light, agile, distributed and disaggregated and capable of optimizing remote fires, to effectively deter aggression, halt attacks and secure critical areas as a precursor to a much larger force. Forces will be empowered by unprecedented situation understanding via a robust information infrastructure that is fully coupled to a decision/planning/execution system on a shared battlespace network (sea/land). The objective of the ACTD is to demonstrate an enhanced integrated command and control/fires and targeting capability to enable rapid employment, maneuver, and fires to support joint dispersed units operating in an extended littoral battlespace. Two Major System Demonstrations (MSDs) is planned for FY99 and FY01. The ELB ACTD was approved by Deputy Under Secretary of Defense (Acquisition and Technology) (DUSD (AT) on 16 January 1997.

(U) The Cruise Missile Defense (CMD)/Theater Air and Missile Defense (TAMD) problem is a very complex one, which must be systematically addressed. How can a single Carrier Battle Group in the "Offshore Presence" mode of operations, effectively defend assets at sea and ashore when it is required to execute "Forced Entry" in the event of hostilities. With the variety of air threats (CMs, TBMs, UAVs, Attack Aircraft), each having the potential of requiring different engagement techniques, coupled with other mission requirements such as STRIKE, and Surface Fire Support, what should be the Naval TAMD system of the future? In response to this, the project will be approaching the demonstrations of Science and Technology TAMD elements in a "system-of-systems" context.

This is a continuation/evolution from the Cruise Missile Defense Program initiated in FY 1994 and completing with land based testing at Makaha Radar Facility, Hawaii, in 1999 and at White Sands Missile Range, New Mexico, in 2000. The next Phase (FY-00 to FY-06) will be performing risk reduction on evolving system elements as well as incorporating advanced methods of integration and control of TAMD engagements in the littorals.

(1). The CMD Phase I "Mountain Top" ACTD (completed January 1996) demonstrated that an AEGIS ship (or other surface/ ground based missile launch platform), using one or more surrogate airborne sensor partners and Cooperative Engagement

Capability (CEC), can provide greatly expanded air defense capability to engage air targets beyond the surface/ground based radar line of sight.

(2). The CMD Phase II program accelerates and aligns the advanced E-2C Airborne Early Warning (AEW) radar system and STANDARD Missile (SM) programs towards a fielded CMD capability. It balances cost, schedule, and risk across multiple technology programs, while initiating advanced missile technology efforts to develop and demonstrate engagement capabilities against next generation cruise missiles and all other air threats.

(3). The Phase III program focuses technology associated with the full "system of systems" which will lead to future Naval capability in TAMD. It will optimize the performance of science and technology products to detect, identify, perform fire control, and intercept CM, TBM, and other theater air threats through the use of risk reduction and integrating tools which are compatible with Navy, Joint Service and International TAMD systems. Included in this program are projects involving: electronically scanned array and IR technology for airborne surveillance; methods of building Combat Identification confidence through a distributed network and automation of Theater-level orders from Commanders directly to "shooters"; electronically scanned array technology for missile application and advanced warhead technology for enhanced lethality.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1.(U) FY 1998 ACCOMPLISHMENTS:
(U) ($3,986) Precision Strike
(U) Direct Attack Munition Affordable Seeker (DAMASK):
(U) Initiate:
- DAMASK project to demonstrate an image guided bomb concept with an image seeker, autonomous three meter precision, through adverse weather, at standoff ranges, and at low cost.
- Develop imaging template and adapt pattern matching software.

(U) ($34,190) (CMD/TAMD)
(U) CMD Phase II
(U) Continue:
- (U) Test planning for sensor demonstration at Makaha Ridge Facility (MRF-99).

- (U) Design, development integration and planning efforts for the Phase II demonstration to support extended horizon engagement of cruise missiles.
- (U) Advanced missile seeker and fuze technology development and surveillance upgrades targeting risk reduction efforts in FY-99 and captive flight testing in FY 2000.

2.(U) FY 1999 PLANS:

(U) ($6,036) Precision Strike

(U) DAMASK:

(U) Continue:

- (U) Begin fabrication and bench test of seeker and signal processor; evaluate simulation of terminal guidance algorithm.

(U) ($9,838) ELB

(U) ELB

(U) Continue:

- (U) Strike weapon control integration (Ring of Fire).
- (U) Common tactical picture.
- (U) Airspace Four Dimensional (4D) deconfliction.
- (U) Conduct MSD I.

(U) Initiate:

- (U) Command and Control (C2) demonstration hardware and software upgrades to support MSD I.
- (U) Field testing of Command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) system.
- (U) Identification, preparation and support of residual technology for retention and further evaluation by the operating forces.
- (U) Assessment Planning.

(U) ($22,273) CMD/TAMD

(U) CMD Phase II

(U) Continue:

- (U) Test planning for MRF 99.
- (U) Design, development, integration and planning efforts for the Phase II demonstration to support extended horizon engagement of cruise missiles.
- (U) Advanced missile fuze and seeker technology development and surveillance upgrades targeting captive flight testing in FY 2000.

(U) Initiate:
- (U) MRF 99 critical experiments/demonstration.
- (U) Conduct affordability focused development and demonstrations to reduce cost of technology transition and evaluate system interoperability; e.g. airborne system with interceptor.

(U) Complete:
- (U) MRF 99 critical experiments/demonstration.

(U) ($9,354) Classified Programs
(U) Advanced Surface Situational Awareness (ASSA): Initiate classified program.
(U) High Powered Microwave: Initiate classified program.

• (U) ($678) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3.(U) FY 2000 PLANS:
(U) ($8,560) Precision Strike
(U) DAMASK: Complete efforts: conduct FA-18 captive carry and free flight tests.
(U) Forward Air Support Marine (FASM):
(U) Initiate:
- Effort to develop an expendable, gun-launched munition capable of direct fire support, surveillance and targeting.
- Develop operational concepts for deployment and perform design trade-offs of airframe/engine configuration.

(U) ($9,866) ELB
(U) ELB:

(U) Continue:
- (U) Common tactical picture.
- (U) MSD I assessment.
- (U) Systems engineering and integration.
- (U) Identification, preparation and support of residual technology from MSD I for retention and further evaluation by the operating forces.

(U) Initiate:
- (U) Planning for full scale MSD in FY01.
- (U) C2 demonstration hardware and software upgrades.

(U) ($8,811) CMD/TAMD

(U) CMD/TAMD

(U) Initiate:
- (U) Management and planning for Theater Air and Missile Defense (TAMD) focus initiative.
- (U) Multifunction Infrared Distributed Aperture System (MIDAS) program, which involves a passive infrared sensor system concept for tactical aircraft, and surface combatants exploiting recent rapid advances in infrared sensor and high speed digital image processing technologies.
- (U) Ultra High Frequency (UHF) Electronically Scanned Array (UESA) effort, which will demonstrate a non-rotating electronically-scanning UHF surveillance radar antenna with a 360 field of regard.

(U) Continue:
- (U) Critical CMD risk reduction efforts leading to full E-2C airborne system demonstration with live STANDARD Missile firing in FY02/03.

(U) Complete:
- (U) Analysis of technical data from MRF-99 critical experiments/demonstration, identifying elements to be included in TAMD focus initiative.

(U) ($20,618) Classified Programs

(U) ASSA: Continue classified program.

(U) High Power Microwave: Continue classified program

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

PROJECT NUMBER: R2145 PROJECT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

(U) Retract Cypress: Initiate classified program.
(U) Claymore Marine: Initiate classified program.

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

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.
(U) RELATED RDT&E:
(U) PE 0203801A (Missile/Air Defense Product Improvement Program)
(U) PE 0204152N (E-2 Squadrons)
(U) PE 0207163F (Advanced Medium Range Air-to-Air Missile (AMRAAM))
(U) PE 0207417F (Airborne Warning and Control System (AWACS)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602111N (Air and Surface Launched Weapons Technology)
(U) PE 0602121N (Ship, Submarine & Logistics Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602232N (Communications, Command & Control, Intelligence, Surveillance & Reconnaissance (C3ISR)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronic and Computer Technology)
(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602435N (Oceanographic & Atmospheric Technology)
(U) PE 0602633N (Undersea Warfare Weapon Technology)
(U) PE 0603006A (C3 Advanced Technology)
(U) PE 0603226E (Experimental Evaluation of Innovative Technologies)
(U) PE 0603238F (Air Defense/Precision Strike Technology Demo)
(U) PE 0603245F (Advanced Flight Technology Integration)
(U) PE 0603270N (Advanced Electronic Warfare Technology)
(U) PE 0603401F (Advanced Spacecraft Technology)
(U) PE 0603563N (Ship Concept Advanced Design)
(U) PE 0603601F (Conventional Weapons Technology)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

PROJECT NUMBER: R2145 PROJECT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

(U) PE 0603609N (Conventional Munitions)
(U) PE 0603726F (C3I Subsystem Integration)
(U) PE 0603755N (Ship Self Defense)
(U) PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
(U) PE 0603794N (C3 Advanced Technology)
(U) PE 0604366N (Standard Missile Improvements)
(U) PE 0604770F (Joint Surveillance/Target Attack Radar Systems (JSTARS)
(U) PE 0604866C (Patriot Risk Reduction Mitigation)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance/Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 1998 ACTUAL	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
R0834 Naval Science Assistance Program (NSAP)	2,994	4,326	4,725	4,872	5,008	5,154	5,282	5,414	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:
The project provides on the spot Science and Technology (S&T) Advisors to Joint, Navy, and Marine Corps operational commands worldwide. It solves high priority Fleet/Force problems rapidly and affordably by insertion and evaluation of mature technologies in operational environments and provides Naval warfighting capability issues to influence the longer-term S&T programs. The program produces a cadre of civilian scientists and engineers fully conversant in operational issues, a compendium of mature technologies, not yet in the acquisition portfolio, available to Fleet/Force Commanders for early at-sea evaluation and concurrent development of new tactics and concepts of operation. NSAP is the two-way bridge between the warfighter and the technical community.

(U) FY 1998 reflected initiation of a new strategy for the NSAP. Until FY 1997, the approach was to support a large field team of Science and Technology Advisors assigned to operational commands worldwide. During FY98, NSAP transitioned to a smaller corps of advisors while increasing the emphasis on providing rapid, affordable solutions to real operational problems. This strategy has been developed with the concurrence of the Chief of Naval Operations and has been implemented cooperatively with the Navy Fleet Commanders and the Commandant of the Marine Corps.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

PROJECT NUMBER: R0834 PROJECT TITLE: Naval Science Assistance Program

(U) PROGRAM ACCOMPLISHMENTS AND PLANS;

1. (U) FY 1998 ACCOMPLISHMENTS:

(U) ($2,994) 14 scientists and engineers served as the S&T Advisors to 14 Joint, Navy, and Marine Corps operational commands, providing the primary interface between operating forces and the technical community. Determined capability shortfalls amenable to technology solutions within the operational commands and provided liaison support to subordinate and component commands. Managed NSAP Headquarters Operations Center at Office of Naval Research (ONR) and identified mature technologies to solve Command Capability Issues (CCI). Provided coordination of operational insertion of these technologies and joint evaluations between the developers and operators. Provided oversight and coordination with S&T Advisors located at other operational commands and at strategic planning groups.

2. (U) FY 1999 PLAN:

(U) ($4,300) 14 scientists and engineers serve as S&T Advisors to 14 Joint, Navy, and Marine Corps operational commands, providing the primary interface between operating forces and the technical community. Determine capability shortfalls, document them in CCIs, and find solutions from mature and on the shelf technologies where possible. Broker the remaining CCIs with longer-term technology programs providing requirements documentation to establish new program directions. Where commercial technologies are appropriate, integrate them into technical solutions. Establish transitions for FY97 and FY98 technology insertions now nearing completion of evaluation phases. Manage new technology insertion Integrated Product Team (IPTs) for products selected from the ONR Blue Book. Provide Fleet/Force customers and other stakeholders with metrics for determining the effectiveness of NSAP products and improve those processes and products accordingly.

(U) ($26) Small Business Innovation Research (SBIR). Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLANS:

(U) ($4,772) 14 scientists and engineers serve as S&T Advisors to 14 Joint, Navy, and Marine Corps operational commands, providing the primary interface between operating forces and the technical community. Determine capability shortfalls,

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Global Surveillance/ Precision Strike and Air Defense Technology

PROJECT NUMBER: R0834 PROJECT TITLE: Naval Science Assistance Program

document them in CCIs, and find solutions from mature and on the shelf technologies where possible. Broker the remaining CCIs with longer-term technology programs providing requirements documentation to establish new program directions. Where commercial technologies are appropriate, integrate them into technical solutions. Establish transitions for FY98 and FY99 technology insertions now nearing completion of evaluation phases. Manage new technology insertion IPTs for products selected from the ONR Blue Book. Provide Fleet/Force customers and other stakeholders with metrics for determining effectiveness of NSAP products and improve those processes and products accordingly.

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

C.OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E: Not applicable.

(U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL COMPLETE
E2194 Electronic Warfare Advanced Technology	9,188	10,211	10,359	9,551	9,725	9,952	10,201	10,455	CONT.	CONT.
R2090 Functional Recognition & Response	9,164	7,882	8,625	8,878	9,106	9,356	9,587	9,829	CONT.	CONT.
TOTAL	18,352	18,093	18,984	18,429	18,831	19,308	19,788	20,284	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Advanced Electronic Warfare Technology (AEWT) is the Navy's continuing, core Advanced Technology Development program for Electronic Warfare (EW) and is oriented to demonstrate and transition EW technology in cooperation with the other Services, placing special emphasis on Naval EW applications of Command and Control Warfare. This program continues to develop technologies which support the effective employment of naval force capabilities in the conduct of the Navy's Joint Mission Areas as defined by the Chief of Naval Operations (CNO) (i.e., Strike, Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Strategic Mobility, Readiness and Training). The program is managed at the Office of Naval Research (ONR) by the same office that directs P.E. 0602270N (Navy EW Technology) and provides the vast majority of projects to this program for demonstration and potential transition to full scale development. The ONR program manager is also a principal of the Director of Defense Research and Engineering (DDR&E) Technology Panel for EW that oversees and coordinates Tri-Service 6.2 & 6.3 EW programs. Consequently, this program is planned jointly in accordance with Defense Science and Technology Reliance agreements that allocate various EW disciplines and their attendant technology development responsibilities between the Army, Air Force and the Navy. As part of the Integrated Science and Technology EW Program, it is subject to the review and execution oversight of the DDR&E. AEWT is responsive to CNO guidance and the Systems Commands, warfighting requirements and needs. It develops EW technologies to

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

counter a broad range of electromagnetic threats and is linked to future joint warfighting capabilities of "maintaining near perfect real-time knowledge of the enemy..." and "to counter the threat of...cruise missiles to the Continental United States and deployed forces."

(U) The program transitions new technologies to tactical aircraft (TACAIR), low observable aircraft, surface EW platforms, and Pre-planned Product Improvement programs (P3I) to address the modern threat (including multi-spectral/multi-modal sensors and seekers). This is accomplished by improving threat detection, identification, location and response through developmental upgrades and direct, advanced technology insertions. Currently, AEWT consists of two projects:

(U) E2194 - Electronic Warfare Advanced Technology: This project is a core continuing effort that transitions high-payoff EW technologies to the Fleet and reduces the integration risk of advanced EW systems. Primary focus is on providing threat warning and countermeasures, particularly infrared countermeasures (IRCM) to TACAIR platforms.

(U) R2090 - Functional Recognition & Response: Develops algorithms and techniques to recognize emitters by measuring and analyzing their observable, radar function parameters and develops generic countermeasures techniques to provide protection against any hostile emitter. Uses non-developmental items or develops hardware (as required) to implement Functional Recognition demonstrations and assess overall operational improvement to extant capabilities.

(U) The Navy Science and Technology (S&T) program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

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

B. (U) PROGRAM CHANGE SUMMARY:

FY 1998	FY 1999	FY 2000

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) FY 1999 President's Budget	16,635	17,169	18,909
(U) Appropriated Value		17,169	
(U) Adjustments from FY 1999 PRESBUDG	+1,717	+924	+75
(U) FY 2000 President's Budget	18,352	18,093	18,984

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 reflects a Small Business Innovation Research reduction (-162) and an actual update adjustment (+1,879). FY 1999 reflects an actual update adjustment (+$1,000) and a Congressional Undistributed Reduction adjustment (-76). FY 2000 reflects a Navy Working Capital Fund rate adjustment (+243), a Civilian Pay adjustment (+107), and a Non-Pay Inflation adjustment (-275).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO ESTIMATE	TOTAL ESTIMATE
E2194 Electronic Warfare Advanced Technology	9,188	10,211	10,359	9,551	9,725	9,952	10,201	10,455	CONT.	CONT.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The program transitions new technologies to Tactical Air (TACAIR), low observable aircraft, surface Electronic Warfare (EW) platforms, and Pre-planned Product Improvement programs, with emphasis on TACAIR, to address the modern threat (including multi-spectral/multi-modal sensors and seekers) by improving threat detection, identification, location and response through developmental upgrades and direct, advanced technology insertions.

(U) This project is a core continuing effort that transitions high-payoff EW technologies to the Fleet and reduces the integration risk of advanced EW systems. Primary focus is on providing threat warning and countermeasures, particularly infrared countermeasures (IRCM) to TACAIR platforms.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: A significant portion of the FY98 Electronic Warfare Advanced Technology (EWAT) project was directed toward aircraft IRCM. The onboard IRCM work was planned and executed through the Tactical Aircraft Directed Infrared Countermeasures (TADIRCM) Integrated Product Team (IPT). The IRCM IPT develops advanced expendables for those Navy aircraft that use the AN/ALE-39 countermeasures (CM) Dispenser and will not receive the Advanced Strategic & Tactical Expendables (ASTE) expendables designed for the new AN/ALE-47 CM Dispensing System. In addition, other EWAT IPTs focused on laser warning and countermeasures, radio frequency (RF) self-protection, improving cockpit situational awareness and providing an EW and live fire demonstration test bed. The project also

sponsored symposia and academic research at the Naval Postgraduate School into countermeasure, warning, and tactical issues of importance to the naval aviation community.

- (U) ($760) Advanced Tactical Aircraft Sensor (ATAS) was flight tested and transitioned to the AN/AAR-47 missile warning system program to integrate laser warning into the existing ultra violet (UV) sensor.
- (U) ($1,578) Advanced IR expendables for the AN/ALE-39 Countermeasure Dispenser were designed, modeled and laboratory tested. Best designs were downselected for flight demonstration in FY99.
- (U) ($464) Advanced Technology Expendables and Dispenser Systems (ATEDS) Symposium was convened to show the fleet a multi-service perspective of current and advanced technologies for aircraft self-protection against existing and future threats.
- (U) ($1,164) Wavelet processor was flight tested to enhance the AN/ALR-67 Radar Warning Receiver sensitivity and resulted in a three decibel improvement in system sensitivity.
- (U) ($754) The Symptom Ares surface to air, shoulder fired, IR missile threat analysis was completed and a final report delivered on the optimal countermeasures solution to the threat.
- (U) ($257) Advanced Graphical Display concept man-in-the-loop simulation tests were completed thereby defining designs for improved aircrew situational awareness.
- (U) ($366) Situational Awareness (SA) Symposium was conducted to bring multi-service perspective to SA functional and performance design objectives.
- (U) ($833) Began the configuration of the QF-4S airframe as an EW aircraft test bed to replace the aging QF-4N. The QF-4S will have a multi-configurable EW Suite that can support electro-optical/infrared/radio frequency (EO)/IR/RF)) warning and countermeasure functions.
- (U) ($2,467) Two color missile warning system was completed for the TADIRCM system. Flight test instrumentation assets were procured.
- (U) ($545) Conducted advanced electronic warfare technical research at the Naval Postgraduate School into EO/IR/RF warning and countermeasures for naval aviation.

2. (U) FY 1999 PLAN: The focus of EWAT for FY99 will continue to be enhancing survivability of tactical aircraft against threats operating in the IR region of the spectrum. Advancements in threat counter-countermeasure techniques drive research in IR countermeasure and warning technologies. Developing solutions for the EW suite

requires exploitation of a variety of technologies resulting in multiple tasks within the EWAT Project. Although EWAT's primary focus lies in IR warning and response, enhancements to RF warning and self-protection are also being investigated. Projects currently ongoing that support the technology demonstrations that the EWAT team addresses are: Advanced IR Threat Countermeasures, Advanced Threat Analyses, Tactical Aircraft Directed IR Countermeasures, Integrated Laser and IR Threat Warning Concepts, Integration and Live Fire Demonstration, Advanced Graphical Display and Electronic Warfare Sensor Fusion, Advanced RF Threat Warning and Self-Protection, and Advanced Electronic Warfare Technical Research.

- (U) ($1,805) ADVANCED IR THREAT COUNTERMEASURES: Conduct flight testing of advanced IRCM flare technologies for tactical fixed wing and rotary aircraft not scheduled to receive ASTE decoys.
- (U) ($854) ADVANCED THREAT ANALYSES: Begin the analysis of the advanced Sensor Pantry air-to-air threat through hardware-in-the-loop testing of the threat system. Analyses from this focus area provide a defined and traceable specification of cruise missile (CM) requirements.
- (U) ($1,995) TACTICAL AIRCRAFT DIRECTED IR COUNTERMEASURES (TADIRCM): Perform laboratory, ground, and flight testing of the TADIRCM System in a pod on the EWAT QF-4 in preparation for a live fire demonstration.
- (U) ($2,119) INTEGRATED LASER AND IR THREAT WARNING CONCEPTS: Develop a co-located two color mid-wave IR focal plane array missile warning sensor and integrate a laser warning capability into the same form factor.
- (U) ($638) INTEGRATION AND LIVE FIRE DEMONSTRATION: Complete conversion of QF-4S to an EW aircraft test bed. Integrate pod version of TADIRCM into the QF-4S aircraft.
- (U) ($732) ADVANCED GRAPHIC DISPLAY AND ELECTRONIC WARFARE SENSON FUSION: Integrate the Advanced Graphical Display concept of the enemy's Launch Acceptability Region (LAR) into the F/A-18's head-up-display. Investigate advanced graphical presentations for development of a concept of sensor fusion hardware for TACAIR EW Systems.
- (U) ($1,026) ADVANCED RF THREAT WARNING AND SELF-PROTECTION: Conduct laboratory, ground, and flight tests of the wavelet transforms and Navy Integrated Antenna Down-converter (NIAD) antenna element and transition them to the AN/ALR-67 (V)2 Upgrade program.
- (U) ($542) ADVANCED ELECTRONIC WARFARE TECHNICAL RESEARCH: Conduct advanced EW technical research at the Naval Postgraduate School for next-generation EW warning and response for naval aviation.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

PROJECT NUMVER: E2194
PROJECT NUMBER: Electric Warfare Advance Technology

- (U) ($431) INVESTIGATION OF OPTIMUM LOGIC AND ALGORITHMS FOR AIRBORNE USE OF INSTANTANEOUS FREQUENCY MEASUREMENT RECEIVERS IN THE LOOK-THROUGH MODE. Upgrade algorithms of radar warning receiver (RWR) systems for sensitivity improvements, prototype hardware in the loop and conduct laboratory demonstration.
- (U) ($69) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN: The EWAT project will continue a strong focus in EO/IR countermeasure technologies, however, the RF self-protection area will receive increased emphasis. Advancements in threat counter-countermeasure techniques will continue to drive research in IR countermeasure and warning technologies. Although EWAT's main concentration is expect to remain in infrared EW technologies, advancements in RF wavelet processing for sensitivity improvements are projected to mature. EWAT will also demonstrate advanced graphical cockpit displays based on prior years research establishing situational awareness guidelines. Projected focus areas that support the technology demonstrations that the EWAT team addresses are: Advanced IR Threat Countermeasures, Advanced Threat Analyses, Tactical Aircraft Directed IR Countermeasures, Integrated Laser and IR Threat Warning Concepts, Integration and Live Fire Demonstration, Advanced Graphic Display and EW Sensor Fusion, Advanced RF Threat Warning and Self-Protection, and Advanced EW Technical Research.

- (U) ($1,916) ADVANCED IR THREAT COUNTERMEASURES: Complete flight testing of advanced IRCM flare technologies for tactical and rotary wing aircraft not scheduled to receive ASTE expendables.
- (U) ($1,097) ADVANCED THREAT ANALYSES: Complete the analysis of the advanced Sensor Pantry air-to-air threat. Initiate a Sensor Pantry follow-on threat analysis. Execution of the analysis requires seeker acquisition so that hardware-in-the loop simulations can be performed.
- (U) ($1,881) TACTICAL AIRCRAFT DIRECTED INFRARED COUNTERMEASURES (TADIRCM): Perform a live fire missile flight test of the TADIRCM System using an unmanned QF-4 aircraft with the TADIRCM pod installed.
- (U) ($2,399) INTEGRATED LASER AND IR THREAT WARNING CONCEPTS: Perform laboratory, ground, and flight testing of the integrated electro-optical/infrared missile warning concept.
- (U) ($518) INTEGRATION AND LIVE FIRE DEMONSTRATION: Support EO/IR/RF threat warning and countermeasures demonstrations through flight tests of advanced systems on the QF-4 EW test bed aircraft.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

PROJECT NUMVER: E2194
PROJECT NUMBER: Electric Warfare Advance Technology

- (U) ($727) ADVANCED GRAPHIC DISPLAY AND ELECTRONIC WARFARE SENSON FUSION: Use man-in-the-loop simulations to demonstrate the sensor fusion system in a laboratory environment.
  (U) ($1,280) ADVANCED RF THREAT WARNING AND SELF-PROTECTION: Continue research into RF self-protection for tactical aircraft including techniques to reduce radar warning receiver ambiguities and enhance angle-of-arrival determination.
- (U) ($541) ADVANCED ELECTRONIC WARFARE TECHNICAL RESEARCH: Conduct advanced EW technical research at the Naval Postgraduate School for next-generation EW warning and response for naval aviation.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

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

(U) RELATED RDT&E: This Program Element (PE) adheres to Defense Reliance Agreements on EW with oversight and coordination provided by the DDR&E and is associated with efforts that are being pursued under the following Army and Air Force PEs:

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602270N (Electronic Warfare Technology)
(U) PE 0602270A (Electronic Warfare Technology)
(U) PE 0603217N (Air Systems and Weapons Advanced Technology)
(U) PE 0603270A (Advanced Electronic Warfare Technology)
(U) PE 0603270F (Advanced Electronic Technology)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604270N (EW Development)

D. SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2090 Functional Recognition & Response	9,164	7,882	8,625	8,878	9,106	9,356	9,587	9,829	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops and demonstrates countermeasures to previously unknown threat systems which may be encountered for the first time during hostilities. Threat systems include anti-ship missile seekers, surface-to-air guidance systems, aircraft intercept radars, and ship surveillance and targeting systems. The Specific Emitter Identification (SEI) technology developed in this program significantly enhances the ability to quickly and accurately perform Combat Identification (ID) and support the Joint Mission Areas as defined by the Chief of Naval Operations (i.e., Joint Strike, Intelligence, Surveillance and Reconnaissance, etc.). Existing Electronic Warfare (EW) warning and countermeasure systems will be modified with techniques demonstrated under this program that do not rely on specific parameters. The approach will demonstrate related technology developed in the EW technology base through field trials and at-sea demonstrations.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($2,329) Demonstrated optimal Functional ID system architecture.
- (U) ($2,215) Demonstrated combined Functional ID and SEI systems.
- (U) ($2,332) Flight tested optimized chaff, expert system and integrated towed decoy.
- (U) ($2,288) Developed Functional ID, SEI and generic countermeasures to support development of Advanced Integrated Electronic Warfare System (AIEWS).

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

PROJECT NUMBER: R2090
PROJECT TITLE: Functional Recognition/ Response

2. (U) FY 1999 PLAN: This objective is focused on developing and demonstrating detection, identification and electronic attack of previously unknown threat systems that may be encountered for the first time during hostilities. Threat systems include anti-ship missile seekers, surface-to-air guidance systems, aircraft intercept radars, and ship surveillance and targeting systems. After detection and classification, the project is focused on generating generic responses that rapidly and effectively counter the threat. Existing EW warning systems will be modified with techniques demonstrated under this program that do not rely on previously known parameters. The approach will demonstrate related technology developed in the EW technology base through field trials and at-sea demonstrations.

- (U) ($2,468) Demonstrate and transition optimal Functional ID architecture into the Navy's AIEWS.
- (U) ($2,525) Demonstrate and transition optimal Functional ID architecture into the Navy's EA-6B and follow-on aircraft.
- (U) ($2,851) Demonstrate Functional ID, SEI and generic countermeasures to support development of AIEWS.
- (U) ($38) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with USC 638.

3. (U) FY 2000 PLAN:

- (U) ($3,137) FUNCTIONAL RECOGNITION -The SEI technology developed in this program significantly enhances the ability to quickly and accurately perform Combat ID and support the Joint Mission Areas as defined by the Chief of Naval Operations (i.e., Joint Strike, Intelligence, Surveillance and Reconnaissance, etc.).
  - (U) Provide system integration of the AN/UYX-3 (SEI Processor) into Increment 1 of the AIEWS, finalize improvements to existing Digital Signal Processing (DSP) code, continue software partitioning and finalize re-hosting and integration with new DSPs, presenting Increment 1 with a capability of identifying specific emitters by radar signature, thus greatly enhancing the Combat ID of the system.
  - (U) Apply technologies developed by Canada (CANEWS 2) and the United Kingdom (PALANTIR) to address improvements to the complex pulse train de-interleaving requirements of AIEWS, allowing for transition of these technologies coupled with the SEI processing capability providing enhanced pulse train analysis.
  - (U) Design and fabricate high speed digital receiver and refine algorithms for application of the Double Delta precision Direction Finding (DF) system addressing the requirement of precise Angle of Arrival (AOA)

information in support of de-interleaving of multiple emitters, situational awareness, and directional countermeasures.

- (U) ($2,811) GENERIC RESPONSE -Existing Electronic Warfare countermeasures systems will be modified with techniques demonstrated under this program that do not rely on specific parameters.
  - (U) Modify existing Synthetic Aperture Radar (SAR) countermeasures development hardware by providing multiple transmit antennas and controls to address the problem posed by the advanced interferometric SAR radars and denying these systems surveillance and targeting capabilities against US forces.
  - (U) Develop techniques capable of being generated by present airborne EW systems and demonstrate their effectiveness against Surface-to-Air threat simulations, providing the present on board EW systems with a capability to handle the modern coherent threat systems with minimal cost impact.
  - (U) Fabricate a Millimeter Wave (MMW) Fiber Optic Towed Decoy (FOTD), integrate with an onboard techniques generator, and flight test against threat simulators demonstrating a capability in the MMW frequency range for application to tactical aircraft in addressing the MMW threat.
  - (U) Develop self-adaptive Electronic Attack (EA) techniques employing Artificial Intelligence (AI) against the counter-surveillance and counter-targeting threats for introduction into Increment 2 (EA) of the AIEWS program.

- (U) ($2,677) EW EFFECTIVENESS -This objective is focused on developing hardware and software models/simulations which allows one to evaluate EW concepts, hardware, techniques and software. Representative scenarios in part or in total must be available. The type of tools required must be representative of the threat, which may include Low Probability of Intercept, selectable radar parameters, and sophisticated signal processing. These tools will be available for both laboratory and field tests.
  - (U) Model ownship monostatic clutter effects, bistatic clutter and assess the environmental effects on the SEI technology, thus providing an analysis of the expected real world performance of a sensitive, high precision DF, SEI capable Electronic Support (ES) sensor in the detection and identification of threats.
  - (U) Develop display graphics and interfaces to provide a visual playback of field tests and digital modeling for users to evaluate the tests results providing a better understanding of system effectiveness, in particular when unknown threats are encountered for the first time.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

PROJECT NUMBER: R2090
PROJECT TITLE: Functional Recognition/ Response

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

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

(U) RELATED RDT&E PROGRAMS: This PE adheres to Defense Reliance Agreements on EW with oversight and coordination provided by the DDR&E and is associated with efforts that are being pursued under the following Army and Air Force PEs:

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602270A (Electronic Warfare Technology)
(U) PE 0602270N (Electronic Warfare Technology)
(U) PE 0603270A (Electronic Warfare Technology)
(U) PE 0603270F (Electronic Combat Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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	33,551	35,222	39,105	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.
R2328 Project M	4,722	4,697	2,410	0	0	0	0	0	0	20,833
R2373 Composite Helicopter Hanger (Congressional Plus up)	9,591	4,989	0	0	0	0	0	0	0	14,580
R2488 Power Electronic Building Blocks (Congressional Plus up)	0	5,986	0	0	0	0	0	0	0	5,986
R2489 Power Node Control Centers (Congressional Plus up)	0	1,995	0	0	0	0	0	0	0	1,995
S1848 Gas Turbine Engine Technology	505	0	0	0	0	0	0	0	0	100,865
TOTAL	48,369	52,889	41,515	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.

A. (U) 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.

(U) In FY 2000, there are two active projects: Ship and Submarine HM&E Advanced Technology (R2224), and Project M (R2328). 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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

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.

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

(U) 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.

(U) PROGRAM CHANGE FOR TOTAL P.E.:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	48,261	39,264	42,165
(U) Appropriated Value:		51,264	-
(U) Adjustments from FY 1999 PRESBUD:	+108	+13,625	-650
(U) FY 2000 President's Budget Submission:	48,369	52,889	41,515

(U) CHANGE SUMMARY EXPLANATION:

- (U) Funding: FY 1998 adjustments reflect Small Business Innovative Research reduction (-$423), Federal technology transfer (-$20) and actual update adjustments (+$551). FY 1999 adjustments reflect miscellaneous adjustments (+$1,798), Congressional Undistributed Reductions (-$173), specific Congressional reduction (-$1,000) and Congressional plus ups: Composite Helicopter Hangar (+$5,000), Pover Electronic Building Blocks

(+$6,000), and Power Node Control Centers (+$2,000). FY 2000 changes reflect Navy Working Capital Fund rate adjustments (+$286), Civilian pay adjustments (-$455), program balance adjustment (-$3,431) and affordability transfer (+$2,950).

- (U) Schedule: Not applicable.
- (U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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										
	33,551	35,222	39,105	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.

A. (U) 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 Advanced Vibration Reducer (AVR), Automation to Reduce Manning (ARM), Ship/Submarine Hull Systems (SSHS), and Advanced Electrical Systems (AES). Project M efforts are reported in Project R2328.

(U) AVR technology reduces submarine acoustic signature. This technology addresses general submarine signature issues and is applicable to current and future submarine classes. AVR technology has been demonstrated through an at-sea acoustic ship trial.

(U) 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 the family of 21st Century Combatants and the 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).

(U) 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 Integrated Ship Hull Form/Propulsor System (ISPS) effort will demonstrate the integration of multi-disciplinary technologies, in particular, the integration of hydrodynamic, mechanical, and structural technology into ship hull/propulsion systems. The Advanced Topside Systems (ATS) effort will demonstrate general ship topside technologies for future ship classes.

(U) 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 size, cost and weight of all electrical systems.

(U) PROGRAM ACCOMPLISHMENT AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

(U) ($1,997) AVR:
(U) COMPLETED:

- (U) Evaluation of at-sea test data.
- (U) Final reports documenting AVR program and transition advanced technology to Naval Sea Systems Command (NAVSEA).

(U) ($9,097) ARM:
(U) INITIATED:

- (U) Selection of automated reasoning and control topology for automated ship damage control system. (DCARM)
- (U) Selection of human-centered designed systems engineering tools for optimized manning. (SC21 Manning)

(U) CONTINUED:

- (U) Development of automated casualty response systems to minimize manning and increase operational reliability. (DCARM)
- (U) Develop human-system performance metrics and predictive engineering models of combat systems decision-makers in warfighting scenarios. (SC21 Manning)
- (U) Develop integrated command environment concept for DD21 land attack mission. (SC21 Manning)
- (U) Evaluate individual multi-modal watchstation console effectiveness in DD21 air dominance and strike scenarios. (SC21 Manning)

(U) COMPLETED:

- (U) Fire and fluid control of damage detection requirements for automated ship damage control system. (DCARM)
- (U) Demonstration to establish baseline for automated ship damage control system. (DCARM)

(U) ($13,908) AES:
(U) TRANSITIONED:

- (U) Tools developed in the Submarine Technology Applied Research program to predict two-dimensional electric motor forces. (QED)

- (U) Diesel fuel processing technology for fuel cells from PE 0602121N. (SSFC)

(U) CONTINUED:

- (U) Construction of small-scale motor variants to evaluate measurement techniques and passive design parameters in quiet electric motors. (QED)
- (U) Generate baseline force and acoustic measurements and predictions of small-scale electric motor variants. (QED)
- (U) Develop concepts for a 2500 kilowatt Ship Service Fuel Cell power systems. (SSFC).
- (U) Electrically Re-configurable Ship concept. (SSSA)
- (U) Demonstration of key equipment capabilities for the Electrically Re-configurable Ship. (SSSA)

(U) ($3,549) SSHS:

(U) TRANSITIONED:

- (U) Transition technology from PE 0602121N for development of Machinery Support Systems (AMSS) for improved shock and acoustic performance. (AMSS)

(U) CONTINUED:

- (U) Evaluation of the impact of flexible truss and shock strengthening concepts on acoustic and shock performance of truss. (AMSS)
- (U) Evaluation of coating optimization through simulation. (AMSS)
- (U) Demonstration of coating holiday impact on radiated noise. (AMSS)
- (U) Fabrication of advanced enclosed mast test article for the LPD-17. (ATS)

(U) ($5,000) Project M:

(U) CONTINUED:

- (U) This is included in the effort described in Project R2328 of this PE.

2. (U) FY 1999 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

(U) ($12,955) ARM:
(U) INITIATE:
- (U) Preparation for remote manual demonstration with 60% damage control manning reduction. (DCARM)
- (U) Develop and optimize water mist distribution controls and logic architecture. (DCARM)

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

(U) COMPLETE:
- (U) Final Demonstration of 3-man Multi-Modal Watchstation team performance for current generation of surface combatants (AEGIS) Strike scenarios. (SC21 Manning)

(U) ($16,501) AES:
(U) INITIATE:
- (U) Development of 3D models for electric motor magnetic fields. (QED)
- (U) Development of active control techniques for electric motors. (QED)

(U) CONTINUE:
- (U) Fabrication of a 500KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)
- (U) Propulsion system concept studies. (QED)
- (U) Development of motor acoustic prediction capability. (QED)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

- (U) Development of critical component technology for intermediate-scale QED demonstration. (QED)
- (U) Demonstration of key system capabilities for the Electrically Reconfigureable Ship. (AED)

(U) COMPLETE:

- (U) Demonstration of prototype self-synthesizing, dynamically re-configurable electric distribution systems. (AED)
- (U) Ship Service Fuel Cell power system concept validation via numerical analysis, and testing of sub-scale articles. (SSFC)
- (U) Demonstration of physical and computational network system simulations. (AED)
- (U) Multi-functional demonstration of second-generation PEBB modules for form and function. (SSSA)
- (U) Demonstration of key equipment capabilities for the Electrically Re-configurable Ship. (SSSA)

(U) ($5,368) SSHS:

(U) INITIATE:

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

(U) CONTINUE:

- (U) Evaluation of the impact of flexible truss and shock strengthening concepts on acoustic performance of truss. (AMSS)

(U) COMPLETE:

- (U) Design guidance for coating holidays. (AMSS)
- (U) Evaluation of coating optimization through simulation. (AMSS)
- (U) Fabrication and demonstration of advanced mast test article for the LDP-17. (ATS)

(U) ($398) SMALL BUSINESS INNOVATION RESEARCH:

- (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

3. (U) FY 2000 PLAN:

(U) ($14,133) ARM:
(U) INITIATE:
- (U) Casualty response/system reconfiguration for reflexive fluid systems (DCARM)

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

(U) COMPLETE:
- (U) Water mist distribution controls and logic architecture (DCARM)
- (U) Complete hardware and software systems integration of fire protection systems (DCARM)
- (U) Complete casualty response/ system reconfiguration for reflexive fluid systems (DCARM)
- (U) Remote manual demonstration with 60% Damage Control Manning Reduction (DCARM)
- (U) Final Demonstration and evaluation of Multi-Modal Watchstation individual and team performance for DD21 warfighting missions. (SC21 Manning)

(U) ($17,967) AES:
(U) INITIATE:
- (U) Development of acoustic prediction capability for electric motors. (QED)
- (U) Development of structural response models for electric motors. (QED)
- (U) Development of models for electric motor controllers. (QED)
- (U) Integration of submarine hydroacoustic model and structural response model. (QED)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

- (U) Development of scale electric motors and controllers for demonstration. (QED)
- (U) Demonstration of equipment capabilities using PEBB-3 technology. (AED)

(U) CONTINUE:
- (U) Demonstration of key system capabilities for the Electrically Re-configurable Ship. (AED)
- (U) Development of active control techniques for electric motors. (QED)

(U) COMPLETE:
- (U) Demonstration of Virtual Test Bed for advanced PEBB based equipment. (AED)
- (U) Development of 3D models for electric motor magnetic fields (QED)

(U) ($7,005) SSHS:
(U) TRANSITION:
- (U) Acoustic coating design methods from PE 0602121N. (AMSS)

(U) INITIATE:
- (U) Design and installation of advanced acoustic coating concept for quarter-scale demonstration at ISMS. (AMSS)
- Demonstration of quiet piping system concept. (AMSS)

(U) CONTINUE:
- (U) In-water quarter-scale demonstration of shock capable Machinery Support Structure System Concept acoustic performance at ISMS. (AMSS)

(U) COMPLETE:
- (U) In-air quarter-scale laboratory demonstration of Machinery Support Structure System concept for shock performance. (AMSS)

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

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

- (U) RELATED RDT&E:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602121N (Ship, Submarine & Logistics Technology)
(U) PE 0602131M (Marine Corps Landing Force Technology)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0603502N (Surface and Shallow Water Mine Countermeasures)
(U) PE 0603513N (Shipboard System Component Development)
(U) PE 0603514N (Ship Combat Survivability)
(U) PE 0603553N (Surface Anti-Submarine Warfare)
(U) PE 0603561N (Advanced Submarine Systems Development)
(U) PE 0603563N (Ship Concept Advanced Design)
(U) PE 0603564N (Ship Preliminary Design and Feasibility Studies)
(U) PE 0603569E (ARPA S&T Program)
(U) PE 0603573N (Advanced Surface Machinery Systems)
(U) PE 0604558N (New Design SSN Development)
(U) PE 0604561N (SSN-21 Developments)
(U) Under the Defense S&T Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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
R2328 Project M	4,722	4,697	2,410	0	0	0	0	0	0	20,833

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Project M develops and demonstrates a technology to control the vibration of naval machinery support structures.

- (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS (Congressional Plus-up ($4,722)):
   - (U) Efforts described in this project are funded at $5M in Project R2224 controls.
   - (U) Installed large scale support structure and associated test fixture in plant.
   - (U) Developed electronics, sensors, magnets, and software for the demonstration system.
   - (U) Prepared test plans for all subsystem and system level tests, including the final in water demonstration.
   - (U) Installed components on the test fixture and test structure and integrate the demonstration system.
   - (U) Conducted structural acoustic characterization tests of the test vehicle (PIKE) at the Intermediate Scale Measurement System (ISMS).

2. (U) FY 1999 PLAN ($4,604):
   - (U) Conduct in-plant system testing of the demonstration system.
   - (U) Conduct in-air performance tests in plant.
   - (U) Deliver Project M demonstration system to Naval Surface Warfare Center (NSWC) Carderock and install in Pike Model.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology
PROJECT NUMBER: R2328
PROJECT TITLE: Project M

- (U) Conduct in-air demonstration testing of Project M in Pike model at NSWC Carderock.
- (U) Transport Project M demonstartion system to the ISMS facility NSWC Bayview for in-water tests.
- (U) Conduct in-water demonstration tests of Project M technology at ISMS facility.

(U) ($93) SMALL BUSINESS INNOVATION RESEARCH:

- (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 2000 PLAN ($2,410):

- (U) Evaluate performance of Project M technology from in-water tests.
- (U) Complete transition of Project M technology to Naval Sea Systems Command.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology
PROJECT NUMBER: R2328
PROJECT TITLE: Project M

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

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

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

D. (U) SCHEDULE PROFILE: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

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

PROJECT NUMBER: R2328
PROJECT TITLE: Project M

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603640M Marine Corps Advanced Technology Demonstrations

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	58467	56187	56943	59410	54814	55572	57003	58031	Continuing	Continuing
C2223 Marine Corps Advanced Technology	22333	18478	10491	11693	15772	15890	17192	17512	Continuing	Continuing
C2297 Marine Corps Warfighting Laboratory (MCWL)	26834	27905	36801	38105	38086	38729	39811	40519	Continuing	Continuing
C2362 Extended Littoral Battlespace (ELB), Advanced Concept Technology Demonstration (ACTD)	9300	9804	9651	9612	956	953	0	0	0	45276
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) **Mission Description and Budget Item Justification:** As the land warfare component of Naval Expeditionary Forces power projection, the Marine Corps has unique and technologically stressing requirements resulting from its amphibious mission; Marine Air-Ground Task Force (MAGTF) organizational structure; and reliance on maneuver, logistic sustainability, and intensive tempo of operations in diverse environments. Critical Marine Corps requirements/imperatives being addressed in this program element (PE) are: Maneuver, Firepower, Command and Control, Logistics, and Training and Education. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in a quasi-operational environment. Multiple transitions into the Demonstration/Validation phase are planned, as well as fieldable prototyping to reduce risk in Engineering and Manufacturing Development. Joint service efforts are in line with Defense Technology Objectives (DTOs) and Joint Warfighting Objectives (JWOs). In addition, Marine Corps Warfighting Experimentation in conceptual operational assessment of emerging technologies is funded. This PE also provides Extended Littoral Battlespace efforts in the areas of: Command, Control, Communications, Computers and Intelligence (C4I); and Fires and Targeting. Efforts focus on connectivity between MAGTF and Fleet organizations and naval sea-based fire support. Specifically, this PE supports the following capabilities: promptly engaging regional forces in decisive combat on a global basis; responding to all other contingencies and missions in the full spectrum of combat operations (high, mid and low intensity) in Military Operations in Urban Terrain (MOUT), and in operations other than war; and warfighting experimentation. By providing the technologies to enable these capabilities, this PE primarily supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. This PE supports all of the Marine Corps mission areas.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603640M Marine Corps Advanced Technology Demonstrations

PROJECT: C2223

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
C2223 Marine Corps Advanced Technology	22333	18478	10491	11693	15772	15890	17192	17512	Continuing	Continuing
C2223 Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) **JUSTIFICATION FOR BUDGET ACTIVITY:** (U) This program is budgeted within the Advanced Technology Demonstration Budget Activity because it encompasses design, development, simulation, or experimental testing of prototype hardware to validate technological feasibility and utility, and reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 Accomplishments:

- (U) $ 7588 Maneuver Imperative: Conducted technology development and demonstrations to enhance the Ground Combat Element's (GCE) abilities to locate, close with, and destroy the enemy. The principle objectives were to improve tactical mobility, survivability and readiness in order to facilitate the Marine Corps-unique Operational Concept, (Operational Maneuver from the Sea (OMFTS). Major focus areas were: technologies for future combat vehicles, incorporated hybrid electric propulsion suites; Technologies to detect minefields from deployed Unmanned Aerial Vehicle's (UAV) rapidly, at safe standoff and fully integrate with the GCE. Efforts included: Continued Future Light Combat Vehicle Technical Concept development. Completed Coastal Battlefield Reconnaissance and Analysis (COBRA) hardware/software optimization and demonstrated COBRA upgrades at the Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD). Transitioned COBRA to Engineering and Manufacturing Development (EMD 6.5). Completed Source Selection and awarded contracts for Detailed Design of Reconnaissance, Surveillance and Targeting Vehicle Advanced Technology Demonstrator (RSTV ATD). Completed Critical Item Demonstrations for key and risk technologies of the RSTV program and Preliminary Design Review with both contractors. Completed System Engineering, to include modeling, analysis and simulation of key technologies and components for Light Armored Vehicle Service Life Extension Program (LAV SLEP) Technology Demonstrator vehicle. Awarded contract for Common Automatic Recovery System (CARS) under Congressional plus up.

• (U) $	6086	Firepower Imperative: Developed and demonstrated technologies to enhance Reconnaissance, Surveillance, and Target Acquisition tasks for supporting arms (Indirect fire and close air support); fire control for direct fire and close combat. Tested and evaluated prototype Objective Individual Combat Weapons (OICW) System. Completed design studies to develop the capability to fire the Shoulder Launched Multipurpose Assault Weapon (SMAW) from an enclosed space under Congressional plus up program. Investigated the integration of Advanced Medium Range Air-to-Air Missile (AMRAAM) missiles onto High Mobility Multi-Wheeled Vehicles (HMMWVs), also known as the Complimentary Low Altitude Weapons System (CLAWS).
• (U) $	769	Command and Control Imperative: Continued to develop and demonstrate technologies and concepts for the elements of the MAGTF, with a focus on the Command Element (CE). Prototype modules for an experimental Jump Command Post (CP) were designed and fabricated. These modules are capable of supporting operations out of multiple prime movers in the USMC inventory. Module designs included shelters, work space layout and ergonomics, lighting, power management, electronic enclosures and environmental control and support the fielding of advanced computer and communication technologies when transitioned to the USMC inventory. Accepted delivery of limited capability prototype ultra wideband unique waveform communication devices.
• (U) $	4285	Logistics Imperative: Continued system concept development and rapid prototype of technologies to support of Combat Service Support Operations Center (CSSOC) and Mobile CSSOC field demonstrations with 1st and 2nd Force Service Support Group (FSSG). Focus of CSSOC was the Request Tracking System (RTS), and a web-based Common Database Repository (COMDAR). The prototype system was structured to provide the logistician with a logistics command and control capability within the common operating center environment. Concluded concept demonstration of an expeditionary container handler, considered as an augmentation to the existing rough terrain container handler, and focused on providing a new capability for movement from ship to shore destination using all current landing craft/lighterage concepts. Initiated investigating of a 2-3 Kilowatt Fuel Cell, electro chemical compressors and reformat gas scrubbers under Congressional plus up program. Completed System configuration description of Logistic Vehicle System-Replacement (LVS-R) Advanced Technology Demonstrator in support of PMs acquisition strategy for LVS-R. Fabrication began and component installation on-going.
• (U) $	2010	Training and Education Imperative: Developed and demonstrated technologies that enhanced the mental abilities of Marines to deal with battlefield uncertainty and chaos, to assimilate information rapidly to be decisive. Initiated the MOUT-IS (Military Operations in Urban Terrain-Instrumentation System) program and awarded the prototype development contract.
• (U) $	1595	Project Albert funds the development methodologies at the Maui High Performance Computer Center (MHPCC) to run and assess large-scale analysis of the Irreducible Semi-Autonomous Adaptive Combat (ISAAC) agent based land combat model; to support the Joint Integrated Virtual Environment for Simulation (JIVES) program and conduct a proof-of-concept of generative analysis in urban warfighting environments; to assess the Swarm artificial life modeling tool in an urban environment; and to incorporate applicable emerging results from the previously mentioned ALBERT processes in the Maneuver Warfare Analytical and Research System (MWARS) structure.
(U)Total $	22333	

(U) FY 1999 Planned Program:

- (U) $ 3296 Maneuver Imperative: Continuation of the Joint Defense Airborne Reconnaissance Program Agency (DARPA)/USMC Reconnaissance, Surveillance and Targeting - Vehicle (RST/V). Fabricated and tested RST/V platform and began integration of survivability and sensor systems. Downselected to single contractor for fabrication, testing and test support for Reconnaissance, Surveillance and Targeting Vehicle. Conducted successful Critical Design Review with contractor. Purchased all critical components and began fabrication of two demonstrator platforms to be delivered 1Q FY 2000. Complete system configuration and began fabrication of technology demonstrator for the Light Armored Vehicle SLEP. Platform will be key enabler for SLEP program and will transition to Program Manager in FY 2000.
- (U) $ 7185 Firepower Imperative: Continue design and fabrication of OICW prototype. Analyze and evaluate Contingent Low Altitude Weapons System (CLAWS), formerly HUMRAAM. Develop the capability to fire the Shoulder Launched Multipurpose Assault Weapon (SMAW) from an enclosed space under Congressional plus up program. Develop a microwave-based weapons pairing system that enables direct weapons fire simulation in realistic battlefield conditions for the K-Band Testing Obscuration Pairing System
- (U) $ 938 Command and Control Imperative: Continue to develop and demonstrate technologies to make decisions, communicate information, and expand knowledge in a high tempo, uncertain, and chaotic battlefield. These technologies will include large screen display technologies that are scalable for Battalion through Division and their appropriate Command Post environment. They will also include horizontal integration of software capabilities/modules such that the commander and his staff see a consolidated picture of the battlespace rather than segregated applications. Continue the effort to develop unique waveform technologies that provide low probability of detection/intercept for squad level communications.
- (U) $ 1477 Logistics Imperative: Continue to develop and demonstrate technologies to enhance MAGTF capabilities in operational and tactical logistics in the areas of CSS vehicles. The goal is to enable seabased logistics, a tailored presence ashore, and reduction in consumables. Program focus includes: CSSOC software and hardware system will be packaged for transition to the Unit Operations Center (UOC) program, to fully support the Personnel and Administration/Logistics, Supply and Embarkation (G4/G1) functionality of logistics command and control. Legacy system interfaces and joint interoperability will be demonstrated. Complete fabrication and testing of Logistic Vehicle System-Replacement (LVS-R) Advanced Technology Demonstrator in support of PMs acquisition strategy for LVS-R. Configuration and testing provided required data and reduced risk and cost while supporting future Milestone Decisions.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603640M Marine Corps Advanced Technology Demonstrations
	PROJECT C2223

• (U) $	1311	Training and Education Imperative: Continue to develop and demonstrate technologies to enhance the cognitive and higher-order abilities of Marine Warfighters. Efforts include: Development of the Closed Loop Artillery Simulator System (CLASS). Development of the Military Operations In Urban Terrain-Instrumentation System (MOUT-IS); conducted DT and transitioned technology to MOUT ACTD and Marine Corps Urban Warrior Advanced Warfighting Experiments (AWE). Continued to support transitions to acquisition.
• (U) $	4000	Project Albert funds the development of data, concepts and tools of 21st Century Operations Analysis especially in the areas of non-linear and asymmetric warfare. The goal is to generate data to support warfighting hypotheses with emphasis on questions relating to urban warfare.
• (U) $	271	Portion of extramural program reserved for Small Business Innovation Research (SBIR) assessment in accordance with 15 USC 638.
(U)Total $	18478	

(U) FY 2000 Planned Program:

• (U) $	3575	Maneuver Imperative: Continue to develop and demonstrate technologies that enhance operational mobility and survivability of platforms of Marine units. Efforts include: Continue the Joint DARPA/USMC Reconnaissance, Surveillance and Targeting - Vehicle (RST/V). Conduct contractor testing and risk reduction through test-fix-test strategy of Reconnaissance, Surveillance and Targeting Vehicles. Testing will encompass Mobility, Survivability, Sensor, and Communications. Conduct Fabrication Review and Test Readiness Review for 2001 delivery to government. Continue testing of Technology Demonstrator for the Light Armored Vehicle SLEP. Conduct testing and transition findings to acquisition manager.
• (U) $	1955	Firepower Imperative: Investigate technologies to increase accuracy, range, lethality, integration and timeliness of direct, indirect and close fires. Continue development and evaluation of Enhanced Target Acquisition and Location System (ETALS). Continue evaluation and integration of CLAWS. Begin development, integration and evaluation of Objective Crew Served Weapon (OCSW) System, a joint Army/USMC program.
• (U) $	1350	Command and Control Imperative: Conduct demonstration of USMC Concept of Operations (CONOPS) and participate in Joint Testing for deployment of tactical digital radios. Continue the development and demonstration of advanced Human Computer Interfaces (HCI) devices for use in Command Operations Centers (COC's) and Command Centers (CC's) for workstations and handheld data processing and communication equipment. Continue horizontal integration of software modules/functionality for an aggregate view of the battlespace. Continue developing unique waveform squad level communications devices and extend it to company level for intra-level communications.

- (U) $ 1900 Logistics Imperative: Continue to develop and demonstrate technologies to enhance MAGTF capabilities in operational and tactical logistics in the areas of CSS vehicles. The goal is to enable seabased logistics, a tailored presence ashore and reduction in consumables. Program focus includes: transition of the CSSOC and mobile CSSOC system concept insertion efforts. Efforts include the technology demonstration of new concepts in expeditionary bulk liquids distribution systems, focused on Naval seamless operation from ship to objective. Insert advanced technology into Logistic Vehicle System Technology Demonstrator platform to demonstrate embedded diagnostics and reporting, enhanced mobility, and improved trafficability and payload handling. Perform system analysis and modeling of future assault support capabilities and assets. Conduct survey, initial analysis and preliminary design of advanced payload handling systems for USMC Logistic Vehicle System and Medium Tactical Truck, to include trailers and load management systems.
- (U) $ 1711 Training and Education Imperative: Continue to develop and demonstrate technologies to enhance the cognitive and higher-order abilities of Marine Warfighters. Efforts include: Development of the Closed Loop Artillery Simulator (CLAS). Development of the Military Operations In Urban Terrain-Instrumentation System (MOUT-IS).

(U)Total $ 10491

B. (U) Project Change Summary

	FY 1998	FY 1999	FY 2000
(U) Previous President's Budget	22392	8520	10701
(U) Adjustments to Previous President's Budget	-59	+9958	-210
(U) Current Budget Submit	22333	18478	10491

(U) Change Summary Explanation:

(U) Funding: Reductions in FY1998 are due to Small Business Innovative Research (SBIR) and a funding realignment to another Marine Corps program. FY99 increases and decreases reflect Congressional increases in the amounts of five $5 million for SMAW, $4 million for Project Albert and $974 thousand for K-Band and eonomic and general adjustments, respectively. FY 2000 decrease is due to revised economic assumption and general adjustments.

(U) Schedule: Not applicable

(U) Technical: Not applicable

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603640M Marine Corps Advanced Technology Demonstrations PROJECT C2223

C. (U) Other Program Funding Summary (APPN, BLI #, NOMEN)

FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost

(U) Not applicable

(U) Related RDT&E

(U) PE 0602618A (Ballistics Technology)
(U) PE 0603004A (Weapons and Munitions Advanced Technology)
(U) PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
(U) PE 0603606A (Landmine Warfare and Barrier Advanced Technology)
(U) PE 0603607A (Joint Service Small Arms Programs)
(U) PE 0603619A (Landmine Warfare and Barrier Advanced Demonstrations)
(U) PE 0603772A (Battlefield Force Integrations)
(U) PE 0604207A (STINGRAY)
(U) PE 0604710A (Night Vision Systems - Engineering Development)
(U) PE 0604806A (Chemical/Biological Defense Equipment - Engineering Development)
(U) PE 0604808A (Landmine Warfare and Barrier Engineering Development)
(U) PE 0602301E (Computing Systems and Communications Technology)
(U) PE 0602702E (Tactical Technology) Technology Demonstrations (ATDs)
(U) PE 0603226E (Experimental Evaluation of Major Innovative Technologies)
(U) PE 0206623M (Marine Corps Ground/Supporting Arms Systems)
(U) PE 0602131M (Marine Corps Landing Force Technology)
(U) PE 0603612M (Marine Corps Mine/Countermeasures Systems)
(U) PE 0603635M (Marine Crops Ground Combat/Support System)
(U) PE 0204163N (Fleet Communications)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0603555N (Undersea Superiority Technology Demonstrations)
(U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
(U) PE 0603794N (Command, Control, Communications, Advanced Technology)
(U) PE 0206313M (Marine Air Ground Task Force Command/Control/Communications/Computers & Intelligence MAGTF C4I)
(U) PE This program is in compliance with Tri-Service Reliance Agreements

D. (U) Schedule Profile: Not applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603640M Marine Corps Advanced Technology Demonstrations

PROJECT: C2297

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
C2297 Marine Corps Warfighting Laboratory (MCWL)	26834	27905	36801	38105	38086	38729	39811	40519	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

A. (U) **Mission Description and Budget Item Justification:**

(U) The Marine Corps Warfighting Laboratory (MCWL) is the centerpiece for the operational enhancement of the Marine Corps. Using the Special Purpose Marine Air-Ground Task Force (Experimental) (SPMAGTF(X)) as its "test bed" organization, MCWL demonstrates the usefulness and necessity of integrating new technological developments and advanced concepts into the Fleet Marine Forces. MCWL focuses on developing and field testing future operational and technological concepts to enhance warfighting capability. The organizational thrust is to provide an institutional mechanism for continuously generating new ideas for warfighting capabilities. Concepts of operation "Sea Dragon" are validated by means of various Warfighting Experiments.

(U) Sea Dragon is a process of experimentation which is designed as an ongoing mechanism to insure the relevance of Marine forces in the face of change. Sea Dragon encompasses inquires into multiple technology and warfighting areas, including: C4I; fires; biological, chemical and non-lethal technologies; expeditionary logistics; and advanced training and education techniques.

(U) Using experimental operational forces, beginning with the SPMAGTF(X) as the forward element of a future Naval Expeditionary Force (NEF), the MCWL will conduct a number of Advanced Warfighting Experiments (AWEs) supported by several Limited Objective Experiments (LOEs) and Limited Technology Assessments (LTAs). An AWE is defined as a large scale operational experiment where advanced warfighting concepts and enabling technologies are evaluated to determine the military utility, operational effectiveness, and operational suitability in as realistic an environment as possible. These AWEs will examine an operational concept that envisions a greatly expanded, lethal, fluid, chaotic, and more opportunistic battlefield within a maneuver warfare approach. LOEs are considerably smaller in scope than AWEs and concentrate on specific aspects of an operational concept. These experimental forces will be highly trained, technologically infused, highly lethal, and intellectually prepared to fight in this chaotic and opportunistic environment. LTAs focus on specific technologies and assess their usefulness by means of analysis or experimentation.

(U) Under the guidance of the extended Five Year Experimentation Plan (FYEP), MCWL's current plans include five AWE "build-up" phases culminating in actual AWE execution:

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Development**	PE NUMBER AND TITLE **0603640M Marine Corps Advanced Technology Demonstrations**

1) Hunter Warrior: (March 1996 through April 1997) Experimented with advanced operational concepts and technologies on an extended and dispersed battlefied, in open and mountainous terrain at the mid-intensity operational level.

2) Urban Warrior: (April 1997 through June 1999) Focuses on developing new tactics, techniques, and procedures; and supporting technologies for operations in urban, close terrain, and near urban littoral areas.

3) Capable Warrior: (June 1999 through 2001) Uses lessons learned in Hunter Warrior and Urban Warrior to integrate the full capability of a Marine Air-Ground Task Force (MAGTF) with naval units operating at the numbered fleet level of a Joint Task Force from the sea.

4) Information Warrior (FY 2002 through FY 2003) Builds on Defense Advanced Research Project Agency's (DARPA's) Small Unit Operations (SUO) program and Massachusetts Institute of Technology's (MIT's) program for voice interface with computer databases to explore the impact of assured communications and large scale computer access to tactical employment of forces.

5) Coalition Warrior (FY 2004 through FY 2005) Focuses on the integration of 21st century sea-based technologies into coalition warfare.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 Accomplishments:

- (U) $ 4332 MCWL Operations (Support): Expanded search for, location, development and evaluation of advanced warfighting operational and organizational concepts and enabling technologies for LOEs, LTAs, and AWEs. Continued research planning; model and simulation development; preparation; execution; and analysis and assessment to extend exploration of critical components. Provided for Marine Forces (Atlantic and Pacific) Battle Laboratories to conduct experimentation. Established temporary MCWL sites at Camp Lejeune and Camp Pendleton to facilitate planning and execution of Urban Warrior LOEs, LTEs, and AWE.

- (U) $ 12001 Command, Control, Communications, Computers, and Intelligence (C4I): Purchased, integrated and supported fundamental hardware and software which will be used to support the Integrated Marine Multi-Agent Command and Control System (IMMACCS) Engine and communications backbone allowing situational awareness and the Common Operational Picture (COP) at all levels of the MAGTF. Continued systems engineering and integration efforts and provided technical support for the Enhanced (Experimental) Combat Operations Center (ECOC). Continued two-dimensional (2D) Viewer requirements, which uses rapid decision making in order to facilitate human understanding of operational plans, to support the IMMACCS concept. Continued to expand and enhance the Shared Net and Internet-Node-in-the-Sky (INITS), Unmanned Aerial Vehicle (UAV) transportable communications system, initiatives. Continued investigations into "Clear Thinking" training and pattern recognition. Continued to develop the single integrated air and ground picture and integration of all sensors to enhance fire support and planning. Developed and implemented the Object-Oriented (OO) database required by the IMMACCS using National Imagery and Mapping Agency (NIMA) data as input. Developed and implemented the required ability to allow updates of the OO database with inputs provided by "intelligent agents". Analyzed configuration recommendations, based on modeling and simulation, for the Urban Warrior communication network.
- (U) $ 2472 Drones and Aviation: Continued enhancing the Expendable Drone (Exdrone) UAV to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Began Dragon Drone integration on board a ship in a manner that allows the system to be easily removed at the end of the deployment. Expanded investigations into Hummingbird, suitcase-portable UAV which operates like a helicopter, concepts. Provided mission planning and visualization capabilities, simulation of urban terrain and digital ground-to-air connectivity in support of urban aviation experimentation. Experimented with the impact of providing digital common tactical picture to the individual aircrew by equipping a representative number of systems with a common tactical picture in the cockpit. Supported modifications, integrating, installing, calibrating, and testing the Tactical Airborne Communications Electronic Support (TACES) system onboard the Dragon Drone UAV. Evaluated the utility of using powered parafoils to insert and extract small teams. Conducted "Real Time Targeting", "Reachback", and "Network-Centric" experiments which provided on-call real-time targeting and situational awareness imagery and text to airborne Fighter and Attack (F/A-18s) aircraft via the Walleye AWW-13 datalink pod.
- (U) $ 3206 Fires and Targeting: Expanded development of the Dragon Fire Mortar System experimental prototype. Continued development of a laser rangefinder targeting system which will provide ground forces with accurate target acquisition. Explored the means for small units to designate and illuminate targets for engagements by direct fire and indirect fire assets against sniper target. Expanded investigations for urban direct fire technologies for remote delivered munitions and identified means to conduct urban breaching for the exterior of structures. Provided a means to conduct virtual close air support through digital data links between controllers and pilots. Provided a means for small units to send and receive video and still images for battlefield surveillance. Explored means to automate the fires systems for use in the joint environment. Investigated available and emerging digital camera/video surveillance technologies.

• (U) $	2164	Seabasing, Logistics, Combat Service Support (CSS), and Combat in Cities (including Training and Education): Searched for and evaluated emerging commercially available technologies that could significantly improve urban CSS mobility. Searched for, evaluated, and performed seabasing analysis. Participated in an experiment to centralize personnel administration at the group, regiment, major subordinate command, and Marine Expeditionary Unit (MEU) Command Element (CE) level. Investigated the impact of MCWL experimental results on manpower reductions. Supported experimentation with aerosolized foams for reinforcing structures as well as bridging and counter-mobility operations. Continued investigations into Guided Precision Air Delivery System (GPADS)and powered parafoil capabilities. Experimented with electronic/urban markers used in complex terrain to help small units maneuver quickly and safely. Provided the sea-based logistician with a multi-faceted logistics support package which includes alternative power sources, small urban movers, delivery systems for ship-to-shore, mobility/counter-mobility foams, enhanced CSS operations center, cargo tagging/recording/tracking technologies, etc. and analyze efforts. Experimented with Carbine Rifle optics to improve the ability to engage with direct fires. Experimented with counter-sniper technologies focusing on increasing the survivability of Marines operating in the urban environment. Leveraged ongoing work in the Day/Night Small Unit Target Acquisition field, of several advanced technology programs and provided field user evaluation/feedback through experimentation. Integrated clothing and equipment that will enhance Marines' survivability in urban combat. Conducted high visibility experiments using existing training rounds at the Military Operations in Urban Terrain (MOUT) training facility. Provided a training munition that allows for live fire training in existing and upgraded urban warfare training facilities that does no damage to buildings and is relatively safe to use.
• (U) $	2659	Chemical/Biolical (Chem/Bio), Analysis, and Non-Lethals: Continued Reachback Communications Systems (RCS) efforts to link chem/bio scientific and medical experts with the Chem/Bio Incident Response Force (CBIRF). Explored capabilities to quickly and safely treat and evacuate casualties from the urban battlefield, with the smallest possible support load on the maneuver commander. Completed integration of an air sampler-biosensor system on a drone for the remote identification of biological warfare agents. Provided an instrumentation capability that will support MCWL experimentation in the urban environment. Expanded efforts to improve upon the automated data collection system designed and implemented during Hunter Warrior. Provided overall systems engineering and integration support for ongoing experimentation. Began development and demonstration of a liquid dispensing upgrade to the Powered Parafoil UAVs in support of non-lethal experimentation.
(U)Total $	26,834	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced Development	0603640M Marine Corps Advanced Technology Demonstrations	C2297

(U) FY 1999 Planned Program:

- (U) $ 2690 MCWL Operations (Support): Continue searching for, locating, developing and evaluating advanced warfighting operational and organizational concepts and enabling technologies for LOEs, LTAs, and AWEs. Continue research planning; model and simulation development; preparation; execution; and analysis and assessment to extend exploration of critical components. Continue to provide for Marine Forces (Atlantic and Pacific) Battle Laboratories to conduct experimentation.
- (U) $ 9415 C4I: Continue systems engineering, integration and technical support for ECOC and IMMACCS. Continue to build the capability to provide situational awareness to all levels of the MAGTF. Continue INITS, Shared Net, and 2D Viewer development efforts. Continue "Clear Thinking" technology pattern recognition efforts. Continue the integration of single integrated air/ground picture for mission planning and fire support. Provide forward-deployed forces with the real-time access to RCS and CBIRF staffs, experts and the supporting establishment.
- (U) $ 8004 Drones, Aviation, and Sensors: Continue development of the Broad Area Unmanned Retail Resupply Operations (BURRO) (helicopter/UAV capable of carrying heavy loads) by initiating conversion of the commercial manned K-MAX helicopter into an unmanned platform, utilizing dynamic response modeling. Continue enhancing the Exdrone UAV (Dragon Drone) to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Complete Dragon Drone ship integration. Complete "Real Time Targeting", "Reachback", and "Network-Centric" experiments. Investigate the capabilities of Unmanned Ground Vehicles (UGVs) equipped with an unattended sensor suite, including video to improve battlefield situational awareness. Provide the Marine Expeditionary Unit with a complete battlefield sensor capability to improve battlefield situational awareness. Expand investigations/experimentation in aviation technologies and aviation employment in the urban environment. Search for new and emerging technologies.
- (U) $ 1569 Fires and Targeting: Continue development of a Box Mortar System experimental prototype. Continue development of a laser rangefinder which will provide ground forces with accurate target acquisition. Continue development of small unit day/night surveillance target acquisition devices. Continue development of automated fires system. Initiate sensor to weapons links for increased responsiveness to calls for fire. Investigate suppressed combat rifle initiatives.
- (U) $ 1121 Seabasing, Logistics, CSS, and Combat in Cities (including Training and Education): Provide small units and individual Marines with an equipment kit that will enhance maneuver in the urban environment. Continue investigations into GPADS capabilities. Continue experimentation with counter-sniper technologies. Continue integrating clothing and equipment that will enhance Marines' survivability in urban combat. Continue to search for, evaluate, and perform seabasing analysis. Continue to experiment with electronic markers. Continue to provide sea-based logistical support. Continue to leverage ongoing work in the Day/Night Small Unit Target Acquisition field. Evaluate combat service support for emerging and developing weapons as they apply to operational concepts of logistics support and sustainment for various non-standard scenarios. Investigate existing and emerging training enhancements and simulation equipment and devices. Continue to search for and evaluate emerging commercially available technologies that could significantly improve efforts in this area.

- (U) $ 4483 Chemical/Biolical (Chem/Bio), Analysis and Non-Lethals: Continue RCS efforts to link chem/bio scientific and medical experts with the CBIRF. Continue medical investigations. Continue to provide an instrumentation capability that will support MCWL experimentation in the urban environment. Continue efforts to improve upon the automated data collection system. Continue to provide overall systems engineering and integration support for ongoing experimentation. Continue development and demonstration of a liquid dispensing upgrade to the Powered Parafoil UAVs in support of non-lethal experimentation. Seek Non-Lethal technologies which can affect an opponents infrastructure without necessarily destroying it. Investigate the use of Non-Lethal technologies to deter, delay, deny, disrupt, and destroy opponents or their material.
- (U) $ 623 Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

(U)Total $ 27,905

(U) FY 2000 Planned Program:

- (U) $ 4701 MCWL Operations (Support): Continue searching for, locating, developing and evaluating advanced warfighting operational and organizational concepts and enabling technologies for LOEs, LTAs, and AWEs. Continue research planning; model and simulation development; preparation; execution; and analysis and assessment to extend exploration of critical components. Continue to provide for Marine Forces (Atlantic and Pacific) Battle Laboratories to conduct experimentation.
- (U) $ 15422 C4I: Continue systems engineering, integration and technical support for ECOC and IMMACCS. Continue to build the capability to provide situational awareness to all levels of the MAGTF. Continue INITS, Shared Net, and 2D Viewer development efforts. Continue "Clear Thinking" technology pattern recognition efforts. Continue the integration of single integrated air/ground picture for mission planning and fire support. Continue to provide forward-deployed forces with the real-time access to RCS and CBIRF staffs, experts and the supporting establishment.
- (U) $ 5171 Drones, Aviation, and Sensors: Continue enhancing the Dragon Drone UAV to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Complete "Real Time Targeting", "Reachback", and "Network-Centric" experiments. Continue to investigate the capabilities of UGVs equipped with an unattended sensor suite, including video to improve battlefield situational awareness. Continue search for new and emerging technologies.

- (U) $ 2332 Fires and Targeting: Complete development of a Box Mortar System experimental prototype. Continue development of a laser rangefinder which will provide ground forces with accurate target acquisition. Continue development of small unit day/night surveillance target acquisition devices. Provide a means to "tagging" targets so that they can be tracked and attacked later. Continue development of automated fires system. Continue sensor to weapons links for increased responsiveness to calls for fire. Continue to investigate emerging fires and targeting technologies.
- (U) $ 1763 Seabasing, Logistics, CSS, and Combat in Cities (including Training and Education): Provide small units and individual Marines with an equipment kit that will enhance maneuverability. Continue investigations into GPADS and powered parafoil capabilities. Continue experimentation with counter-sniper technologies. Continue integrating clothing and equipment that will enhance Marines' survivability. Continue to search for, evaluate, and perform seabasing analysis. Continue to experiment with electronic markers. Continue to provide sea-based logistical support. Continue to leverage ongoing work in the Day/Night Small Unit Target Acquisition field. Continue to evaluate combat service support for emerging and developing weapons as they apply to operational concepts of logistics support and sustainment for various non-standard scenarios. Continue to investigate existing and emerging training enhancements and simulation equipment and devices. Continue to search for and evaluated emerging commercially available technologies that could significantly improve efforts in this area.
- (U) $ 7412 Chemical/Biolical (Chem/Bio), Analysis, and Non-Lethals: Continue RCS efforts to link chem/bio scientific and medical experts with the CBIRF. Continue medical investigations. Continue to provide an instrumentation capability that will support MCWL experimentation in the urban environment. Continue efforts to improve upon the automated data collection system. Continue to provide overall systems engineering and integration support for ongoing experimentation. Continue development and demonstration of a liquid dispensing upgrade to the Powered Parafoil UAVs in support of non-lethal experimentation. Continue to seek Non-Lethal technologies which can affect an opponents infrastructure without necessarily destroying it. Continue to investigate the use of Non-Lethal technologies to deter, delay, deny, disrupt, and destroy opponents or their material.

(U)Total $ 36,801

B. (U) Project Change Summary

	FY 1998	FY 1999	FY 2000
(U) Previous President's Budget	36388	23584	23985
(U) Adjustments to Previous President's Budget	-9554	+4321	+12816
(U) Current Budget Submit	26834	27905	36801

(U) Change Summary Explanation:

	DATE **February 1999**
BUDGET ACTIVITY **3 - Advanced Development**	PE NUMBER AND TITLE **0603640M Marine Corps Advanced Technology Demonstrations**

(U) Funding: FY 1998: Transfer of the Extended Littoral Battlespace (ELB) program to project C2362 within this PE, SBIR tax, and economic and general reductions.
FY 1999: Increase due to Congressional Plus-up of $5M in support of the Broad Area Unmanned Retail Resupply Operations (BURRO) project and various undistributed adjustments.
FY 2000: Reflects increase in Department priorities and revised economic and general adjustments.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) **Other Program Funding Summary (APPN, BLI #, NOMEN)**	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost

(U) Not applicable

(U) Related RDT&E:
(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations), Project C2223, Advanced Technology Demonstrations
(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations), Project C2362, Extended Littoral Battlespace, Advanced Concept Technology Demonstration
(U) PE 0305204M (Marine Corps Tactical UAV), Project C2672, Marine Corps Close range Tactical UAV (Dragon Warrior)

D. (U) Schedule Profile: Not applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1999

BUDGET ACTIVITY: 3 - Advanced Development

PE NUMBER AND TITLE: 0603640M Marine Corps Advanced Technology Demonstrations

PROJECT: C2362

COST *(In Thousands)*	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
C2362 Extended Littoral Battlespace (ELB), Advanced Concept Technology Demonstration (ACTD)	9300	9804	9651	9612	956	953	0	0	0	45276
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

A. (U) **Mission Description and Budget Item Justification:**

(U) Concept of Operations for the Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) responds to the top level military need to rapidly deploy a Naval Expeditionary Task Force with an embarked Marine Air Ground Task Force (MAGTF) as part of a larger Joint Task Force to any region of the world's littorals and conduct military operations from a sea base across the spectrum of conflict to implement national military strategy. Forces employed ashore will be light, agile, distributed and disaggregated and capable of optimizing remote fires, to effectively deter aggression, halt attacks and secure critical areas as a precursor to a much larger force. Forces will be empowered by unprecedented situation understanding via a robust information infrastructure that is fully coupled to a decision/planning/execution system on a shared battlespace network (sea/land). The objective of the ACTD is to demonstrate an enhanced integrated command and control/fires and targeting capability to enable rapid employment, maneuver, and fires to support joint dispersed units operating in an extended littoral battlespace. Two Major System Demonstrations (MSDs) are planned for FY 1999 and FY 2001. The ELB ACTD was approved by DUSD(AT) on 16 January 1997.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603640M Marine Corps Advanced Technology Demonstrations PROJECT C2362

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 Accomplishments:

• (U) $	560	Completed baseline Command, Control, Communications, Computers, Intelligence, Surveillance & Reconnaissance (C4ISR) system design in sufficient time to develop modeling and simulation, verification and validation, integration and evaluation/assessment criteria to meet FY 1999 demonstration schedule. Initial design will allow for message-based and limited database and object interoperability between emerging technology and legacy systems, provide a common tactical picture for collaborative decision making, and accommodate technology advancements in command and control all within a framework of a tailorable/scaleable Enhanced Combat Operations Center (ECOC).
• (U) $	2407	Conducted enabling technologies efforts to select, incorporate and integrate commercial state-of-the-shelf technologies in areas of communications, combat operations center, sensor integration, and fires and targeting into the initial demonstration. Enabling technologies include command and control collaborative planning tools, visualization enhancement for battlefield assessment, and communications enhancement for an IP-based battlenet.
• (U) $	2992	Initiated planning for conducting Integrated Feasibility Demonstrations (IFDs) to provide an early operational assessment and to collect data relative to technologies/systems for purpose of defining technical risks and refinement of hardware/software design configurations. Showed technical feasibility of beyond line-of-sight communications using airborne relay and commercial wireless LAN.
• (U) $	1423	Selected, purchased, and installed initial set of system and subsystem hardware, software, for FY 1999 demonstration. Initial buy of hardware/software has been installed at various testbed sites to accommodate training, early testing and validation, as well as the distributed C4ISR system for MSD I in FY 1999.
• (U) $	1918	Initiated system interface and integration of commercial off-the-shelf and legacy systems and subsystem components supporting the ECOC and command center variants; performed initial system integration tests at systems integration laboratory and major distributed command center nodes.
(U)Total $	9,300	

(U) FY 1999 Planned Program:

• (U) $	6058	Continue pre-demonstration activities to include system installation, integration, test, software verification and validation, ship installation, operator training, system scenario tests and dry runs. Complete the integration of selected enabling technologies into the C4ISR system. The C4ISR system will be deployed on ELB testbeds and integrated with other distributed command center nodes, integrated feasibility demonstrations will be performed, and demonstration training will commence along with final preparations for MSD I.
• (U) $	1272	Conduct a demonstration of C4ISR system architecture in a realistic combat scenario utilizing operational forces from the Fleet and the Fleet Marine Force. Demonstration will provide the means for operators and developers to evaluate the operational utility, technological feasibility, and life cycle implications of new technologies.
• (U) $	1442	Initiate demonstration/post demonstration analysis for evaluating the system concept and assessing its military utility.
• (U) $	310	Initiate planning for MSD II.
• (U) $	500	Initiate planning for transition sets of MSD I technology to appropriate users for military utility assessment.
• (U) $	242	Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.
(U)Total $	9,804	

(U) FY 2000 Planned Program:

• (U) $	900	Continue planning and augment/scope the C4ISR system design for MSD II in FY 2001 based on results of MSD I in sufficient time to develop necessary interface/integration of hardware and software, verification and validation, and assessment criteria.
• (U) $	2861	Conduct enabling technologies efforts to incorporate and integrate newly emerging commercial state-of-the-shelf technologies in areas of communications, combat operations center, sensor integration, and fires and targeting into the second demonstration. Provide full database and object interoperability between emerging and legacy systems.
• (U) $	2820	Initiate selection, purchase, and installation of "next generation" mature commercial off-the-shelf system and subsystem components for the FY 2001 demonstration.
• (U) $	2000	Plan and conduct integrated feasibility demonstrations to provide an operational assessment and to collect data relative to technologies/systems for purposes of defining technical risks and refinement of hardware/software design configurations.
• (U) $	570	Conduct engineering, technical and operational assessments to define system demonstration scenarios.
• (U) $	500	Complete the demonstration/post demonstration analysis. Determine, provide, and support transition sets of MSD I technology to appropriate users for further military utility assessment.
(U)Total $	9,651	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
BUDGET ACTIVITY 3 - Advanced Development	PE NUMBER AND TITLE 0603640M Marine Corps Advanced Technology Demonstrations
	PROJECT C2362

B. (U) Project Change Summary

	FY 1998	FY 1999	FY 2000
(U) Previous President's Budget	0	9,827	9,790
(U) Adjustments to Previous President's Budget	+9300	-23	-139
(U) Current Budget Submit	9,300	9,804	9,651

(U) Change Summary Explanation:

(U) Funding: FY 1998 adjustment is due to the transfer of the ELB program to this project from project C2297, SBIR tax, and economic and general reductions. FY1999 and FY2000 adjustments are due to revised economic assumption and general adjustments.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) Other Program Funding Summary (APPN, BLI #, NOMEN)

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Compl	Total Cost
(U) Not Applicable										

(U) Related RDT&E

(U) PE 0603238N (Precision Strike and Air Defense Advanced Technology)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
(U) PE 0603750D (Advanced Concept Technology Demonstrations)
(U) PE 0603217N (Air Systems and Weapons Advanced Technology)

D. (U) Schedule Profile: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in Thousands

PROJECT NUMBER & ACTUAL	FY 1998 ACTUAL	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
R0095 Fleet Health Technology	9,387	11,199	9,605	10,368	10,539	10,732	13,797	14,841	CONT.	CONT.
R0096 Fleet Health Standards	4,757	5,420	5,459	5,561	5,653	5,757	5,880	6,006	CONT.	CONT.
R2332 Mobile Medical Device	1,902	2,000	0	0	0	0	0	0	0	9,668
R2333 Rural Health	2,931	2,993	0	0	0	0	0	0	0	12,542
R2334 Bone Marrow	32,164	33,922	0	0	0	0	0	0	0	79,147
R2336 Freeze Dried Blood	1,416	848	0	0	0	0	0	0	0	4,598
R2375 Dental Research	0	2,993	0	0	0	0	0	0	0	2,993
R2376 Natural Gas Cooling/Desiccant Demo	2,362	0	0	0	0	0	0	0	0	2,362
R2377 National Biodynamics Lab	2,453	1,796	0	0	0	0	0	0	0	9,782
R2491 Naval Blood Research Lab	0	1,497	0	0	0	0	0	0	0	1,497

PROJECT NUMBER & ACTUAL	FY 1998 ACTUAL	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
R2492 Med Read Telemedicine	0	2,993	0	0	0	0	0	0	0	2,993
R2493 Directly Transfusable Blood										

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

	0	848	0	0	0	0	0	0	0	848
R2494 Center for Disaster Management										
	0	998	0	0	0	0	0	0	0	998
R2495 Telemedicine										
	0	998	0	0	0	0	0	0	0	998
TOTAL	57,372	68,505	15,064	15,929	16,192	16,489	19,677	20,847	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Navy Medical Department's mission includes providing medical care and treatment to Navy and Marine Corps personnel in operational theaters. Goals include increasing return-to-duty rates of troops injured in combat, enhancing personnel performance in demanding Fleet jobs (and the selection of candidates for these jobs), reducing operationally related morbidity and mortality, and ensuring the physical readiness and safety of deployed personnel. This program element supports Joint Support Areas including Readiness, Support & Infrastructure, and Manpower, Personnel & Shore Training. Specific task areas include medical care and life-saving therapies for shipboard and battlefield casualties, blood and stem cell products and substitutes, treatments for wounds and multiple organ system failure, methods for managing injuries related to extreme thermal environments, and new capabilities in field diagnostics and medical/dental support. This program element also provides validated techniques for the selection of personnel based on medical criteria and standards and procedures which will protect Fleet personnel during exposure to Navy and Marine Corps operational environments. The impact of this program element includes improved medical logistics, safety, Service-wide standards and technologies. This program element also has supported the Navy's effort to register and match donors and complete bone marrow transplants.

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

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

(U) PROGRAM CHANGE FOR TOTAL P.E.:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	68,151	18,728	15,865

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) Appropriated Value:	-	68,728	-
(U) Adjustments from the FY 1999 PRESBUDG:	-10,779	+49,777	-801
(U) FY 2000 President's Budget Submission:	57,372	68,505	15,064

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 decrease is due to the Actual Update adjustment (-2,380), Small Business Innovative Research (-1,121) and transfer to Army of Biocide and Dental Congressional Plus-Ups (-7,278). The FY 1999 increase is due to Congressional Add for Telemedicine (+1,000), National Biodynamic Laboratory (+1,800), Rural Health (+3,000), Bone Marrow Donor (+34,000), Freeze Dried Blood (+850), Dental Research (+3,000), Navy Blood Research (+1,500), Medical Readiness Telemedicine (+3,000), Directly Transfusible (+850), Center for Disaster Management (+1,000), Revised Economic Assumption (-157) and minor adjustment (-66). The FY 2000 decrease is due to program adjustment (-583) and Non Pay Inflation adjustment (-218).

(U) Schedule: Not applicable

(U) Technical: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT NUMBER & ACTUAL	FY 1998 ACTUAL	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
R0095 Fleet Health Technology	9,387	11,199	9,605	10,368	10,539	10,732	13,797	14,841	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Encompasses critical endeavors designed to enhance fleet health care, augment field treatment capabilities, and improve medical logistics necessary for support of Naval and Marine Corps forces and combat casualties. Ongoing projects focus on key biomedical and casualty-relevant areas including: (1) casualty stabilization and far-forward echelon critical care; (2) blood products, blood substitutes, and hematopoietic stem cells; (3) combat wounds and multiple organ system failure; (4) fleet health in extreme environments; and (5) field diagnostics and medical/dental support capabilities.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($2,200) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continued studies that validate the efficacy of life sustainment and stabilization interventions. Continued testing potential modalities that impact metabolic down-regulation and delayed resuscitation. Continued studies in large animal models into the medical complications of hemorrhagic shock and its late sequelae. Initiated studies to develop hemostatic agents/devices in formulations for easy delivery to wounds in the combat environment.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0095 PROJECT TITLE: Fleet Health Technology

- (U) ($2,100) BLOOD AND BLOOD SUBSTITUTES: Continued clinical trials and modifications for final Food and Drug Administration (FDA) approval for technologies that extend the refrigerated liquid storage time for red blood cell transfusion units. Completed the enzymatic conversion of red blood cells to universal O. Completed the refinement of A to O conversion and transition Phase II/III clinical trials. Completed the development of Rh positive to Rh negative conversions. Completed studies to develop a one-step red blood cell freezing technology that permits immediate post-thaw transfusion without the necessity of pre-transfusion washing. Continued development of freeze-dried red blood cell units having a minimum of a two-year room temperature shelf-life and ease of use with immediate transfusion post-rehydration. Continued the development of improved frozen and freeze-dried platelet products with enhanced storage capabilities, Initiated clinical trials for freeze-dried platelets. Completed the development of liposome encapsulated hemoglobin as an oxygen carrying blood substitute.

- (U) ($1,700) MODULATION OF IMMUNE SYSTEM IN COMBAT CASUALTIES: Continued the studies and development of advanced modulation techniques for cytokines and immune cell functions that impact the cellular and physiological responses of combat casualties. Continued large animal studies to demonstrate the efficacy of cytokines in preventing complications from combat relevant trauma and hemorrhage. Continued study to enhance transplant acceptance by modulation of the immune response.

- (U) ($1,487) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Completed testing formulation of vasopressin regimen in clinical trials for submission to the FDA for licensure. Completed studies to reduce or prevent cold related injuries for combat personnel, particularly related to non-freezing cold related injuries in the extremities. Continued studies to modify physical training programs to reduce training related injuries in female recruits. Continued to study the value of intervention techniques which preclude high risk individuals from becoming victims of musculoskeletal trauma.

- (U) ($1,200) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continued to interface selected medical databases for advanced medical support planning and casualty management. Continued validation of the relationships of these databases and ensure their effectiveness in military environments. Continued to develop models for projecting casualty rates for various battle scenarios and war fighting intensities upgrading systems to current war fighting and enemy systems information. Continued to investigate and model casualty flows between echelons of care and developed planning factors needed to forecast medical requirements at these echelons and project necessary evacuation assets incorporating terrain features into optimization models based on changing warfighting scenarios and medical support capabilities.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0095 PROJECT TITLE: Fleet Health Technology

- (U) ($700) NAVY DENTAL EMERGENCIES: Completed efforts encompassing the systematic investigation of problems related to the oral health, wellness, disease, and injuries of Navy and Marine Corps personnel that may adversely impact deployment and dental emergencies requiring evacuation from remote Navy platforms. Completed development of multimedia diagnostic systems for corpsmen and maintained advanced information through system updates, continued risk assessment strategies and programs.

2. (U) FY 1999 PLAN:

- (U) ($2,800) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continue studies that validate the feasibility and efficacy of life sustainment and casualty stabilization interventions. Continue testing modalities that impact metabolic down-regulation and delayed resuscitation. Continue studies into the complications of hemorrhagic shock and late sequelae that may be prevented with early immune modulator or other interventions. Continue to extend studies in large animal models. Continue development of improved local hemostatic agents/devices. Initiate studies of traumatic injury to the central nervous system.

- (U) ($3,500) BLOOD AND BLOOD SUBSTITUTES: Continue clinical trials and modifications for final FDA approval for technologies that extend the refrigerated liquid storage time for red blood cell transfusion units. Continue development of freeze-dried red blood cell units having a minimum of a two-year room temperature shelf-life and ease of use with immediate transfusion post-rehydration. Continue the development of improved frozen and freeze dried platelet products with enhanced storage capabilities. Continue clinical trials for freeze-dried platelets. Initiate studies to develop freeze-dried plasma.

- (U) ($1,900) MODULATION OF IMMUNE SYSTEM IN COMBAT CASUALTIES: Continue the studies and development of advanced modulation techniques for cytokines and immune cell functions that impact the cellular and physiological responses of combat casualties. Continue large animal studies to demonstrate the efficacy of cytokines in preventing complications from combat relevant trauma and hemorrhage. Continue study to enhance transplant acceptance by modulation of the immune response.

- (U) ($1,498) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Complete study to modify physical training programs to reduce training related injuries in female recruits. Complete study to access the value of intervention techniques which preclude high risk individuals from musculoskeletal trauma. Initiate study to evaluate dietary interventions to reduce loss of bone mineral density in physically active females.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0095 PROJECT TITLE: Fleet Health Technology

- (U) ($1,399) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continue interface for selected medical databases for advanced medical support planning and casualty management. Continue validation of the relationships of these databases and ensure their effectiveness in military environments. Continue to develop models for projecting casualty rates for various battle scenarios and war fighting intensities, upgrading systems to current war fighting and enemy systems information. Complete model of casualty flows between echelons of care and develop planning factors needed to forecast medical requirements at these echelons and project necessary evacuation assets incorporating terrain features into optimization models based on changing warfighting scenarios and medical support capabilities.

- (U) ($102) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($2,400) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continue studies that validate the feasibility and efficacy of life sustainment and casualty stabilization interventions. Continue testing modalities that impact metabolic down-regulation and delayed resuscitation. Continue studies into the complications of hemorrhagic shock and late sequelae that may be prevented with early immune modulator or other interventions. Continue to extend studies in large animal models. Continue development of improved local hemostatic agents/devices. Continue studies of traumatic injury to the central nervous system.

- (U) ($3,500) BLOOD AND BLOOD SUBSTITUTES: Continue clinical trials and modifications for final FDA approval for technologies that extend the refrigerated liquid storage time for red blood cell transfusion units. Continue development of freeze-dried red blood cell units having a minimum of a two-year room temperature shelf-life and ease of use with immediate transfusion post-rehydration. Continue the development of improved frozen and freeze dried platelet products with enhanced storage capabilities. Continue clinical trials for freeze-dried platelets. Continue studies on the development of freeze-dried plasma.

- (U) ($1,800) MODULATION OF IMMUNE SYSTEM IN COMBAT CASUALTIES: Continue the studies and development of advanced modulation techniques for cytokines and immune cell functions that impact the cellular and physiological responses of combat casualties. Continue large animal studies to demonstrate the efficacy of cytokines in preventing complications from combat relevant trauma and hemorrhage. Complete study to enhance transplant acceptance by modulation of the immune response.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROJECT NUMBER: R0095
PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT TITLE: Fleet Health Technology

- (U) ($800) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Initiate studies to develop predictors and preventive interventions for traumatic and exercise related injuries among shipboard personnel during deployment. Initiate studies to establish performance standards and training guidelines for Military Operations in Urban Terrain (MOUT), which optimize performance and minimize musculoskeletal injury. Continue study to evaluate dietary interventions to reduce loss of bone mineral density in physically active females.

- (U) ($1,105) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continue interface for selected medical databases for advanced medical support planning and casualty management. Continue validation of the relationships of these databases and ensure their effectiveness in military environments. Continue to develop models for projecting casualty rates for various battle scenarios and war fighting intensities, upgrading systems to current war fighting and enemy systems information.

B. (U) PROGRAM CHANGE SUMMARY: See total program summary for P.E.

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0604771N (Medical Development (ENG))
(U) This program is coordinated through the Armed Services Biomedical Research Evaluation and Management Committee.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in thousands)

PROJECT NUMBER & ACTUAL	FY 1998 ACTUAL	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
R0096 Fleet Health Standards	4,757	5,420	5,459	5,561	5,653	5,757	5,880	6,006	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Develops valid medical standards for selection, training, and retention, reduces attrition and injury, and enhances personnel performance in Navy operational environments.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($600) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Continued development of programs to enhance the safety of Navy divers/submariners. Identified areas of the brain associated with high pressure oxygen seizures to help develop prevention drugs. A biochemical decompression technology developed to accelerate decompression. Pharmacological agents identified to reduce incidence of decompression sickness.

- (U) ($500) DELIVER GUIDELINES: Provided recommendations for use of biomedical countermeasures to counteract performance decrements associated with sustained operations. Exploited current technology for evaluation of stimulant effects, susceptibility to sleep loss, and fatigue-related impairment. Fielded guidance for use of specific pharmacological agents during SUSOPS.

- (U) ($550) MEDICAL STANDARDS FOR SELECTION: Fielded an integrated, updated database of medical conditions associated with, or precluding, service.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0096 PROJECT TITLE: Fleet Health Standards

- (U) ($700) ENHANCED HUMAN PERFORMANCE: Fielded a model of the physical and perceptual stress of shipboard firefighting. Provided guidance for use of existing Physiological Heat Exposure Limits (PHEL) for women, including use of ice vests for microclimate cooling. Continued investigation of operational impact of photorefractive keratectomy (PRK). Initiated development of occupational physical standards for sustained operations. Initiated study concerning reduction of neck and back injuries in Naval aviators.

- (U) ($600) AVIATION/SPATIAL DISORIENTATION ATTRITION AND INJURY REDUCTION: Continued program in identification and prevention of aircraft mishaps due to spatial disorientation, human performance and human factors problems.

- (U) ($200) REDUCE ATTRITION AND INJURY RELATED TO HAZARDOUS MATERIALS: Initiated development of air sampling device utilizing state-of-art sensor technology to better evaluate shipboard hazardous chemical exposures.

- (U) ($550) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY: Continued development of Neuromolecular Toxicity Assessment System (NTAS) a molecular-level set of tests that can assess possible performance deficits caused by exposure to hazardous chemicals.

- (U) ($400) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY/SHIPBOARD FIRES: Initiated testing, evaluation, and refinement of physiologically-based pharmacokinetic and pharmacodynamic models of shipboard exposures to cleaning solvents. Completed toxicological evaluation of chemicals associated with Navy workplace to develop exposure standards. Developed a prototype Shipboard Industrial Hygiene Expert System to assist with health hazard evaluations; transitioned to field validation testing. Identified important toxicants involved with acute respiratory distress from shipboard fires.

- (U) ($200) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY: Delivered guidelines for health promotion and physical readiness of active duty personnel.

- (U) ($457) RADIO FREQUENCY (RF) RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Continued development of a computational dosimetry model for RF radiation exposures. Completed data on ocular effects of pulsed microwaves for development of exposure standards. Initiated testing and evaluation of chronic health effects of RF-induced body and limb currents from topside shipboard exposures; utilized results to develop exposure standards and guidelines.

2. (U) FY 1999 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0096 PROJECT TITLE: Fleet Health Standards

- (U) ($852) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Continue development of programs to deliver products that enhance the safety and effectiveness of Navy divers/submariners and extend the operational envelope by permitting extended use of hyberbaric oxygen, faster decompression procedures, longer bottom time, and submersed rescue operations.

- (U) ($450) DELIVER GUIDELINES: Continue to provide recommendations for use of biomedical countermeasures to counteract performance decrements associated with sustained operations. Continue to exploit current technology for evaluation of stimulant effects, susceptibility to sleep loss, and fatigue-related impairment. Complete guidance for use of specific pharmacological agents during SUSOPS.

- (U) ($581) MEDICAL STANDARDS FOR SELECTION: Continue to field an integrated updated database of medical conditions associated with, or precluding, service. Begin validation.

- (U) ($600) ENHANCED HUMAN PERFORMANCE: Continue to field a model of the physical and perceptual stress of shipboard firefighting. Complete guidance for use of existing PHEL for women, including use of ice vests for microclimate cooling. Continue investigation of operational impact of PRK. Continue development of occupational physical standards for sustained operations. Continue study concerning reduction of neck and back injuries in Naval aviators.

- (U) ($600) AVIATION/SPATIAL DISORIENTATION ATTRITION AND INJURY REDUCTION: Continue program in identification and prevention of aircraft mishaps due to spatial disorientation, human performance and human factors problems.

- (U) ($329) REDUCE ATTRITION AND INJURY RELATED TO HAZARDOUS MATERIALS: Continue development of air sampling device utilizing state-of-art sensor technology to better evaluate shipboard hazardous chemical exposures.

- (U) ($580) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY: Identify mechanisms of action for select neurotoxicants; utilize the results to develop the Neuromolecular Toxicity Assessment System (NTAS), a molecular-level set of tests that can assess possible performance deficits caused by exposure to hazardous materials. Upon completion of final validation studies, transition Neuromolecular Toxicity Assessment Battery (NTAB) to toxicology laboratories for testing of navy materials as part of the Health Hazard Evaluation program.

- (U) ($523) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY/SHIPBOARD FIRES: Develop capability to measure particle-vapor interactions of smoke and measure their effects upon pulmonary function. Initiate development of

biomakers (enzymes and cytokines) that can be used to identify the onset of acute respiratory distress syndrome (ARDS).

- (U) ($300) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY: Complete evaluation of current health and physical readiness level of Navy personnel.

- (U) ($598) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Complete computational dosimetry model of RF-induced current. Test and evaluate mock-up shipboard topside to evaluate RF-induced body and limb currents; utilize results to develop criteria for exposure standards and guidelines.

- (U) ($7) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($821) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Continue development of programs to deliver products that enhance the safety of Navy divers/submariners and extend the operational envelope by permitting extended use of hyberbaric oxygen, faster decompression procedures, longer bottom time, and submersed rescue operations.

- (U) ($450) DELIVER GUIDELINES: Provide recommendations for use of biomedical countermeasures to counteract performance decrements associated with military operations. Complete studies on evaluation of stimulate effect and provide guidance. Continue to exploit current technology for evaluation of methodologies to improve impaired operational performance due to stress and fatigue. Initiate development of measurement tests for assessment of performance of Navy/Marine Corps personnel in operational environments.

- (U) ($590) MEDICAL STANDARDS FOR SELECTION: Continue to field an integrated updated database of medical conditions associated with, or precluding, service. Continue validation.

- (U) ($600) ENHANCED HUMAN PERFORMANCE: Continue to field a model of the physical and perceptual stress of shipboard firefighting. Continue investigation of operational impact of PRK. Continue development of occupational physical standards for sustained operations. Continue study concerning reduction of neck and back injuries in Naval aviators.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT NUMBER: R0096 PROJECT TITLE: Fleet Health Standards

- (U) ($600) AVIATION/SPATIAL DISORIENTATION ATTRITION AND INJURY REDUCTION: Continue program in identification and prevention of aircraft mishaps due to spatial disorientation, human performance and human factors problems.

- (U) ($487) REDUCE ATTRITION AND INJURY RELATED TO HAZARDOUS MATERIALS: Continue development of air sampling devices utilizing state-of-art detector technology to better evaluate hazardous chemical exposures aboard ship and in the field and work environments.

- (U) ($680) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY: Perform application testing of military-relevant chemicals utilizing the NTAS, a molecular-level set of tests that can assess possible performance deficits caused by exposure to hazardous materials; initiate development of a clinical set of tests based on the NTAS that can be used eventually for medical surveillance examinations of exposed personnel.

- (U) ($615) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY/SHIPBOARD FIRES: Develop real-time measures of acute response and hypersensitivity, and other measures of permanent damage, from certain smoke and fire gases and incorporate them into experimental models. Develop predictive models of aerosol lung deposition and clearance, carboxyhemoglobin formation (biomarker), and changes in lung ventilation.

- (U) ($616) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Compare and validate mockup exposures and models to RF-induced currents against actual shipboard exposures. Evaluate chronic health effects of RF-induced body and limb currents from topside shipboard exposures.

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

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

(U) RELATED RDT&E:
(U) PE 0601152N (In-House Laboratory Independent Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0604771N (Medical Development (ENG)

D. U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R0542 Human Factors Engineering (HFE)	2,983	3,171	3,294	3,392	3,482	3,579	3,666	3,756	CONT.	CONT.
R1770 Manpower and Personnel Development	3,037	4,156	4,210	4,290	4,361	4,441	4,536	4,633	CONT.	CONT.
R1772 Training Systems Development	8,896	13,651	13,128	13,514	13,716	13,948	14,254	14,571	CONT.	CONT.
R2378 Virtual Reality Environment/Training Research	3,529	0	0	0	0	0	0	0	0	3,529
R2379 Center for Integrated Manufacturing Studies	1,895	998	0	0	0	0	0	0	0	2,893
R2496 Advanced Distributed Learning	0	4,490	0	0	0	0	0	0	0	4,490
TOTAL	20,340	26,466	20,632	21,196	21,559	21,968	22,456	22,960	CONT.	CONT.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element supports the Joint Support Areas for Manpower & Personnel, Training, and Readiness, Support & Infrastructure; it also supports the Joint Mission Area assessments for most warfare areas, and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. It develops technologies that enable the Navy to select, assign and manage its people; to train effectively and affordably in classroom settings, in simulated environments and while deployed; and to operate and maintain complex weapon systems. It consists of the following technologies:

1. (U) HFE: These projects develop information management techniques, advanced interface technologies, and Decision Support System, all of which help ensure that complex systems will be operated and maintained more effectively, with fewer human-induced errors, and with greater safety.

2. (U) Manpower and Personnel: This project provides Navy personnel system managers with the ability to choose and retain the right people and to place them in jobs that best use their skills, training, and experience. Fleet readiness can be enhanced and personnel costs reduced via such technologies as modeling, mathematical optimization, advanced testing, statistical forecasting, and human performance measurement.

3. (U) Training Systems: This project improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. The project develops and

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

evaluates systems to improve basic through advanced individual and team training, skill maintenance, and mission rehearsal capability. It improves training efficiency and cost-effectiveness by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.

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

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

(U) PROGRAM CHANGE FOR TOTAL PE:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	21,834	21,042	20,814
(U) Appropriated Value:	-	26,542	-
(U) Adjustments from FY 1999 PRESBUDG:	-1,494	+5,424	-182
(U) FY 2000 OSD/OMB Submission	20,340	26,466	20,632

(U) Funding: The FY 1998 decrease is due to Actual Update adjustment (-1,162) and Small Business Innovative Research (-332). The FY 1999 increase is due to Revised Economic Assumption (-61), Civilian Personnel Underexecution (-15) and Congressional Add for Advanced Distributed Learning (+4,500) and Integrated Manufacturing (+1,000). The FY 2000 decrease is due to Civilian Pay Rate (+31), Navy Working Capital Fund (+86) and Non Pay Inflation (-299).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	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
R0542 Human Factors Engineering (HFE)	2,983	3,171	3,294	3,392	3,482	3,579	3,666	3,756	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The goal of this project is to improve platform, task force and battle group operations by developing human factors technology for incorporation into operational systems and training programs. General objectives of the project are to enhance human performance effectiveness, reduce design-induced critical human performance errors, and accelerate insertion of advanced HFE technology into existing and new weapons systems. Outcomes from this technology reduce operational errors, provide a better match between personnel and skill/knowledge requirements, and reduce training requirements. The project emphasizes human-centered design and has tasks that address: integration and display of operator-oriented navigation/targeting information; adaptive automation in support of human operators; three dimensional (3-D) visualization of command and control information; modeling and simulation (MST) tools for design and evaluation of ship manning; human computer interface requirements in workstation design; collaborative support technologies for distributed planning and analysis; advanced sonar operator perception techniques; command and control warfare analysis aids, advanced data fusion and presentation techniques; decision support for joint and coalition Command, Control, Communication, Computers & Intelligence systems; multi-modal sonar workstation design; advanced alerting techniques; and intelligent integration of doctrine and display technology.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- ($412) Initiations:
  - (U) Modeling and Simulation Tools (MST) to Support The Design For Human Performance In Early Phases Of Ship Acquisition - This addressed the lack of a formal, validated technique for identifying, analyzing, and integrating human performance requirements sufficiently early in the ship design process in order to address

human impacts. Initiated integration of a set of validated MST tools to ensure manning and human performance requirements are adequately addressed early in the design process resulting in more effective ship designs.

- ($455) Continuations:
  - (U) Combat Enhancement through Integrated Decision Support (CEIDS) - Developed a functional specification for a Decision Support System (DSS) for the Joint Operations Center on the COMTHIRDFLT flagship to support the decision making requirements of the Battle Watch Captain. Interview and observational data were collected during operational exercises and analyzed. Unique DSS functional specifications were developed and several modifications were embedded into the Tactical Decision support System for evaluation. Work continued on the development of a detailed functional specification of the DSS-2 for use by system engineers in developing a functional, integrated prototype. Work also continued on the knowledge engineering tasks aboard the USS Coronado.

- ($393) Continuations:
  - (U) Open Systems Advanced Workstation (OSAW) - Developed IT-21 compliant ergonomic workstation supporting multi-modal user control and input. The workstation includes high-resolution flat panel displays integrated with touch screens, speech recognition and synthesis system, and 3D sound localization system. Developed multi-modal user interface for the Enhanced Common Operational Picture application. Performed the research on the usage of a multiple display workstation with an emphasis on supervision and multi-tasking environments.

- ($527) Completions:
  - (U) Image-Based Navigation (IBN) - Conducted a flight technology demonstration of on-board perspective view images with overlays for targeting and tactical decision making in a precision strike close air support mission environment. Successfully completed efforts to determine how to store "still images" in the data page section of an Aircraft Optical Disk for use as auxiliary target recognition aids during flight test. Flight test results were documented in a final report as well as specific recommendations as to the pilot-interface design best suited for image-based navigation.

- ($1,196) Completions:
  - (U) Collaborative Tools for Command Center Staff (COLLAB) - A collaborative software program was delivered to the CINCLANTFLT Action Officers who develop the Mission Needs Statements (MNS) and Operational Requirements Documents (ORD) for the entire Navy. The tools in the program give the Officers improved information access on approved MNS and ORD documents from OPNAV and the personal contacts and documents Officers use in their review of documents. Because of the database structure and archival information availability, use of this new program will result in more thoroughly researched MNS and ORDs that are actually processed in a shorter time frame. The application is in integration testing for operational use on the SIPRNET. The access to the

collaborative application on the SIPRNET will provide expanded participation in the MNS/ORD development process. At the conclusion of the project, the program will become a permanent part of the MNS & ORDs processing system.

- (U) Command and Control Warfare Commander (C2WC) - Developed a new architecture for the information warfare (IW)/C2WC to allow him to pull IW data from various Intel and Joint Maritime Command Information System databases as well as solutions from various specialized stovepipe analysis tools into his own working database. Continued to develop further components required for that data to be integrated with data, analyses, and recommended responses developed by the IW Officer and his team. When completed our prototype will provide a proof of concept demonstration of an integrative decision aid and associated architecture that allows the IW Officer and various collaborators to perform IW planning, efficiently generating various required products and outputs to be further integrated into comprehensive Combined Joint Task Force mission plans. The Joint IW Officer of Second Fleet will evaluate the prototype.
- (U) Advanced Acoustic Detection (AAD) - A report documenting the development of a qualitative model of an active sonar automatic classification function (AAP/ETC) was prepared. The report includes a detailed description of how the qualitative model can be utilized in quantitative experiments investigating human interface design requirements for the automatic function. Data was collected in experiments evaluating color-code formats of our design for active sonar search displays. Our data supports specific recommendations for more efficient active search display formats. Results will be documented in a report at the conclusion of the project.

3. (U) FY 1999 PLAN:

- ($622) Initiations:
  - (U) Adaptive Automation (AA) - Develops a DSS incorporating adaptive automation that provides a dynamic function allocation of operational tasks. The adaptive automation will recognize high operator/pilot workload conditions and transfer normal monitoring and adjustment tasks, as well as other, more routine, human-initiated tasks, to automation. The AA will also recognize high Operating Tempo and potentially stressful situations to dynamically re-allocate appropriate operational tasks. Accomplishments include: (1) identification of the most appropriate target platform(s) and operators to demonstrate these advanced automation decision support tools and techniques (2) identification of appropriate mission scenarios and Measures of Effectiveness, and (3) preliminary selection of those adaptive automation technologies that seem best suited to the operator/pilot environment.

- ($1,014) Initiations:
  - (U) Decision Support System for Coalition Operations (DSSCO) - Develop a DSS that assists U.S. military personnel in developing operational decisions in a cross-cultural coalition military environment. The DSS will aid U.S. decision makers in collaborative planning, situation assessment, response management, and plan

revision across culturally diverse military and civilian organizations as well as in coalition operations and operations other than war. The first year will address the taxonomy and identification of relevant parameters for developing and maintaining situation awareness in a multi-cultural context as well as compilation of past coalition operations and lessons learned associated with planning, re-planning, and executing operation other than war.

- (U) Sonar Workstations (SWKS)- Develop a prototype version of a SWKS demonstrating the critical technologies of: (1) multiple flat-panel visual displays and helmet mounted display technology, (2) three-dimensional synthetic audio, 3) multi-modal control and input methods including touch (augmented with a stylus), automatic speech recognition and synthetic speech production, 4) information management user support including modality change, attention alerting mechanisms.
- (U) Display and User Enhancement Technologies (DUETS) - Develop a cost-effective, user sensitive, and mission relevant add-on 3-D display for use with Command, Control, Communication, Computers & Intelligence (C4I) operational systems. This project will (1) review the critical human performance (e.g., perceptual, cognitive, and motor-response) issues related to specific 3-D display and object manipulation techniques, (2) identify a C4I system suitable for 3-D capability, (3) analyze C4I system actions and procedures used to display the battle space environment and maintain the common tactical picture (4) add a system independent 3-D display to an operational C4I system, and design and develop 3-D object manipulation and display techniques for user actions related to increased understanding of the battle space environment, and (5) demonstrate and evaluate 3-D object manipulation and display concepts.- (U) Advanced Alerting (ADALT) - Establish requirements, design and prototype an attention allocation subsystem which can be upgraded and improved beyond the simple buzzer-alert model used with contemporary naval command and weapon control systems.

- ($450) Continuations:
  - (U) In CEIDS the re-hosted Tactical Decision-Making Under Stress (TADMUS) software will be evaluated in a next generation tactical aircrew environment and new display parameters will be added based upon user evaluation from both laboratory and field tests. Approved TADMUS software will be incorporated into actual shipboard combat system computers and the displays will be located within battle staff space for real-world testing and evaluation.

- ($550) Continuations:
  - (U) In MST, document and analyze the current process for designing ship and weapon systems. Develop a process model for ship and weapon system design - the generic design process for new ship and weapon systems and identify those events where human factor considerations are critical. Categorize the high payoff areas for human performance modeling and simulation tools. Survey existing modeling and simulation tools and applications. Assess existing MST tools and applications for applicability in evaluating ergonomic and human performance requirements.

- ($525) Completions:
  -(U) In OSAW, conduct final performance demonstrations of the workstation in operational environments. Transition the multi-modal interface design guideline and ergonomic design to DD-21 and Q-70 programs.

- (U) ($10) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- ($2,811) Continuations:
  - (U) In AA, complete knowledge engineering of operator/pilot tasks. Identification of avionics architecture and software support systems insertion points.
  - (U) In ADALT,- identify and map both visual and auditory alerting modalities onto ongoing tactical console operator task activities.
  - (U) In DUETS,- design and implement the prototype 3-D displays, procure 3-D hardware. Complete 3-D software tools. Design user interface. Perform software modifications to identified C4I system. Draft mission scenarios based on identified C4I track database. Validate scenarios with subject matter experts. Implement 3-D user interface for finalized scenarios.
  - (U) In DSSCO,- conduct evaluations in military exercises to assess decision requirements for operation other than war (OOTW) planning with coalition military forces and civilian organizations in demanding, uncertain situations. Define, and partially implement, the prototype design requirements for DSS for coordinated OOTW operations.
  - (U) In SWKS, develop quantitative procedures for laboratory evaluations of proposed Integrated Undersea Warfare-21 display formats will be developed and initial testing started. Special attention will be given to quantifying risks and gains associated with multi-modal display support for data fusion and multi-source information integration. Work will begin on development of appropriate laboratory demonstrations of interface concepts.
  - (U) In MST,- develop plan for integrating, modifying, and augmenting identified available models and tools. Modify and augment existing tools and techniques to facilitate integration. Develop strategy to fill the gaps. Define a plan to validate the tool set. Validate and modify tool set.

- ($483) Completions:
  - (U) In CEIDS, complete at-sea demonstration of revised TADMUS display software for battle group personnel. Incorporate all user evaluations in embedded training modules and then transition to Third Fleet Flagship. Begin development and testing of AEGIS application of TADMUS Decision Support Software.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

PROJECT NUMBER: R0542
PROJECT TITLE: Human Factors Engineering

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

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(U) RELATED RDT&E:

(U) PE 0601152N (In-House Independent Laboratory Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Readiness, Training & Environmental Quality Technologies)
(U) PE 0602270N (Technology Development)
(U) PE 0603226N (Advanced Distributed Simulation)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604703N (Manpower, Personnel, Training, Simulation and Human Factors)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1770 Manpower and Personnel Development	3,037	4,156	4,210	4,290	4,361	4,441	4,536	4,633	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the Manpower & Personnel Joint Support Area by responding to requirements for technologies that will maintain or improve fleet readiness while reducing personnel end strength; enable the Navy to manage the force effectively and efficiently; and optimize the selection and assignment of personnel to highly demanding jobs. The major goals are to ensure that the Navy has a force that is flexible, integrated, responsive, and affordable so that skilled personnel are available to handle complex weapons systems when needed; and that smaller forces will have greater capabilities by placing the right person in the right job at the right time. The program supports the delivery of new technologies in modeling, mathematical optimization, advanced testing, statistical forecasting, and human performance measurement.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- ($2,197) Continuations:
  - (U) Developed methods to eliminate multiple Armed Services Vocational Aptitude Battery selection composite eligibility cut scores for highly technical, difficult-to-fill Nuclear Field ratings. Developed simplified/new selection composites that potentially increase Nuclear Field recruit eligibility pool by 1,500, while increasing graduation rates by 3-5%.
  - (U) developed a web-based prototype variable dimensional community management tool that simultaneously supports three modeling options (reenlistment, advancement, and rotation). The prototype was expanded to include all ratings and Enlisted Management Communities.

- (U) Integrated the Annualized Cost of Leaving econometric module developed in the recently completed 6.3 Economics of Retention project into the Navy Enlisted Force Analysis Model (NEFAM). This long range policy analysis model will be critical in managing the enlisted inventory by skills as the Navy slows the rapid downsizing and emerging retention problems threatens a hollow force. Developed a prototype flow data assessment system.
- (U) Completed the first phase of the Computing and Communications technology experiment for the Boston area Navy Recruiters. This experiment compared the productivity and quality of life for Navy Recruiters for a group with the advanced technology tools (Laptops with mobile tools, cell phones and reengineered business practices) and a control group.
- (U) Developed comprehensive distribution process maps and researched and developed a prototype alternative enlisted manning, allocation and requisition model. The prototype alternative requisition model simultaneously optimizes the manning, allocation and requisition processes, which leads to a better global solution for allocation of the scare enlisted inventory to maximize fleet readiness. At the same time greatly simplifies the process for better operational efficiency and increased flexibility to handle additional requirements for the distribution computer systems under design by the System Executive Office for Manpower and Personnel.
- (U) Researched and quantified permanent change of station (PCS) cost and personnel readiness metrics and relationships. Developed and experimented with simulation modeling environments, which includes an optimization algorithm. This hybrid environment will be essential to effectively modeling the more complex problems that require optimization and dynamic simulation over time.

• ($840) Completions:
- (U) Completed testing and evaluation of the integrated Officer Planning system. This provides an integrated Officer Personnel Management environment that supports the development of effective polices to combat the developing Officer shortages in the critical and expensive pilot and nuclear communities.
- (U) Completed the Manpower & Personnel Vision of the Future sub-project that developed a conceptual vision of the future Manpower & Personnel system as an integrated system to reduce sub-optimization. The vision details needed technologies as well as process changes required to integrate the manpower/personnel processes.

2. (U) FY 1999 PLAN:

• ($1,121) Initiations:
- (U) Investigate and apply advanced survey technologies to develop new survey instruments (tools) for Manpower and Personnel policy decision-makers. Navy's Toolkit for Enhancing Measurement of Personnel Opinions (TEMPO) will capitalize on advances in survey instrumentation and technology resulting in a state-of-the-art survey assessment capability for Manpower and Personnel policy makers. TEMPO will be assessed and tested within the

context of a research and development effort to determine the extent to which it is feasible with dispersed and mobile Navy personnel.

- (U) Initiate Comprehensive Officer Force Management Environment sub-project. This effort will build from the 6.2 research integrated distribution and force management project to design a comprehensive Officer modeling environment that includes readiness assessment. The research will focus on the development of an intelligent data-mining approach that will uncover emerging trends and identify data problems.
- (U) Initiate Simulation Modeling Tool for Manpower Requirements sub-project. Development of a prototype simulation model that will capture the relationship between Navy force structure (e.g., ships, aircraft) and supporting infrastructure. Such a model would be expected to provide manpower, financial and facility planners with a tool to assess the impact of changes in force structure size, configuration and operating tempo on the size of the Navy's infrastructure. The first year's effort will focus on detailing the functional requirements, data needs and developing the model design.

• ($555) Continuations:
- (U) Research and develop algorithmic corrections for modeling anomalies associated with high and low end point or extreme value cases for the NEFAM. Develop prototype linkages between the Navy Enlisted Strength Planning system and NEFAM. Develop an intelligent automated user override processing approach to minimize the potential for human error.

• ($2,480) Completions:
- (U) Complete development of the Assessment Planning Model that calculates personnel flows for training and their associated training costs.
- (U) Complete development of Selection and Classification Management tools for Chief of Naval Recruiting.
- (U) Complete Modeling and Information Advances project that provides support for school and sea/shore optimization. Implement school and sea/shore optimization to the web-based prototype variable dimensional community management tool. Approaches to incorporate advancement cycle forecasting and Fiscal Year interpolation to cycles will be evaluated.
- (U) Simulate alternative recruit operational classification processes and optimize the Navy's recruit classification algorithms. Develop and incorporate a vocational interest instrument to maximize job satisfaction and performance and minimize attrition.
- (U) Complete the Computing and Communications technology experiment for the Boston and the San Diego area Navy Recruiters. The results, costs and benefits will be evaluated and Navy-wide implementation recommendations will be developed.
- (U) Expand the prototype alternative enlisted manning, allocation and requisition model to integrate personnel assignment. Conduct pilot testing and evaluated expanded prototype. Develop preliminary design of sea-shore

crediting model. The model nearly eliminates the Operating Tempo priority inefficiencies and inequities in the current projection date based approach.

- (U) Complete PCS/Temporary Duty Under Instructions (TEMDUINS) Model for improved decision making, bound resource expenditures per assignment cycle (every two weeks), and improve linkages between personnel unit readiness and PCS/TEMDUINS budgets.

3. (U) FY 2000 PLAN:

- ($2,288) Initiations:
  - (U) Initiate prototype development for assessing Total Force Manpower Management System (TFMMS) Change Requests sub-project. This sub-project's objective is to explore the feasibility of using artificial intelligence: Expert Systems, Fuzzy Logic, and Neural Networks to develop a prototype system to improve the TFMMS manpower change process. The inability of TFMMS to capture the critical Navy manpower business practices with respect to sea-shore rotation, Defense Officer Personnel Management Act, validity of application of military essentiality codes, Navy Enlisted Classification requirements, and others results in inaccurate demand signals to the fleet that must be corrected. The preliminary prototype system will be designed based on the preliminary knowledge developed during this first year.
  - (U) Initiate Shore-based Forces Attrition Model. The objective of this effort is to demonstrate new technologies applicable to estimating the quantity and quality of personnel replacements and fillers needed to support contingency and war plans. These new technologies will be synthesized into a demonstration system that will assist OPLAN, mobilization and personnel planners to better manage Active and Reserve Component personnel for use as attrition replacements.
  - (U) Evaluate the feasibility of a personnel battlefield simulator that would develop an interactive personnel "war gaming" simulator that would visually model the Manpower and Personnel processes, to provide the expected location and utilization status of all personnel resources at a point in time.
  - (U) Initiate the reengineering of officer career paths to evaluate the feasibility of alternative force structure to support reduced manning that would result from the Smart ships under development. The current career paths may not support the more experienced and senior force structures dictated by the reduced manning initiatives under development to support the reduced manning.
  - (U) Initiate the development of intelligent distribution agents to increase the flexibility and responsiveness of the distribution system to emerging readiness and other requirements, as well as priorities.
  - (U) Initiate the development of selection and classification instruments that will support reduced manning that would result from the Smart-ships under development.

- ($1,472) Continuations:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1770
PROJECT TITLE: Manpower and Personnel Development

- (U) Continue development of a prototype intelligent data-mining agent to implement the approach developed the previous year. Research the development of a model capable of simulating any and all potential trends uncovered by the intelligent data-mining agent. The modeling environment will be designed to evaluate the possible emerging scenarios and their probabilities. The development of an advanced visual interface will begin to enable the manpower manager to turn the voluminous data into decision-making information.
- (U) Continue development of a prototype simulation model that will capture the relationship between Navy force structure (e.g., ships, aircraft) and supporting infrastructure. Such a model would be expected to provide manpower, financial and facility planners with a tool to assess the impact of changes in force structure size, configuration and operating tempo on the size of the Navy's infrastructure.
- (U) Continue the evaluation of the Navy's TEMPO to capitalize on advances in survey instrumentation and technology resulting in a state-of-the-art survey assessment capability for Manpower and Personnel policy makers. TEMPO will be assessed and tested within the context of a research and development effort to determine whether the results are valid and able to be generalized to larger Navy populations.

• ($450) Completions:
- (U) Design and evaluate data visualization of complex scenarios to increase the NEFAM use for simultaneous multiple issue analysis. Implement cost estimates for projected force structure. Develop a steady state profile with a given set of flow rates, inventory and targets. Test and evaluate the prototype linkages between the Navy Enlisted Strength Planning system and NEFAM to integrate the short and long term planning horizons. Complete, test and evaluate prototype data assessment system. Modify and test prototype models for the existing computer environment.

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

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

(U) RELATED RDT&E: This project adheres to Tri-Service Reliance Agreements on Manpower and Personnel Technology. Work is related to and fully coordinated with efforts in:

(U) PE 0601152N (In-House Independent Laboratory Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Readiness, Training & Environmental Quality Technologies)
(U) PE 0603007A (Human Factors, Personnel and Training Advanced Technology
(U) PE 0603227F (Personnel, Training, and Simulation Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1772 Training Systems Development	8,896	13,651	13,128	13,154	13,716	13,948	14,254	14,571	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the Training Joint Support Area, as well as most Joint Mission Areas (JMAs) and Joint Chiefs of Staff Future Joint Warfighting Capabilities, all of which depend on high quality training to ensure mission success. The project responds to requirements for effective and affordable education, training and mission rehearsal capability by applying advanced simulation technology and innovative instructional concepts to the design of individual and team training methods and systems. It applies operations research, modeling and simulation, and instructional, cognitive, and computer sciences in order to address requirements for improving (a) training through put, efficiency and affordability necessary for "right-sizing" both the operational forces and the training infrastructure; (b) the effectiveness of training for increasingly complex weapons systems employed in littoral warfare, under fast-paced and stressful conditions, and with limited opportunities for "real-world" practice; and (c) training assessment and training system feedback capabilities for maximizing training responsiveness to operational requirements. Examples of JMA requirements supported by tasks in this project include: training for near-real-time targeting (Strike); training operators and decision makers to respond to data received and processed at increasing speeds (Command, Control, Communications, Computers & Information Warfare); and training personnel to deal with target sets that are variable and difficult to identify as friendly or hostile (Intelligence, Surveillance, Reconnaissance).

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

2. (U) FY 1998 PLAN:

- ($1,237) Initiations:
  - (U) Initiated development of Deployable Sonar Operator/Tactician Training (DSOT) using Interactive Multisensor Analysis Training (IMAT) methodology. IMAT methods are being generalized for sonar and tactical-planning

training for on-board use in submarine pre-deployment and exercise training. DSOT also supports advanced training for submarine Acoustic Rapid Commercial-Off-The-Shelf Insertion (A-RCI).

($550) Initiations:
- (U) Initiated the development and demonstration of an automated, deployable, multimedia system for training tactical knowledge and decision making skills. Selected an authoring tool for the creation of multimedia training materials and lessons in the area of tactical decision-making (TDM) in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction.

- ($2,221) Continuations:
  - (U) Implemented and continued development/demonstration/evaluation of IMAT technologies. IMAT uses advanced scientific visualizations of physics-based models for acoustic and electromagnetic/electro-optical properties of threat platforms and weapons, environmental effects on energy propagation, and sensor/processor systems, to build conceptual training for air, surface, and subsurface shore and at-sea enlisted and officer training in undersea warfare. Evaluations to date show that IMAT greatly improves school performance and reduces training development costs. Conducted at-sea training for submarine, surface, and air anti-submarine warfare (ASW) exercises; results showed that IMAT training provided significant improvements in performance.

- ($3,048) Continuations:
  - (U) Demonstrated component technologies for a Transportable Strike/Assault Rehearsal System (TSTARS) for precision strike. Continued development and adaptation of physics based models for Forward Looking Infrared Radar, radar, and night vision devices for real time training applications. Evaluated training mission rehearsal requirements, simulation components and supporting databases.
  - (U) Training Effectiveness Assessment Methodology (TEAM) - Demonstrated an automated performance recording system to greatly improve deployable tactical training and decision making. Continued development of human performance models in order to automate performance assessment of individual and team skills.

- ($320) Completions:
  - (U) Implemented Virtual Environment Training for Engineering (VET-E) prototype training program at surface warfare officer's school (SWOS), Newport, for schoolhouse test and evaluation. Provided on-site user support and technical documentation to the SWOS instructors, evaluators, and students. Collected, evaluated, and analyzed beta test data and document results. Conducted initial cost-benefit analysis for Integrated Logistic Support package. Drafted and finalized life cycle management plan.

- ($1,520) Completions:

- (U) Implemented improved virtual environment training for a submarine piloting system (VESUB) in order to provide better training to reduce the potential of ship-handling errors and save lives and property. Conducted training effectiveness evaluations at two submarine training facilities. Demonstrated connection to ship handling trainer for team training.
- (U) Implemented vastly improved shipboard instructor training support (SITS) based on new technology onboard a ship in support of afloat training and Battle Force Tactical Training in order to improve tactical team training and complex decision making.

2. (U) FY 1999 PLAN:

- ($1,377) Initiations:
  - (U) Initiate the development of Conning Officer Virtual Environment (COVE) modular training technologies for teaching shiphandling knowledge and skills for various classes of ships. The technology demonstrator will deliver initial, intermediate, advanced, and remedial, "seaman's eye," shiphandling instruction and practice which alternatively tests and remediates until mastery is complete for a wide variety of shiphandling tasks.
  - (U) Initiate the development of PCM, a system that supports planning and real-time control and modification of learning-based scenarios in large-scale modeling and simulation training environments.

- ($3,052) Initiations:
  - (U) Initiate the development of Computer Simulation Based Training System with Intelligent Tutoring Components (CSITS). This project provides quality-reasoning skills about circuits and troubleshooting of systems.

- ($3,800) Continuations:
  - (U) Conduct DSOT development and evaluation, including on-board data collection. For evaluation purposes, prototype systems will be built for test and evaluation aboard ship. Scenario-based performance exercises will be constructed to include opportunities for users to develop search plans and propose tactics to deal with particular sonar or environmental circumstances. Evaluation methods for user planning and tactical knowledge will be developed.

- ($3,195) Continuations:
  - (U) Demonstrate authoring tool for the creation of multimedia training materials and lessons in the area of TDM in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction.
  - (U) Continue development of required technology components and demonstrate TSTARS for precision strike using validated training mission rehearsal requirements, simulation components and supporting databases.

- ($1,000) Completions:

- (U) Complete IMAT development and evaluation in shore school based Undersea Warfare training and at-sea ASW exercises.

- ($1,200) Completions:
  - (U) Implement TEAM automated performance recording and assessment of individual and team skills in order to greatly improve deployable tactical training and decision making.

- (U) ($27) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- ($1,100) Initiations:
  - (U) Initiate the development of Computer-based Automated Training Effectiveness Evaluation System (CATEES).

- ($11,464) Continuations:
  - (U) Continue DSOT development and evaluation Phase II, including A-RCI interface and further at-sea test and evaluation.
  - (U) Design and develop initial software components for the COVE intelligent tutoring system, instructor/operator system, and marine simulation. Conduct task analysis for shiphandling tasks.
  - (U) Continue the development of an authoring tool for the creation of multimedia training materials and lessons in the area of tactical decision making (TDM) in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction. Conduct a training effectiveness evaluation.
  - (U) Continue CSITS development and initiate controlled experiments on cognitive processing, misconceptions and instructional strategies.
  - (U) Continue PCM development, focusing primarily on designing and developing common data structures to enable distributed databases to act in a collaborative manner.

- ($564) Completions:
  - (U) Implement TSTARS for precision strike using validated training mission rehearsal requirements, physics based sensor models for Forward Looking Infrared Radar and night vision goggles, correlated sensor displays, and supporting data bases.

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

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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

PROJECT NUMBER: R1772
PROJECT TITLE: Training Systems Development

(U) RELATED RDT&E: This project adheres to Tri-Service Reliance Agreements on Training Systems technology. Work is related to and fully coordinated with efforts in:

(U) PE 0601152N (In-House Independent Laboratory Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Readiness, Training & Environmental Quality Technologies)
(U) PE 0603216A (Synthetic Flight Simulator Devices Development)
(U) PE 0604703N (Personnel, Training, Simulation, and Human Factors)
(U) PE 0603007A (Human Factors, Personnel, and Training Advanced Technology)
(U) PE 0603227F (Personnel, Training, and Simulation Technology)
(U) PE 0605798D (Joint Services Manpower and Personnel Technology)

D. (U) SCHEDULE PROFILE: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

PROJECT NUMBER: R1772
PROJECT TITLE: Training Systems Development

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	14,661	17,026	18,513	17,815	19,790	20,279	21,385	22,059	CONT.	CONT.
R2206 Environmental Requirements Advanced Technology (ERAT)	3,160	4,254	5,222	4,698	6,209	6,353	6,506	6,662	CONT.	CONT.
R2337 Smart Base	5,931	0	0	0	0	0	0	0	0	24,586
R2380 Proton Exchange Membrane Fuel Cell	1,676	0	0	0	0	0	0	0	0	1,676
R2384 Visualization of Technical Information	1,899	98	74	0	0	0	0	0	0	2,071
R2498 Visualization of Technical Information	0	1,995	0	0	0	0	0	0	0	1,995
TOTAL	27,327	23,373	23,809	22,513	25,999	26,632	27,891	28,721	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element funds the Navy's advanced technology development core efforts in environmental quality and logistics. The focus is on Navy-unique aspects of these technologies. The Logistics Engineering Advanced Demonstrations (LEAD) project supports, maintains and upgrades Navy systems and processes. It extends systems life cycles and streamlines processes to increase reliability and reduce operations. In FY 1995, an environmental quality project (Environmental Requirements Advanced Technology (ERAT)) began, that is aimed at demonstrating ways to reduce shipboard pollution, remediation of harbors and shore facilities, and improve industrial treatment processes. Ongoing environmental quality efforts funded under LEAD transitioned to this project. Program response to affordability requirements includes research and development on antifouling hull coatings, waterfront structures, amphibious logistics,

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

maintenance, electronics logistics and replenishment. The FY 1998 Congressional plus up, the Visualization of Technical Information project develops an automated process for converting page-oriented technical manuals into a revisable database format.

(U) The Navy S&T program includes projects that focus and have attributes that enhance the affordability of warfighting systems.

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

(U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	25,462	20,919	26,008
(U) Appropriated Value:	-	22,919	-
(U) Adjustments from FY 1999 PRESBUDG:	+1,865	+2,454	-2,199
(U) FY 2000 President's Budget Submission:	27,327	23,373	23,809

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 change reflects actual update adjustments (+$2,062) and Small Business Innovative Research reduction (-$197). FY 1999 changes reflect actual update adjustment (+$552), Congressional undistributed reductions (-$98), and Congressional Plus-up for Visualization of Technical Information (+$2,000). FY 2000 changes reflect

program balance adjustments (-$2,392). Navy Working Capital Fund rate adjustments (+$355), non pay inflation adjustment (-$344) and civilian pay rate adjustments (+$182).

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	14,661	17,026	18,513	17,815	19,790	20,279	21,385	22,059	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops technologies to support vital and integral logistics aspects of Joint Mission Areas, specifically in Support & Infrastructure and Readiness. Science and Technology investment in logistics assures affordable technologies that provide rapid deployment, replenishment, and sustainment of Naval and other combat forces in peacetime and wartime operations. Other needs addressed include reducing life cycle and maintenance costs while increasing system capability and readiness. This project also responds to several Defense Technology Area Plan (DTAP) goals, including Materials & Process and Ground & Sea Vehicles. This project responds to Defense Science & Technology Strategy Areas including: Affordability, Dual Use, and Strong Technology Base. The LEAD project improves weapon system readiness and supportability through development of advanced logistics technology. Tasks in this project typically fall into the following categories per the Defense Logistics Agency: Supply, Maintenance, Transportation, and Engineering. This project facilitates transition of concepts from Applied Research to higher development categories or directly to the fleet.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($2,000) Condition Based Maintenance (CBM):
  - (U) Continued advanced development of material for CBM oil analysis and machinery diagnostics.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($2,200) Affordability:
  - (U) Affordable High Lethality Green Energetic Materials will demonstrate propellents and explosives which can lower the life-cycle cost of ordnance systems by reducing the waste and pollution created during manufacture and loading of the materials and by reducing the waste and pollution associated created during the demilitarization of the propellants and explosives at the end of the useful life of ordnance.

- (U) ($292) Commander in Chief (CINC) Support:
  - (U) Obtained evaluations and feedback from Fleet/Force CINC Commands on selected "mature" technologies.

- (U) ($2,661) Sustainable Hardware and Affordable Readiness Practices (SHARP):
  - (U) Demonstrated advanced electronic packaging cooling and interconnect techniques for support of high performance electronics. Tasks include high temperature packaging, advanced thermal interconnects, advanced convection cooling, dual use advanced photonics technology and high throughput interconnects.
  - (U) Continued development/technology insertion and demonstration of "AA" low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) Developed/evaluated commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) Continued to demonstrate improved repairability and logistics support in cost efficient and timely, transportable techniques and processes for replacing nonprocurable/unreliable electronic circuit assemblies.
  - (U) Evaluated the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.

- (U) ($100) Next Generation Test Generator (NGTG):

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R1910 PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Developed and demonstrated the capability to perform fault diagnostics using neural network technology to develop test program set software for electronic systems.

- (U) ($1,280) Advanced Lighterage for High Sea State Operations:
  - (U) Continued effort to demonstrate and evaluate improved lighterage platforms and connector systems.

- (U) ($1,048) Waterfront Structures Repair and Upgrading:
  - (U) Continued effort to demonstrate improved performance of new technology for waterfront structures.

- (U) ($900) Real Time Infrared (RTIR):
  - (U) Continued optics upgrade fabrication, and performed system integration for Real Time Infrared Test Set.

- (U) ($1,078) Battery Charger/Analyzer:
  - (U) Developed battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.

- (U) ($70) Water Mitigators for Ordnance Facilities:
  - (U) Developed design criteria for water mitigators in ordnance facilities. Reduced exposure of personnel and property to unacceptable risk of injury and damage from accidental explosions.

- (U) ($1,087) D-Day Mobile Fuel Distribution:
  - (U) Developed and demonstrated light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($895) Low Cost Radio Frequency (RF) Power Measurement Devices:
  - (U) Produced RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.

- (U) ($600) Naval Total Asset Visibility (NTAV):
  - (U) Demonstrated the concepts of wide-area asset visibility using radio frequency identification (RFID) technology and interoperability with logistics command and control systems.

- (U) ($450) Laser Weld:
  - (U) Completed demonstration of a laser repair cell utilizing a 3-dimensional telerobotic manipulator.

2. (U) FY 1999 PLAN:

- (U) ($2,000) CBM:
  - (U) Continue advanced development of material for CBM oil analysis and machinery diagnostics.

- (U) ($1,212) RTIR:
  - (U) Continue optics upgrade fabrication, and performed system integration for RTIR Test Set.

- (U) ($1,099) Battery Charger/Analyzer:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.

- (U) ($1,236) D-Day Mobile Fuel Distribution:
  - (U) Develop and demonstrate light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.

- (U) ($1,400) Low Cost RF Power Measurement Devices:
  - (U) Produce RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.

- (U) ($1,206) NTAV:
  - (U) Continue to demonstrate the concepts of wide-area asset visibility using (RFID) technology and interoperability with logistics command and control systems.

- (U) ($400) Water Mitigators for Ordnance Facilities:
  - (U) Continue design criteria for water mitigators in ordnance facilities.

- (U) ($900) Advanced Logistics Configuration Management System:
  - (U) Demonstrate advanced mission-specific and uniquely-tailored capabilities for cost effective, real-time capture and display of 3D space configuration for use in design, alteration, modernization and logistics.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($3,600) Affordability:
  - (U) Affordable High Lethality Green Energetic Materials will demonstrate propellents and explosives which can lower the life-cycle cost of ordnance systems by reducing the waste and pollution created during manufacture and loading of the materials and by reducing the waste and pollution associated created during the demilitarization of the propellants and explosives at the end of the useful life of ordnance.

- (U) ($1,100) Technology Assessment Management Tool
  - (U) Develop a comprehensive capability to proactively manage all aspects of support and sustainment of military systems whether the system or support is government derived or commercial. (This task was formerly under the "SHARP" heading in the previous submission.

- (U) ($405) Arc Fault Wire Protection
  - (U) Develop the ability to detect a 400Hz power wire insulation failure which could ignite a fire on the ground or in the air. This affordable arc fault detection would reduce the maintenance time to find the damaged wire to be repaired by 35%. This tasks was under the "SHARP listing in the previous submission.

- (U) ($600) Autonomous Marine Booster Pump
  - (U) Develop a reliable, automated pressure boosting mechanism to permit ship-to-shore transfer of bulk liquids from extended standoff distances during the assault phase of an amphibious operation.

- (U) ($600) Pier Lateral Stability
  - (U) Develop non-destructive diagnostic techniques coupled with computer modeling to rapidly assess pier capacity to resist lateral loads imposed by berthing impact, wind, and current on berthed vessels, or by earthquakes.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($1,000) High Sea State Shipboard Crane Technology
  - (U) Develop enhanced capabilities and reduced training requirements for advanced shipboard crane to facilitate loading/unloading operations in sea states 3 and above.

- (U) ($174) Waterfront Structures Repairs and Upgrades
  - (U) Complete demonstration of improved performance of new technology for waterfront structures.

- (U) ($94) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

2. (U) FY 2000 PLAN:

- (U) ($2,000) CBM:
  - (U) Continued advanced development of material for CBM oil analysis and machinery diagnostics.

- (U) ($1,100) Technology Assessment Management Tool
  - (U) Develop a comprehensive capability to proactively manage all aspects of support and sustainment of military systems whether the system or support is government derived or commercial.

- (U) ($800) Arc Fault Wire Protection
  - (U) Develop the ability to detect a 400Hz power wire insulation failure which could ignite a fire on the ground or in the air. This affordable arc fault detection would reduce the maintenance time to find the damaged wire to be repaired by 35%.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($800) Battery Charger/Analyzer:
  - (U) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.
- (U) ($400) D-Day Mobile Fuel Distribution:
  - (U) Develop and demonstrate light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.
- (U) ($500) Water Mitigators for Ordnance Facilities:
  - (U) Complete design criteria for water mitigators in ordnance facilities.
- (U) ($650) Low Cost RF Power Measurement Devices:
  - (U) Produce RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.
- (U) ($1,708) Collaborative Infrastructure Assessment Tool:
  - (U) Develop technology to determine the applicability of artificial intelligence blackboard systems with multiple expert agents to assist human decision-makers in the preparation of plans, budgets, and facilities capabilities assessments to support present and projected CINC mobilitization requirements.
- (U) ($2,055) Electroset Desktop Manufacturing of Spare Parts:

- (U) Develop electroset technology with a desktop computer to inexpensively manufacture spare and replacement polymeric parts on demand at sea.

- (U) ($2,000) Built-In Calibration (BIC) for Micro Electro Mechanical Systems (MEMS) Sensors:
  - (U) Develop and demonstrate BIC technology for MEMS sensors.

- (U) ($850) Advanced Logistics Configuration Management System:
  - (U) Demonstrate advanced mission-specific and uniquely-tailored capabilities for cost effective, real-time capture and display of 3D space configuration for use in design, alteration, modernization and logistics.

- (U) ($1,850) Advanced Shipboard Crane Technology:
  - (U) Develop technology to enhance ship-mounted crane control technology in order to increase crane performance capabilities in higher sea states and reduce overall life cycle costs.

- (U) ($1,300) Autonomous Marine Booster Pump:
  - (U) Develop technology for a reliable, automated pressure boosting mechanism to permit the ship-to-shore transfer of bulk liquids from extended stand-off distances during the assault phase of an amphibious operation.

- (U) ($1,100) Seabased Logistics Modeling & Simulation:
  - (U) Develop a sea-based logistics technology assessment tool with intelligence.

- (U) ($1,400) Submersible Cache:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Develop a near shore submersible fuel and dry cargo cache to provide immediate moveable logistics facility, extend range of Sea Base transporters, and provide uninterrupted supply for troops ashore.

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

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2206 Environmental Requirements Advanced Technology (ERAT)	3,160	4,254	5,222	4,698	6,209	6,353	6,506	6,662	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops enabling technologies to support vital and integral Joint Mission Areas, specifically in Support & Infrastructure and Readiness for environmental protection. Science and Technology (S&T) investment in environmental technologies assures lowering operational costs, minimizing future adverse environmental impacts, enhancing deployment capabilities and attaining acceptable environmental standards in the production and use of platforms. Only by reducing or eliminating hazardous materials and those processes that generate hazardous by-products can the Department of Defense begin to lower overall compliance and cleanup costs. This project also addresses Defense Technology Area Plan (DTAP) concerns relating to restriction on peacetime Naval operations and the cost of complying with environmental protection laws. This project is essential to fulfilling the DTAP goals including: reducing the volume of shipboard and facility hazardous waste disposal by 50 percent by the year 2000; demonstrating advanced biological treatment of organic wasteto reduce costs by 50 percent and accurately monitoring and predicting noise impacts on marine species by the year 2002; and eliminating all polluted waste water discharges from ships and exceeding Marine Pollution (MARPOL) criteria worldwide by the year 2005.

(U) This project supports near-term advances in support of the four Project Reliance environmental quality pillars: Pollution Prevention, Clean-up, Conservation, and Compliance. Primary focus will be on minimizing shipboard pollution, remediation of harbors and shore facilities, and improved methods of industrial waste treatment.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R2206 PROJECT TITLE: Environmental Requirements Advanced Technology

- (U) ($700) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Continued development of multi-national program for full scale pierside treatment demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($766) Marine Mammal Mitigation:
  - (U) Continued development of mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($962) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) Continued development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($732) Thermoacoustic Cooling:
  - (U) Continued development and demonstration of a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

2. (U) FY 1999 PLAN:

- (U) ($843) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Demonstrate multi-national program for full scale pierside demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($735) Marine Mammal Mitigation:

- (U) Demonstrate mitigation technologies for minimizing impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($843) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) Continue development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($1,105) Thermoacoustic Cooling:
  - (U) Demonstrate a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

- (U) ($728) Innovative Coatings Husbandry Technologies:
  - (U) Demonstrate a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

3. (U) FY 2000 PLAN:

- (U) ($500) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Demonstrate multi-national program for full scale pierside demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($1,965) Marine Mammal Mitigation:
  - (U) Demonstrate mitigation technologies for minimizing impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($880) Automated Underwater Hull Maintenance/Monitoring System:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

PROJECT NUMBER: R2206 PROJECT TITLE: Environmental Requirements Advanced Technology

- (U) Continue development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($638) Thermoacoustic Cooling:
  - (U) Demonstrate a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

- (U) ($1,239) Innovative Coatings Husbandry Technologies:
  - (U) Demonstrate a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

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

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602121N (Surface Ship Technology)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2384 Visualization of Technical Information	1,899	98	74	0	0	0	0	0	0	2,071

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Develop a cost-effective automated system to convert existing page-oriented (digital and paper) technical manuals into a revisable data base format. This technology is a component of the Computer Aided Acquisition and Logistic Support (CALS) program, which is a joint Department of Defense-Industry initiative for making cost-effective use of computer technology and interoperability.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: (Congressional Plus-up)

   - (U) (1,899) Developed recognition and decomposition techniques to analyze and categorize technical information contained in Navy technical manuals in order that it may be used to populate the Interactive Electronic Technical Manual data base in accordance with the Content Data Model (CDM) specified in Military Specification MIL-D-87269.

2. (U) FY 1999 PLAN:

   - (U) (98) Conduct a large scale demonstration of a cost-effective, production-capable prototype which can be transitioned to a production system to be used to convert an entire weapon system's suite of technical manuals.

3. (U) FY 2000 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R2384 PROJECT TITLE: Visualization of Technical Information

- (U) (74) Complete a large scale demonstration of a cost-effective, production-capable prototype which can be transitioned to a production system to be used to convert an entire weapon system's suite of technical manuals.

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

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology
PROJECT NUMBER: R2384
PROJECT TITLE: Visualization of Technical Information

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2497 Joint Warfighting Experimentation	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.
TOTAL	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.

*Was executed in Program Element 0603727D8Z in FY 1998.
**$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Chairman of the Joint Staff's Joint Vision (JV) 2010, the Services' 21st Century visions and the Revolution in Military Affairs (RMA) all stress the critical role technology will play in achieving full spectrum force dominance. On 15 May 1998 the Secretary of Defense appointed the Command in Chief, United States Atlantic Command (CINCUSACOM) as the Department of Defense Executive Agent for Joint Experimentation effective 1 October 1998. This program element directly supports that initiative. New operational concepts, doctrine, organizations, and training enabled by technology will need to be explored and experimented with to understand the new capabilities needed to achieve the next century's military objectives. This program element provides funding to begin developing, analyzing and experimenting with those concepts. The program element funds three separate but related efforts: a Joint Advanced Warfighting/Revolution in Military Affairs (JAW/RMA) analysis activity, a transition activity, and a Joint Warfighting Experimentation program. The JAW/RMA activity will meet the need for analytical support for the development of candidate Joint Vision 2010 and RMA advanced systems and joint warfighting concepts. This capability, which will include advanced simulation and analysis tools, will provide the catalyst for joint warfighting hypotheses based on revolutionary and evolutionary joint warfighting concepts enabled by advanced technologies.

(U) The Joint Warfighting Experimentation program funds the field experiments and supporting simulation to evaluate potential systems and concepts and their contribution toward achieving the JV 2010 and RMA objectives. It provides the capability to rapidly incorporate new and emerging systems with advanced concepts, doctrine, organizations, and technology, and experiment

with them to prove their value. Initially, this effort will be focused on the development and execution of Information Superiority experiments which will be fundamental to achieving Dominant Maneuver (DM), Precision Engagement (PE), Full Dimensional Protection (FDP) and Focused Logistics (FL). The Advanced Battlespace Information System (ABIS) Task Force produced the most comprehensive assessment, vision and strategy to date for achieving the requisite grid, technologies, and concepts to make JV 2010 possible. The 1998 edition of the Joint Warfighting Science and Technology Plan (JWSTP) provided to Congress in compliance with the Fiscal Year 1997 Defense Authorization Act (Section 270) presents the technology investment plan consistent with JV 2010 and the ABIS recommendations. The JWSTP defines and maps the requisite technology development and advanced concept technology demonstrations to enable Information Superiority. The effort funded in this program element enables the joint warfighter and evolving Federated Joint Battle Laboratory to work as an integrated team with the objective to experiment with and quantify the impact of information technologies and concepts, along with commercial off the shelf (COTS) and government off the shelf (GOTS) products and to co-evolve organization and doctrine to optimize the Joint and Service Warfighting mission. We will establish and deploy this integrated environment with COTS hardware and existing software (COTS, GOTS, and applications), incurring minimal cost in set-up and operation.

(U) Industry has recognized that business processes must be changed to take full advantage of new information technologies. Lessons learned from earlier service experiments point out the importance of having a firm conceptual basis upon which to build experiments. In order to develop non-parochial revolutionary concepts, we have established the Joint Advanced Warfighting Program (JAWP). This organization of senior civilian and military people support Atlantic Command (ACOM), the Joint Staff, and the Office of the Secretary of Defense.

(U) The joint experiments will be very dependent on advanced distributed simulation or on limited live command post exercises that are being driven by simulations. Therefore, it is critical the Defense Modeling and Simulation Office (DMSO) insure that the simulations that are being developed are consistent with the department's long term simulation goals. Distributed simulations also require a robust network to interconnect the various sites. Often times, these simulations press the state of the art in networking capability. To support joint experiments and other bandwidth intensive applications such as video teleconferencing and high definition television, an Information Technology Backplane (ITB) has been established. The ITB is a virtual network capitalizing on existing physical networks such as the Defense Information System Network (DISN), the Defense Information Systems Agency (DISA)-Defense Advanced Research Project Agency (DARPA) Leading Edge Services Network, and the experimental ATD net. The 21st Century Challenges roadmaps prepared by the Joint Staff identify a number of existing

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

technical efforts that have the potential to feed joint experiments. These resources provide the means to change the scope of a technical demonstration to support experiments.

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

(U) This program element is in direct response to the FY 1997 Authorization Act Report 104-267, which calls for "…a process to ensure that the emerging long-term visions of each of the Services will be melded into an affordable, coordinated series of operational concepts that will drive the JWSTP developed in the office of the Director, Defense Research and Engineering (DDR&E)." and FY 1998 Authorization Act Report 105-29 requests a Joint Experimentation Plan to address: "how the fielding of advanced technologies are being synchronized across the military services" and "…how Command, Control, Communications, and Computers (C4) and Intelligence, Surveillance and Reconnaissance (ISR) capabilities are being integrated jointly to achieve information superiority." The National Defense Authorization Act for Fiscal Year 1999 (105-261) directed the Secretary of Defense to implement a "process of joint experimentation to investigate and test technologies and alternative forces and concepts in field environments."

B. (U) PROGRAM CHANGE FOR TOTAL Program Element:

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	*8,761	0	0
Adjustments from FY 1999 President's Budget	0	**30,000	41,840
FY 2000 President's Budget Submission	*8,761	**30,000	41,840

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

* Was executed in Program Element 0603737D8Z in FY 1998.
**$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1999 adjustments reflect $14,100 being executed in OSD P.Es 0603727D8Z,and 0208049J, and an above threshold reprogramming of $15,900. FY 2000 adjustments reflect transfer of funds and responsibility for this program from OSD (+$42,445); and Non Pay Inflation adjustment (-$605).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2497 Joint Warfighting Experimentation	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.

* Was executed in Program Element 0603727D8Z in FY 1998.
'$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Chairman of the Joint Staff's Joint Vision 2010, the Services' 21st Century visions and the Revolution in Military Affairs (RMA) all stress the critical role technology will play in achieving full spectrum force dominance. New operational concepts, doctrine, organizations, and training enabled by technology will need to be explored and experimented with to understand the new capabilities needed to achieve the next century's military objectives. This program element provides funding to begin developing, analyzing and experimenting with those concepts. The program element funds three separate but related efforts: a Joint Advanced Warfighting/Revolution in Military Affairs (JAW/RMA) analysis activity, a transition activity, and a Joint Warfighting Experimentation program. The JAW/RMA activity will meet the need for analytical support for the development of candidate Joint Vision 2010 and RMA advanced systems and joint warfighting concepts. This capability, which will include advanced simulation and analysis tools, will provide the catalyst for joint warfighting hypotheses based on revolutionary and evolutionary joint warfighting concepts enabled by advanced technologies

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PROJECT TITLE: Joint Experimentation

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

(U) In FY 1998 this program was funded by PE 0603727D8Z Office of Under Secretary of Defense OUSD (Acquisition and Technology (A&T)) Joint Warfighting program. A joint effort had been established among the Office of the Secretary of Defense (OSD), Joint Staff, Joint Battle Center, Joint Warfighting Center, Joint Warfare Analysis Center, Services and Agencies led by the Director, Defense Research & Engineering (DDR&E), J6 and J7. A detailed roadmap of a series of experiments was developed which supports information superiority as well as the four operational capabilities of Dominance Maneuver (DM), Precision Engagement (PE), Focused Logistics (FL), and Full Dimensional Protection (FDP). The roadmap documents the flow of these experiments so that later initiatives build upon previous lessons learned. Joint warfighters and acquisition personnel will experiment with both operational concepts and technologies in order to determine improved operational capabilities via field experiments, system integration laboratory efforts, modeling, simulation, visualization, or other techniques. A management and test plan will be initiated for the first Joint Warfighting Experiment (JWE) to be conducted as an embedded experiment in a joint training exercise in the year 2000 to determine progress, improve advanced joint warfighting concepts and evolve future operational architectures.

(U) ($1,500)
(U) The Joint Advanced Warfighting Program (JAWP) was established in April 1998. The JAWP works with Office of the Secretary of Defense (SECDEF), the Joint Staff, the United States Atlantic Command (USACOM) and their subordinate activities in support of Joint Vision 2010 implementation and have: (1) identified key elements of the joint warfighting experimentation process; (2) developed prototype experimentation plans; and (3) conducted research and seminars to classify notable works on future operational concepts and future security environments that are relevant to joint experimentation.

(U) ($3,605)
(U) The Joint Experimentation Program got off to a successful start in FY 1998 culminating with Information Superiority Experiment 1.1. Leveraging the U. S. Air Force Expeditionary Force Experiment (EFX-98), USACOM working in

concert with the Joint Staff J-6, tested and assessed time critical targeting sensor-to shooter technologies, applications, doctrine and concepts. The experiment utilized modeling and simulation events in the development of primary and alternative hypotheses prior to experimentation in a live environment. Analysis of data is ongoing and will be concluded in FY 99. Additionally, advanced planning and modeling and simulation activities have begun for USACOM Joint Experiment-1 (JE-1). JE-1 is a preliminary event required to support other joint experiments and will eventually lead to a future "Olympic Event" (OE-1) that will generate empirical data, supporting this effort. JE-1 will be conducted 4th quarter FY 99.

(U) ($956)
(U) Information Technology (IT) Backplane compliant with the Joint Technical Architecture, and the Advanced Battlespace Information Structure (ABIS) were integrated and put in place, thereby providing an environment of existing information technology components into which prototype and other emerging products can be inserted, exercised and evaluated with respect to interoperability and joint warfighting potential. The IT Backplane builds on existing networks and complements, not duplicates, similar efforts by Defense Information System Agency (DISA), Defense Advance Research Project Agency (DARPA), and Naval Research Laboratory (NRL).

(U) ($2,700)
Extended emerging network protocols to the IT Backplane. These included Asynchronous Transfer Mode (ATM) Local Area Network Emulation (LANE) and Multiple Protocol Over ATM (MPOA). Began work in a number of technical areas: (1) mapping legacy application flows to ATM traffic types such as Constant Bit Rate (CBR) and Variable Bit Rate (VBR) to achieve desired performance through Quality-of-Service (QoS); (2) measuring data flows to automatically trigger Virtual Circuit (VC) shortcuts to eliminate traffic bottlenecks; (3) developing JAVA-based Private-Network-to-Network Interface (PNNI) topology mapping to update the network state; (4) investigating dynamic path allocation to improve call-setup performance; and (5) implementing end-to-end authentication of assets using security protocols based on Kerberos Version. Began to evaluate and further develop single-protocol network devices such as Voice-Over-ATM (VOA) telephony workstations and hubs. Support was given to USACOM to provide input to their implementation plan and advise on internal network design as well as developing future IT backplane requirements to meet Joint Experimentation objectives identified by Atlantic Command (ACOM). These study activities will determine bandwidth requirements,

hardware requirements, and assess future technology to support joint experiments.

2. (U) FY 1999 PLAN:

(U) ($14,980)
The FY 99 objectives will be laid out in the USACOM Joint Experimentation Campaign Plan 99 (CPLAN 99). The Campaign provides a methodology for laying out a schedule and implementation plan for identified subjects to be considered in future Joint Warfighting Experiments. The events chosen for the first full year of the Joint Warfighting program will evaluate the technologies and means to validate the Desired Operational Capabilities (DOCs) identified in the Joint Vision 2010 Implementation plan. Additionally the planned activities will focus on identifying Future Operational Capabilities (FOCs) which will be critical to Joint Warfighting. These experiments are product of a future warfighting Concepts Conference which was sponsored by USACOM in October 1998. This conference attended by Battle Laboratory representatives from all the services, the Joint Staff and Unified CINCs nominated 46 future warfighting experiments. USACOM subsequently identified 8 concepts which are schedule for initiation in FY 99. These concepts will leverage on going service demonstrations/experiments, ACTDs and ATDs. They will include experiments which evaluate the following concepts: Attack Operations Against Critical Military Targets, Future Collaborative Information Environment, Joint Contingency Force Operations, Focused Logistics, Common Relevant Operational Picture, Adaptive Joint Command and Control, Interoperable Combat ID and Surveillance and Fires From Space. These eight concepts will form the basis of the experimentation process USACOM will initiate in FY99. This effort has also supported the independent assessment of the Joint Advanced Warfighting Program (JWAP). The results from JWAP have been considered by and integrated into the overarching USACOM Joint Experimentation program.

(U) ($2,849) Expansion of the on going technical work development of the Information Technology Backplane (ITB). Particular attention will be paid to linking the capabilities of several ACTDs including joint logistics, joint planning, rapid battlespace visualization, battlefield awareness data dissemination and Synthetic Theatre of War (STOW). Support will be given to implementers at USACOM and the individual Military Services to assist in the design and execution of information superiority and warfighting experiments.

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(U) ($3,050)
Experimentation Feeder Support: Experimentation Feeder Support provides resources to ensure that the joint experimentation program is consistent with the high level architecture and Defense Modeling and Simulation Office (DMSO's) simulation roadmap and existing on-going demonstrations with the potential for enhancing military operational capability or cost effectiveness to participation in joint experiments.

(U) ($9,121)
The USACOM Joint Experimentation Implementation Plan (I-Plan) dated 14 July 98 is CINCUSACOM's concept and plan for executing the SECDEF Charter for Joint Experimentation. It establishes the experimentation process and describes how USACOM will task organize to accomplish the mission. Leveraging existing resources and work accomplished by the Joint Staff and Joint Warfighting Center, USACOM's FY 99 experimentation focus will be to test and subsequently refine the "Proof of Concept" envisioned for the experimentation process by conducting Joint Experiment Number 1 (JE-1). JE-1 will test emerging concepts and joint doctrine by utilizing advanced simulations, virtual environments, and wargames. In concert with JE-1, USACOM will host a "Futures Program" consisting of workshops, seminars and symposiums as part of the experimentation process. The Futures Program will explore future Doctrine, Organization. Training and Education, Materiel, Leadership, People (DOTML-P) issues by reviewing emerging technologies and concepts that support doctrine, organizations, training, materiel, leadership and people by bringing together warfighters, futurists, academics, and industry. The Futures Program will explore use of wargames, modeling and simulation and virtual environments in developing future concepts for experimentation. JE-1 and the Futures Program will leverage the existing Information Technology (IT) Backplane to conduct experiments. However, it is envisioned that robust experimentation will require continued development of the existing IT Backplane capabilities.

3. (U) FY 2000 PLAN:

(U) ($30,740) This funding will support continued activities by USACOM as the Executive Agent for Joint Experimentation in the execution and assessment of two USACOM generated Joint Warfighting Experiments, five Major Leveraged Military

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PROJECT TITLE: Joint Experimentation

Service events and seven Minor Leveraged Military Service experiments and demonstrations. Additionally USACOM will continue to sponsor the ongoing series of Future Seminars and Warfighter reviews of technologies and operational concepts, which examine the developments and prospects for technological innovation and their relationships to mid-term and future operational concepts. USACOM will also sponsor other technological-operational concept development studies and required Red Team technology vulnerability assessments. Specific experimental technologies which are relevant to the operational issue, including prototypes, advanced technologies, surrogates and required integration materials will be used to support these integration efforts. Modeling and simulation and wargames will continue to be an integral element of the FY 00 plan to develop, assess and generate new concepts and identify new technologies suitable for experimentation.

(U) ($8,600) Coordination of scheduled Joint Experimentation initiatives with the results of scheduled Military Service warfighting experiments and concept demonstrations and those of other Unified CINCs. This will include identification and inclusion of relevant Military Service and Defense Agency science and technology initiatives which might support USACOM's overarching experimentation process.

(U) ($2,500) Advanced planning and support for development and coordination of scheduled FY 01 and FY 02 experiments will be conducted in parallel with on going FY 00 experiments.

(The growth between FY 99 and FY 00 is the result of the increased number of Joint Experiments and the coordination with the associated service and other Unified CINC experiments and demonstrations.

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

(U) RELATED RDT&E:

- (U) PE 0601153N Defense Research Sciences
- (U) PE 0602111N Air and Surface Launched Weapons Technology
- (U) PE 0602121N Ship, Submarine and Logistics Technology

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- (U) PE 0602122N Aircraft Technology
- (U) PE 0602232N Communications, Command and Control, Intelligence, Surveillance and Reconnaissance (C3ISR)
- (U) PE 0602233N Human Systems Technology
- (U) PE 0602234N Materials, Electronics and Computer Technology
- (U) PE 0602270N Electronic Warfare Technology
- (U) PE 0602314N Undersea Warfare Surveillance Technology
- (U) PE 0602435N Oceanographic and Atmospheric Technology
- (U) PE 0602633N Undersea Warfare Weapon Technology
- (U) PE 0603750D Advanced Concept Technology

D. (U) SCHEDULE PROFILE: Not applicable.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	39,624	43,222	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.
R2381 LCAC GPU-5 Gunpod	728	0	0	0	0	0	0	0	728	728
R2499 ALISS	0	998	0	0	0	0	0	0	998	998
TOTAL	40,352	44,220	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore.

(U) This Program Element (PE) transitions technologies responding to high-priority Naval Expeditionary Warfare mission requirements. The emphasis is on simulating and testing prototypes of technologies with the potential for providing Naval capabilities in six major areas:

- Mine Countermeasure (MCM) techniques for clandestine surveillance and reconnaissance; organic minehunting and clearance; and organic ship protection.
- Offensive Sea Mining
- Battlefield surveillance, reconnaissance, and targeting.
- Naval fire support.
- Command, control, communications, information processing, and mission planning supporting land battles.
- Force mobility and survivability.

(U) Task ADVANCED DEGAUSSING was begun in FY 1993, and is designed to enhance current and future ship passive mine self-defenses by lowering the magnetic signatures of the ship. Four main areas of improvement are: advanced deperming to reduce

the vertical magnetic signature by 50% over current capabilities, advanced degaussing by using 3-axis sensing coils and controllers to reduce magnetic signatures by 75%, closed loop degaussing to maintain magnetic signatures in real-time, and secondary field signature reductions due to corrosion-related magnetic fields. ADVANCED DEGAUSSING is currently scheduled for completion in FY 1999 and will be transitioned to Amphibious Transport Dock (LPD-17) baseline design, PE 0603502N for the MCM ships, and PE 0603513N for steel-hulled ships.

(U) Task ADVANCED SURVEILLANCE/RECONNAISSANCE was begun in FY 1996 and is designed to utilize National Technical Means more efficiently in support of MCM operations and amphibious assaults. The focus is upon improving algorithms for detection of mines, minefields, and essential elements of information, together with improving the methods and types of data acquisition in a timely manner.

(U) Task MODELING AND SIMULATION is a continuing effort, designed to determine project utility via simulations, wargames, and system studies. Initially focused on mine warfare, the focus of the modeling and simulation effort is on the assessment of potential Expeditionary Warfare technologies (specifically those associated with naval surface fire support). The methodology is to utilize warfighter-technologist interactions and warfighter driven simulation/visualization based technology assessment to explore current and proposed advanced technologies in tandem with relevant concepts of operations.

(U) The JOINT COUNTERMINE ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (JCM ACTD) began in FY 1995 with funds provided by the Office of the Secretary of Defense under another PE. Funding support was transferred to this PE in FY 1996. The JCM ACTD is a joint Army-Navy program with significant participation by the Marine Corps. The ACTD will integrate emerging new technologies with those already existing in the field to demonstrate seamless sea-to-shore mine countermeasure/countermine operations with heavy emphasis on clandestine surveillance and reconnaissance in support of expeditionary warfare objectives. Major demonstrations were conducted in FY 1997 and FY 1998. Following completion of the demonstrations, selected "residuals" of new equipment will remain with field forces until FY 2000 to facilitate "user" feedback, refine the concept of operations, and develop tactical doctrine. A Joint Countermine Operational Simulation and a Command, Control, Communications, Computers and Intelligence appliqué will be developed to facilitate system integration, allow for mission planning, and provide improved displays for operational commanders.

(U) Task ADVANCED AIRBORNE TARGET DESIGNATOR was begun in FY 1996 and is designed to improve targeting of precision guided munitions (PGM) from over-the-horizon (OTH) battlefield objects in support of Naval Surface Fires (NSF). Efforts include laser target rangefinding and laser designation from unmanned and manned platforms, rapid reporting of targets in existing and compatible formats.

(U) Task EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING was begun in FY 1996 and is designed to improve the connectivity between sea and land forces, particularly in support of NSF and for OTH operations. Concepts to be examined will include: prototype ship-to-shore, high data rate, digital, dynamically controlled network for timely sensor-to-shooter connectivity supporting littoral operations such as close air support, and Naval fire support including existing or planned systems for linking organic and theater surveillance assets such as Joint Surveillance Target Attack Radar System, EP-3, ES-3, and Airborne Warning and Control System. High Frequency (HF)/Very HF (VHF) /Ultra HF(UHF), cellular, and satellite communications

systems such as Joint Tactical Information Distribution System, Common High Bandwidth Datalink, Military Strategic and Tactical Relay, and wideband line-of-sight tactical video will be included. Prototypes to be considered should be interoperable with the Improved Data Modem and Automated Target Handoff System and be capable of transitioning to the Navy's Communication Support System.

(U) Task SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE was begun in FY 1996 and is designed to improve the Navy's ability to monitor and survey the land battlespace for PGM from OTH in all-weather conditions from either manned or unmanned vehicles in support of NSF.

(U) Task MINE IDENTIFICATION was begun in FY 1998 and is designed to provide the capability to conduct rapid mine identification. Rapid mine identification has been identified as crucial to improving mine countermeasures timelines and for organic mine countermeasures. This effort focuses on the application of commercial off the shelf (streak tube technology for underwater imaging for mine identification.

(U) Task LITTORAL SEA MINE begins in FY 1999 and is designed to provide the technologies for development of an affordable littoral sea mine. The focus of this effort is on the development and demonstration of technologies for a wide area, littoral sea mine with remote control.
(U) Task VERY SHALLOW WATER (VSW)/EXPLOSIVE ORDNANCE DISPOSAL RECONNAISSANCE begins in FY 1999 and is designed to provide technologies to improve the capability to conduct MCM operations in VSW. The near term objective of this task is to improve the efficiency of our current diver operations in VSW through the demonstration and transition of improved diver technologies and Unmanned Underwater Vehicle (UUV) technologies which improve the efficiency of current VSW diver operations. The long term goal of this task is to demonstrate and transition technologies which fully replace the functions which are currently performed by divers.

(U) Task ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES begins in FY 1999 and is directed at providing the technologies for transition of naval MCM capabilities from dedicated to organic.

(U) Task SZ NEUTRALIZATION OF MINE AND OBSTACLES begins in FY 1999 and is directed at developing and demonstrating small, autonomous minehunting vehicles capable of detection, classification, identification and neutralization of small mines in surf zone environments.

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

(U) The Navy Science and & Technology program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity because it encompasses design, development, simulation, or experimental testing or prototype hardware to validate

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technological feasibility and concept of operations and reduce technical risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	$36,876	$41,710	$48,930
(U) FY 1999 Appropriated Value:		$42,710	
(U) Adjustments from 1999 PRESBUDG:	$ 3,476	$2,510	$ -219
(U) FY 2000 President's Submission	$40,352	$44,220	$48,711

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 increase is due to Actual Execution Update (+3,476). The FY 1999 increase is due to Execution Update (+2,000), Revised Economic Assumptions (-98), Civilian Personnel Underexecution (-70), Contract Advisory and Assistance reduction (-295), FFRDC (-27) and Congressional Plus-up for ALISS (+1000). FY 2000 decreases reflect adjustments for NWCF Rates, Civilian Pay Rates, and Inflation (-219).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	39,624	43,222	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1.(U) FY 1998 ACCOMPLISHMENTS:

- (U) ($6,500) ADVANCED MINE AND OBSTACLE CLEARANCE: Demonstrated 1/5 scale beach zone (BZ) array (inert) and deployment system for neutralization of BZ mines. Transitioned beach zone array deployment technology to program element (PE) 0603502N. Demonstrated inert explosive line charges, Surf Zone (SZ) array, and Landing Craft, Air Cushion fire control in Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD) as part of Maritime Combined Operational Training (MARCOT98)/Unified Spirit (a combined Canadian/North Atlantic Treaty Organization (NATO) exercise).

- (U) ($4,400) ADVANCED MINE SWEEPING: Completed integration of acoustic spark gap source and conductively cooled, low temperature superconducting magnetic subsystems on demonstration platform. Conducted final tests of both systems and performed field tests. Demonstrated Advanced Lightweight Influence Sweep System

technologies in the JCM ACTD as part of MARCOT98/Unified Spirit (a combined Canadian/NATO exercise). Transitioned magnetic and acoustic technologies to PE 0603502N.

- (U) ($5,100) ADVANCED DEGAUSSING: Completed tests of first generation closed-loop degaussing algorithms, advanced deperming, and stray field minimization technologies. Initiated transition of degaussing technologies to PE 0603513N, PE 0603502N, and to the Amphibious Transport Dock (LPD-17) program.

- (U) ($4,200) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continued utilizing advanced sensors to measure critical battle space parameters and quantify their effectiveness. Demonstrated surveillance and reconnaissance of beach defense obstacles in the JCM ACTD demonstration. Began focused efforts to develop algorithms for determining beach topography, off-shore currents, and surf conditions in real-time.

- (U) ($1,224) MODELING AND SIMULATION: Initiated modeling and simulation to conduct concept based assessment of potential Mine and Expeditionary Warfare technologies. The effort has emphasized warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and proposed advanced technologies in tandem with relevant concepts of operations (e.g. Operational Maneuver From The Sea, Sea Dragon).

- (U) ($7,300) JCM ACTD: Completed analysis of JCM ACTD demonstration I data. Conducted second JCM ACTD demonstration as part of MARCOT98/Unified Spirit military exercise (combined Canadian/NATO exercise in Newfoundland, Canada). The JCM ACTD demonstration II included the demonstration of 10 novel mine countermeasures technologies plus demonstration of Joint Countermine Operational Simulation (JCOS) and JCM Command, Control, Communications, Computer and Intelligence (C4I) appliqué. Began post exercise analysis of JCM ACTD demonstration II. Began support for "residual" equipment to be left with operational forces for further evaluation.

- (U) ($1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Conducted field tests of airborne target designator with live fires to determine accuracy of targeting to resulting fire locations. Completed documentation of field

test results and quantification of localization accuracy. Initiated efforts to improve navigational accuracy of airborne test bed.

- (U) ($1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Conducted communication system interoperability tests in a laboratory and range environment. Demonstrated the shipboard integration and operation of advanced high capacity radio frequency links between ships at sea, as well as ship to an objective ashore. Began analysis and assessment of high capacity radio linkages between ships and ship to objective ashore.

- (U) ($3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Demonstrated emerging commercial off the shelf (COTS) technologies for real-time management and visualization of the Littoral Battlespace. Initiated analysis to assess potential increase in effectiveness and commensurate reduction of vulnerabilities of expeditionary forces.

- (U) ($4,300) MINE IDENTIFICATION: Initiated effort to develop a prototype underwater imager, using COTS Streak Tube technology for rapid identification of mines from Air Mine Countermeasures helicopters and remote minehunting systems. Completed preliminary design review of Streak Tube Imaging Laser (STIL) mine identification prototype. Initiated laboratory testing of receiver and laser optical components.

2. (U) FY 1999 PLAN:

- (U) ($3,770) ADVANCED DEGAUSSING: Complete all efforts in advanced deperming, closed loop degaussing, and algorithm development. Complete documentation of algorithms and demonstration results. Complete transition of degaussing technologies to PE 0603513N, PE 0603502N, and the LPD-17 construction program.

- (U) ($3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused efforts on environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious assaults. Continue transitioning critical battle space products to the Naval Oceanographic Office. Demonstrate littoral remote sensing products during Fleet Battle Experiment (FBE) Echo (Kernal Blitz).

- (U) ($1,500) MODELING AND SIMULATION: Continue simulation based concept based assessment focusing on assessment of technologies for naval surface fire support. The effort will continue to emphasize warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and advanced technologies in tandem with relevant concepts of operations. Initiate concept visualization of naval surface fire support technologies.

- (U) ($2,700) JCM ACTD: Complete post exercise analysis of JCM ACTD Demonstration II. Document demonstration results. Continue logistics support for ACTD "residual" equipment left with operational forces. Complete JCOS and C4I documentation. Demonstrate C4I and JCOS during FBE-Echo (Kernal Blitz) as part of the residual phase. Incorporate "user" comments into final ACTD documentation.

- (U) ($1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete field tests and demonstrations with live fires to determine accuracy of targeting to resulting fire locations. Continue documentation of field test results and quantification of localization accuracy. Initiate transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and Unmanned Aerial Vehicles (UAVs).

- (U) ($1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue demonstration of advanced high capacity radio frequency links between ships at sea, focusing on beyond line of sight communications between ships and objectives ashore. Complete assessment of high capacity radio technologies between ships at sea.

- (U) ($3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Initiate development of component technologies for demonstration of a low cost, high speed guided projectile for Naval guns. Begin development of actuated aerodynamic control surfaces for control of high velocity projectiles. Begin development of an ultracompact, high G (>40,000 G) Global Positioning System/Inertial Measuring Unit (GPS/IMU) guidance package for guidance of high velocity naval ordnance.

- (U) ($5,213) MINE IDENTIFICATION: Begin integration of component technologies together in the laboratory. Begin fabrication of final design suitable for tow-body configuration. Begin integration and performance of final design. Conduct tank tests of preliminary system.

- (U) ($4,531) LITTORAL SEA MINE: Initiate design of littoral sea mine technology demonstration model. Initiate fabrication/testing of individual components. Begin development of data fusion algorithms and assured communication algorithms.

- (U) ($5,769) VERY SHALLOW WATER/EXPLOSIVE ORDNANCE DISPOSAL (VSW/EOD) RECONNAISSANCE: Initiate integration of diver-portable detection, classification, and identification technologies such as diver-portable sonar, underwater imaging Light Detection and Ranging, and autonomous underwater vehicles. Develop simulation which provides for the evaluation of the approach and effectiveness of Unmanned Underwater Vehicles (UUVs) under varying environmental conditions to perform critical Mine Countermeasure VSW missions including search and inspection. Initiate trade-off studies of technical and operational concepts to include directed versus autonomous operation, deployment, recovery, command, control and communication. Prototype low-cost acoustic and magnetic induction navigation transponders and receivers to enable localization in VSW. Begin demonstrating technologies during training exercises to assess operational effectiveness.

- (U) ($4,500) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Begin demonstration of advanced technologies for organic minehunting during Fleet training exercises to assess operational effectiveness and develop concept of operations. Demonstrate rapid, organic mine identification using electro-optic sensor (laser line scan technology) and synthetic aperture sonar during FBE Echo (Kernal Blitz). Demonstrate high speed influence minesweeping using ALISS technologies during FBE Echo (Kernal Blitz).

- (U) ($4,700) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Initiate development a system of small, autonomous minehunting vehicles capable of detection, classification, identification, and neutralization of mines and

obstacles in the SZ environments. Demonstrate navigation and communications capabilities of unmanned bottom vehicles operating in the surf zone environment. Demonstrate capability to achieve area coverage using random, programmed, and co-located group strategies.

- (U) ($439) Portion of extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN

- (U) ($3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious operations. Continue transition of critical battle space products to the naval oceanographic office.

- (U) ($1,800) MODELING AND SIMULATION: Continue simulation based concept based assessment of technologies for naval surface fire support. Continue concept visualization of naval surface fire support technologies focusing on air space deconfliction.

- (U) ($1,500) JCM ACTD: Continue logistics support for select ACTD "residual" equipment left with operational forces for further evaluation.

- (U) ($462) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete documentation of field test results and quantification of localization errors. Complete transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and UAVs.

- (U) ($3,000) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue evaluation of advanced high capacity communications links between ships at sea and ship to objectives ashore through assessment during Amphibious Ready Group deployments. Complete analysis and assessment of high capacity radio linkages between ships at sea and ships to objective ashore.

- (U) ($5,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Complete development of actuated control surface for high speed projectile. Conduct wind tunnel tests. Complete development of ultracompact, high G GPS/IMU guidance package for high speed projectile. Integrate components and demonstrate guidance and control of an inert, high velocity 5 inch projectile. Begin development of composite metal fleschette and packaging and distribution warhead.

- (U) ($6,200) MINE IDENTIFICATION: Complete integration of component STIL technologies in airborne minehunting sonar (AQS-20) towbody. Initiate development of automated mine identification algorithms. Demonstrate mine identification at operational speeds from a surface ship tow. Quantify performance as a function of operational parameters. Demonstrate mine identification from a helicopter tow. Begin transition of STIL mine identification technology to PE 0603502N and PE 0604373N (Airborne Mine Countermeasures).

- (U) ($5,000) LITTORAL SEA MINE: Demonstrate and evaluate assured communications between an underwater testbed and an external surface and subsurface control authority. Demonstrate and evaluate long baseline target detection and tracking sensor hardware and algorithms against quiet underwater targets.

- (U) ($5,930) VSW/EOD RECONNAISSANCE: Develop search strategies which are optimized based on information provided by environmental survey data acquired by search and reconnaissance UUVs. Develop sensing technologies and capability to conjunctively employ sensed information between communicating platforms employing independently acquired sensed data. Demonstrate coordinated navigation and positioning in very shallow water through actual deployments of a search vehicle and inspection vehicle.

- (U) ($7,319) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Complete analysis of Fleet Battle Experiment demonstration of advanced technologies for organic minehunting. Demonstrate and evaluate the use of a scaleable, interoperable tactical control system common to both UAVs and remote minehunting vehicles. Initiate development of a prototype H-60 compatible, conductively cooled, low temperature superconducting magnetic solenoid for organic sweeping of influence mines.

- (U) ($4,000) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Demonstrate coordinated navigation and positioning in the SZ through actual deployments of an unmanned bottom crawling vehicle. Demonstrate autonomous detection and classification of threat-like bottom objects in the presence of natural and man-made clutter in the SZ. Demonstrate group search (up to 5 vehicles), report back of target information, and marking of targets.

- (U) ($5,000) BZ NEUTRALIZATION OF OBSTACLES: Initiate development of Inverse Guidance Law concept which allows guidance of air dropped ordnance with GPS position and velocity state data only. Assess performance of against conventional GPS updated inertial navigation concepts. Begin development of air delivered, reactive, intermetalic darts for neutralization of mines on the beach.

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602131M (Marine Corps Landing Force Technology)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

PROJECT NUMBER: R2226
PROJECT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (MCM, Mining and Special Warfare Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0603502N (Surface and Shallow Water MCM)
(U) PE 0603513N (Shipboard System Component Dev)
(U) PE 0603528N (Non-Acoustic ASW)
(U) PE 0603612M (Marine Corps Mine Countermeasures)
(U) PE 0603640M (Marine Corps Advanced Technology)
(U) PE 0604373N (Airborne Mine Countermeasures)
(U) PE 0604784N (Distributed Surveillance System)

D. (U) SCHEDULE PROFILE: Not Applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1889 Advanced Technology Demonstration	68,054	64,174	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.
R2382 Fast Patrol Craft	9,500	0	0	0	0	0	0	0	0	0
R2383 High Frequency Surface Wave Radar (HFSWR)	3,795	0	0	0	0	0	0	0	0	0
R2411 SWATH Technology Development	4,745	0	0	0	0	0	0	0	0	0
R2600 SLICE Trailer	0	9,478	0	0	0	0	0	0	0	0
TOTAL	86,094	73,652	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program demonstrates high-risk/high-payoff technologies that could significantly improve the warfighting capabilities of the fleet and joint forces, and provides the opportunity to identify and move emerging technologies quickly and efficiently from the laboratory to the fleet. Advanced Technology Demonstration (ATD) programs are selected for a match between technological potential and Navy requirements which are derived from operational issues of concern to the fleet and Joint Warfighting Capabilities Assessment. Risk-reducing ATDs cover integrating and assessing technology in a realistic operational environment and are focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration is designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

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

(U) PROGRAM CHANGE FOR TOTAL PROGRAM ELEMENT (PE):

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	83,510	74,392	76,316
Appropriated Value		73,892	
Adjustments from FY 1999 President's Budget	+2,584	-740	-681
FY 2000 President's Budget Submission	86,094	73,652	75,635

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 increase (+$2,584) reflects Actual Execution Update (+$2,777) and Small Business Innovation Research Reduction (-$193). FY 1999 decrease (-$740) reflects reductions for Revised Economic Assumptions (-$170), Civilian Personnel Underexecution (-$62), Congressional Reduction (-$10,000), Federally Funded Research and Development Center Distribution (-$8), and Congressional Add for SLICE Trailer (+$9,500). FY 2000 decrease (-$681) reflects net Navy Working Capital Fund Rate Adjustment (-$681).

(U) Schedule: Reductions have delayed initiation of Reactive Material Advanced Warhead from FY 1999 to FY 2000 and have significantly curtailed FY 1999 efforts for Advanced Linear Motor.

(U) Technical: Low Cost Missile System was terminated for high payoff technical alternatives, cost growth and lack of transition support. FY 1999 efforts are limited to documentation of progress to date.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1889 Advanced Technology Demonstration	68,054	64,174	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program demonstrates high-risk/high-payoff technologies that could significantly improve the warfighting capabilities of the fleet and joint forces, and provides the opportunity to identify and move emerging technologies quickly and efficiently from the laboratory to the fleet. ATD programs are selected for a match between technological potential and Navy requirements which are derived from operational issues of concern to the fleet. Risk-reducing ATDs cover integrating and assessing technology in a realistic operational environment and are focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration is designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 ACCOMPLISHMENTS:

- (U) ($255) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Completed ATD.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($1,080) TACTICAL AIRCRAFT DIRECTED INFRARED COUNTERMEASURES (DIRCM) -- Completed ATD: conducted flight testing and field demonstrations of developed hardware and countermeasures techniques.
- (U) ($4,231) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Completed ATD: conducted final demonstration of shipboard prototype and evaluated system performance.
- (U) ($4,500) ADVANCED ELECTRONIC COUNTERMEASURES (ECM) TRANSMITTER FOR SHIP DEFENSE -- Completed ATD: completed system integration, lab and field testing, and conducted final demonstration.
- (U) ($4,500) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SUPER HIGH FREQUENCY (SHF) PHASED ARRAY ANTENNA -- Completed ATD: completed X-band antenna array fabrication; conducted demonstration.
- (U) ($3,111) SMART SKINS ARRAY -- Continued ATD: fabricated Advanced Development Model (ADM) and conducted ADM ground test/analysis.
- (U) ($4,450) COMPETENT MUNITIONS FOR THE 5" GUN -- Continued ATD: completed laboratory testing of inertial-only guidance fuse package and global positioning system/inertial guidance fuse package.
- (U) ($6,095) LOW COST MISSILE SYSTEM -- Continued ATD: completed fabrication of subsystems. Integrated subsystems, conducted aerodynamic/wind tunnel testing, hardware-in-the-loop simulation and booster insensitive munitions testing.
- (U) ($6,123) MULTIFUNCTION ELECTRONICS RADIATING SYSTEM (MERS) -- Continued ATD: completed fabrication of performance model and conducted mast mock-up performance tests; built demonstration model and performed component shipboard environmental tests.
- (U) ($5,180) BEST BUY -- Continued ATD: fabricated and tested composite airframe components; fabricated and tested high lift-to-drag airframe.
- (U) ($5,600) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Continued ATD: demonstrated a real-time voice/data link between submarine and surface vessel and a real-time slow scan video link between submarine and submarine.
- (U) ($4,000) ADVANCED COMMUNICATION INTELLIGENCE (COMINT) VOICE PROCESSING -- Continued ATD: fabricated and assembled voice processor components; conducted subsystem testing.
- (U) ($2,100) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS, AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Initiated ATD to demonstrate DNA vaccines designed to protect against complex, multistage microorganisms or against multiple simple pathogens. Performed gene cloning to produce human-use plasmids.
- (U) ($3,990) LOW OBSERVABLE MULTI-FUNCTION STACK -- Initiated ATD to demonstrate a surface ship composite exhaust stack having embedded multi-function satellite communication array antennas. Completed stack and antenna designs.
- (U) ($3,000) RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS) -- Initiated ATD to demonstrate an airborne system to detect, target, and explosively destroy near surface mines using laser directed (LIDAR) fire of a supercavitating

projectile from a helicopter mounted gun. Conducted tower demonstration of projectile lethality against key mine types.

- (U) ($4,872) AFFORDABLE ARRAY TECHNOLOGY -- Initiated ATD to demonstrate an affordable, reliable, and all-optical acoustic sensor/array technology for reconfigurable large aperture sonar arrays. Conducted lake tow test for baseline of thinline system noise.
- (U) ($2,546) ADVANCED SURFACE SITUATIONAL AWARENESS -- Classified program.
- (U) ($2,421) Selected and performed planning for FY00 start ATDs. Conducted independent reviews of on-going ATD programs.

(U) FY 1999 PLAN:

- (U) ($3,146) SMART SKINS ARRAY -- Complete ATD: conduct F/A-18 testing to demonstrate operational utility.
- (U) ($493) LOW COST MISSILE SYSTEM -- Document completed activities of terminated ATD.
- (U) ($1,446) COMPETENT MUNITIONS FOR THE 5" GUN -- Complete ATD: conduct flight testing demonstration.
- (U) ($5,418) BEST BUY -- Continue ATD: demonstrate two-piece composite projectile gun auto-loading and conduct flight test of unguided composite projectile.
- (U) ($4,446) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Complete ATD: demonstrate multi-net connectivity between submarines, ships, and aircraft.
- (U) ($4,046) ADVANCED COMINT VOICE PROCESSING -- Complete ATD: perform system integration with ES-3 aircraft and conduct flight demonstration of automated voice processing system.
- (U) ($5,046) ANTI-TORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Continue ATD, as coupled with NATO effort, with at-sea tests in realistic environments.
- (U) ($4,746) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Continue ATD: continue clinical trials, combined multi-stage DNA vaccines.
- (U) ($4,546) RAMICS - Continue ATD: demonstrate system integration/gun-sensor interface.
- (U) ($4,446) AFFORDABLE ARRAY TECHNOLOGY -- Continue ATD: perform tow and reel tests, develop array/transmitter/receiver.
- (U) ($5,146) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: fabricate stack/shroud and antenna; evaluate test articles.
- (U) ($5,546) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Initiate ATD to demonstrate full-scale plasma-arc pyrolysis system for controlled thermal destruction of shipboard wastes. Perform preliminary design.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($4,046) LONG-ENDURANCE, LOW FREQUENCY ACOUSTIC SOURCE (LELFAS)-- Initiate ATD to demonstrate a low-cost, affordable, rapidly deployable, long-endurance, low frequency acoustic source. Perform initial system design and analysis. Develop high-energy density thermal power source.
- (U) ($1,046) ADVANCED LINEAR MOTOR -- Initiate ATD: demonstrate an aircraft recovery system using linear motor technology. Develop preliminary concept and conduct design evaluations.
- (U) ($4,046) REDUCED SHIPS' CREW BY VIRTUAL PRESENCE (RSVP) -- Initiate ATD: demonstrate at sea an automated system providing environmental, machinery, structural and personnel situational awareness. Define requirements, develop system architecture, conduct feasibility demonstrations and initiate subsystem development.
- (U) ($3,846) SHIPBOARD HIGHBAND MULTIFUNCTION RECEIVE SYSTEM (HBMRS) - Initiate ATD: develop and demonstrate radar, electronic warfare and communication functions in a phased array. Perform prototype design; design, fabricate and test sub-array and transmit/receive modules.
- (U) ($1,700) Select and perform planning for FY01 start ATDs. Conduct independent reviews of on-going ATD programs.
- (U) ($1,019) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

(U) FY 2000 PLAN:

- (U) ($1,429) BEST BUY -- Complete ATD: conduct long-range firing demonstration of projectiles to validate payload capacity and the ability to dispense submunitions over target area.
- (U) ($5,030) ANTI-TORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Complete ATD with at-sea tests.
- (U) ($3,830) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Complete ATD: complete clinical trials.
- (U) ($7,530) RAMICS - Complete ATD: demonstrate system targeting on an operational platform.
- (U) ($5,130) AFFORDABLE ARRAY TECHNOLOGY -- Complete ATD: complete development of prototype array and conduct research vessel tow tests.
- (U) ($4,530) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: conduct land-based demonstration of antenna hardware. Install stack suppresser and shroud/antennas on test ship.
- (U) ($4,830) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Continue ATD: design and test feed subsystem in lab-scale reactor; demonstrate process control with various waste feed mixtures.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($5,530) LONG-ENDURANCE, LOW FREQUENCY ACOUSTIC SOURCE (LELFAS)-- Continue ATD: finalize system design and initiate system fabrication.
- (U) ($4,230) ADVANCED LINEAR MOTOR -- Continue ATD: complete prototype design; conduct critical component testing and complete test site design.
- (U) ($5,530) REDUCED SHIPS' CREW BY VIRTUAL PRESENCE (RSVP) -- Continue ATD: perform lab prototype system development, integration and demonstration and conduct system development Final Acceptance Tests.
- (U) ($5,831) SHIPBOARD HIGHBAND MULTIFUNCTION RECEIVE SYSTEM (HBMRS) -- Continue ATD: perform software development; fabricate and test beamformer; and conduct shared aperture system integration.
- (U) ($4,381) REACTIVE MATERIAL ADVANCED WARHEAD -- Initiate ATD: demonstrate capability of solid reactive materials to extend mission kill in air, cruise missiles and ship self-defense arenas. Characterize materials and parameterize fragment design. Develop initial warhead concept and conduct initial vulnerability tests and analyses.
- (U) ($3,030) ADVANCED SHIPBOARD CRANE MOTION CONTROL SYSTEM: Initiate ATD: develop and demonstrate a crane control system that combines recent advances in nonlinear control system technologies with existing strategic Auxiliary Crane Ship electro-hydraulic cranes.
- (U) ($4,032) BUOYANT CABLE ANTENNA FOR HIGH DATA RATE SUB COMMS: Initiate ATD: develop and demonstrate an advanced Buoyant Cable Antenna (BCA) System to provide a submerged submarine with two-way, higher data rate Ultra High Frequency Fleet Satellite Communications and line-of-sight (LOS), L-band (Iridium) and K-band communications, as well as accessory sensor functions - Global Positioning System, Video, and Radar Early Warning.
- (U) ($4,030) MULTI-PLATFORM BROADBAND PROCESSING: Initiate ATD: develop and demonstrate a common, broadband integrated processing architecture for submarine, surface ship, and weapon sonar system platforms.
- (U) ($5,032) COMPOUND HELICOPTER CONCEPT: Initiate ATD: demonstrate reduction in fatigue loads, vibration levels and maintenance requirements through use of pumpjet for forward thrust with vectoring vanes at the tail, aimed at Airborne Mine Countermeasures (MCM) towing missions.
- (U) ($1,700) Select and perform planning for FY02 start ATDs. Conduct independent reviews of on-going ATD programs.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

B. (U) PROGRAM CHANGE SUMMARY: See Total Program Change Summary for PE.

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

(U) RELATED RDT&E:

- (U) PE 0601153N Defense Research Sciences
- (U) PE 0602111N Air and Surface Launched Weapons Technology
- (U) PE 0602121N Ship, Submarine and Logistics Technology
- (U) PE 0602122N Aircraft Technology
- (U) PE 0602232N Communications, Command and Control, Intelligence, Surveillance and Reconnaissance (C3ISR)
- (U) PE 0602233N Human Systems Technology
- (U) PE 0602234N Materials, Electronics and Computer Technology
- (U) PE 0602270N Electronic Warfare Technology
- (U) PE 0602314N Undersea Warfare Surveillance Technology
- (U) PE 0602435N Oceanographic and Atmospheric Technology
- (U) PE 0602633N Undersea Warfare Weapon Technology

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
X2091 Space and Electronic Warfare (SEW) Advanced Technology	13,612	20,800	22,022	22,528	23,030	23,583	24,142	24,722	CONT.	CONT.
R2239 Advanced Targeting	8,276	928	1,786	6,487	3,848	3,562	6,246	6,540	CONT.	CONT.
R2601 Dominant Battlespace Awareness	0	2,993	0	0	0	0	0	0	0	2,993
R2602 National Technology Alliance	0	14,965	0	0	0	0	0	0	0	14,965
TOTAL	21,888	39,686	23,808	29,015	26,878	27,145	30,388	31,262	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) develops Command, Control and Communications (C^3) technologies which enhance battle targeting for naval forces in Navy, Joint and Coalition operations. The tasking of this PE is executed in accordance with the Information Technology Management Reform Act (ITMRA) of 1996. This PE is being restructured to support the Navy's high priority technology needs for Navy implementation of network centric warfare and Joint Vision 2010. Primary products include technology for dynamic, reconfigurable, secure, radio frequency networks; high data rate, radio frequency communications; multi-function apertures; high assurance systems; distributive, collaborative,

planning and execution; complex information processing support for deliberate precision weapons engagements; and algorithms for specific target identification.

(U) This PE primarily supports the following Joint Mission Areas and Support Areas: Land Attack (comprised of precision strike and naval surface fire support functions), Amphibious Warfare, Information Warfare, Anti Air Warfare, Maritime Dominance, Theater Ballistic Missile Defense and Readiness/Training. The focus is on development and demonstrations of next-generation C^3 systems with high quality and certifiable quality of service to support joint war fighting operations, involving land units, ships, aircraft, and submarines. C^3 capabilities in the 21st century are key to the success of all aspects of military operations including force level planning and rehearsal quality as well as unit level battlespace awareness and weapons engagement execution.

1. (U) SEW Advanced Technology (X2091) -- This project is pursuing work in dynamic, reconfigurable, secure, radio frequency networks; high data rate, radio frequency communications; multi-function apertures; high assurance systems; and distributive, collaborative planning and execution. Efforts will develop:

(a) Low observable, high data rate apertures. Ships, aircraft and submarines in the 21st century must have signature-controlled apertures to enhance operational effectiveness. Apertures must provide connectivity between satellites, ships, aircraft and submarines and land units as well as provide for surveillance and active and passive electronic warfare.

(b) State-of-the-art telecommunications technologies for high data rate over the air communications with low probability of intercept and robustness with regard to jamming.

(c) High capacity Radio Frequency (RF) information networks using commercially developed advanced information handling techniques such as Asynchronous Transfer Mode (ATM) or modifications thereto for multi-media communications that meet unique military data transfer requirements and environments. These systems must be able to satisfy the full range of Quality of Service requirements including certifiable low latency for weapons engagements and critical equipment control. Commercial off-the-shelf (COTs) adapted, high speed, secure local area networks (LANs) will enhance the ability to perform collaborative strike planning, battlespace awareness and time sensitive fire support execution using real-time information from sources such as the Precision Signals Intelligence (SIGINT) Targeting System (PSTS) and tactical reconnaissance and surveillance sources.

(d) Automated command, control, communications, computers, intelligence sensors and reconnaissance (C4ISR) systems to minimize manning requirements e.g. an intelligent communications resource manager capable of adjusting bandwidth/frequency to

balance system loading. Expert systems including intelligent databases and tactical decision aids, for processing, correlation and fusion of large amounts of information which can allow a single operator to be more effective. Tools for ensuring information is available when required. Modified COB collaborative software for military missions.

(e) Tools to ensure integrity, validation, and verification of COTS and other software as well as aids for development. Techniques to ensure integrity or networks and information on networks.

(U) This program will match maturing information technologies with operational warfighting requirements to procure modern C4ISR capability based on an accelerated acquisition cycle.

2. (U) Advanced Targeting (R2239) -- This project is pursuing evaluation of current and emerging technologies to improve communications, surveillance and targeting capabilities for airborne, ground, and shipbased forces.

(a) The Precision Sigint Targeting System (PSTS): Is a Joint Service/Defense Agency effort to develop and demonstrate the capability to provide tactical users with near-real-time target identification and precision targeting information,sensor to-shooter target updating, and Battle Damage Assessment. PSTS will enhance the tactical utility/applicability of existing national assets and provide the tactical commander with performance improvements in terms of targeting accuracy, targets of interest, timeliness, and target identification. Technical challenges include development of advanced signal processing and data fusion algorithms for target detection and classification; and exploitation of multiple signal characteristics for specific emitter identifications.

(b) The advanced multifunction RF system will provide the capability to radiate and receive arbitrary communications, electronic warfare, and radar waveforms from common apertures which will reduce the antenna farms on Naval platforms, reduce life cycle costs, increase stealth characteristics of platforms, and enhance the effectiveness of the RF capabilities of the platforms for warfighting.

3. (U) Dominate Battle Space Command (R2601) -- This project is pursuing evaluation of visualization software and computer technologies to improve battlespace awareness, shorten the command and control decision-making cycle and interface with existing C4ISR systems, data links, and networks. Efforts include: networks that will provide the Command and Control (C2) operator with a real time interactive 3D visualization of the battle space; timely and dynamic management of intelligent, surveillance and reconnaissance (ISR) resources; and rapid and dynamic replanning.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

4. (U) National Technology Alliance (R2602) -- This project is pursuing identification and applicability of current and emerging satellite, commercial and consumer technologies to enhance Naval warfighting systems performance and capability while reducing costs. Navy decision-makers need to understand the impact of these technologies in order to employ the best solutions, plot a technology development course, and map out procurement strategies. The end result will be to develop systems that will support joint and future naval operations in the 21st Century by providing seamless access to tailorable information for warfighters, planners, decision makers and analyst at all echelons.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the Advanced Technology Budget Activity because it encompasses design, development, simulation, or experimental testing of prototype hardware and software to validate technological feasibility and concept of operations and reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

(U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	21,619	22,294	22,922
(U) Appropriated Value		40,294	
(U) Adjustments from FY 1999 PRESBUDG	+269	+17,392	+886
(U) FY 2000 PRESBUDG Submission	21,888	39,686	23,808

(U) CHANGE SUMMARY EXPLANATION:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) Funding: FY1998 adjustments reflect a Small Business Innovative Research reduction (-277) and an actual update adjustment (+546). FY1999 adjustments reflect the Congressional Plus-Up Dominant Battlespace Command Initative (+3,000), Congressional Plus-Up National Technology Alliance Program (+15,000); Congressional undistributed reductions (-124), and execution adjustment (-484). FY2000 adjustments reflect Science & Technology rate adjustment (+884); Navy Working Capital Fund (NWCF) rate adjustment (+258); Civilian Pay Rates (+88), and Non Pay Inflation reduction(-344).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
X2091 Space and Electronic Warfare (SEW) Advanced Technology	13,612	20,800	22,022	22,528	23,030	23,583	24,142	24,722	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project demonstrates advanced technology components, subsystems and systems that will improve the Navy's management and operational use of time-critical command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) data with certifiable assurance functionality, high data rates, optimization and automation of network resources, multi-level access and security of databases and the ability to transmit and receive multi-media data (voice/data/video) over high data rate communication circuits. Capabilities realized from these efforts will contribute to the Navy's ability to maintain an accurate situation assessment and tactical picture with required accuracy and timeliness to allow all forces to have detailed knowledge of the battlespace. This project is being restructured to support the Navy's high priority technology needs for Navy implementation of network centric warfare and Joint Vision 2010. Primary technology focus areas include dynamic reconfigurable secure radio frequency networks, high data rate radio frequency communications, multi-function apertures, high assurance systems, and distributive collaborative planning and execution. The highest emphasis is currently multifunction radio frequency (RF) apertures as these are absolutely essential. As funding is available over the FYDP the issues in the other key areas will be addressed

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

- (U) ($829) High Assurance Systems: The focus of this technology is verification & validation of mission critical systems. Designed and developed an approach and an initial capability for building customized system prototypes from a systems requirements specification. This Java-coded capability was used to build two small interfaces. Developed prototype implementation of formal techniques that automatically reduce requirements specification. Developed initial capability tool for generating test sets from system requirements specifications. Analyzed requirements specifications for Programmable Embeddable INFOSEC Product (PEIP) system and began interface builder for validation.

- (U) ($3,220) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Developed elements for multi-functional multi-beam broadband antenna. Elements cover extra high frequency (EHF) Satellite Communications (SATCOM)/Global Broadcast System (GBS) two-dimensional (2D) Receive Only Antenna sub-array. Conducted ultra high frequency (UHF) SATCOM/International Maritime Satellite (INMARSAT) sub-array demonstration to include hybrid reliability study and tracking/hand-off demonstration. Continued design of UHF/L/K/Q Band Planar Phased Array SATCOM antennas

- (U) ($1,520) Dynamic Reconfigurable Secure radio frequency (RF) Networks: This activity focuses on the Navy's critical need for management of heterogeneous network environments supporting mobile forces and land units in maritime operations. Conducted operational demonstration of Asynchronous Transfer Mode (ATM) hardware and associated software on the USS Abraham Lincoln during Joint Task Force Exercises 98-1. A Java applet and Java-based server were developed in support of Advanced Digital Network System.. Initiated a remote pier-side monitoring effort to support Commander in Chief, Pacific Fleet (CINCPACFLT) and the Joint Maritime Communications System (JMCOMS). Developed an autonomous network management application to perform functions specific to the Navy's pier-side network hook-up devices and applications. Supported successfully a Joint Command Information System (JCIS) network management demonstration in support of the Sea Based Battle Lab, particularly providing management of the ATM local area networks (LANs), including multicast and flow control. Transitioned results to JMCOMS.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

- (U) ($1,012) High Data Rate RF Communications: This technology focuses on the Navy's critical need for increased RF communications throughput for planning and execution in Joint Operations aboard all platforms. Purchased and tested components of a small aperture (approx. 1 meter diameter) Ku Band SATCOM system using a Code Digital Multiplexing Analysis (CDMA) MODEM for multi-terminal networked applications, in support of the Navy's Commercial SATCOM Communication Initiative (CSCI). Identified and modified spread spectrum modems. Performed initial antenna pointing and link margin testing. Performed antenna pedestal testing on a ship motion simulator. Tested power amplifiers and transceivers. Conducted technology assessments for RF communications in network centric warfare. Developed concepts and models, and demonstrated in Global 98 War Game.

- (U) ($7,031) Distributive Collaborative Planning and Execution: This area supports the Navy's need for increased speed and accuracy in collaborative planning and execution, conduct of distributed maritime operations with reduced staffs, and improved Joint service situational assessment, planning, and execution. Developed and demonstrated leading edge information processing and display technologies in an open system, advanced, multi-modal workstation environment that supports collaborative planning staff operations, tactical decision making and information management. Delivered the Beta release of hardened collaborative software for distributed group planning. Began installation and experimentation with the Joint Maritime Command Information System (JMCIS) program office personnel in the customer segment areas of training, planning and logistics; and with Commander, Third Fleet (COMTHIRDFLT) in support of the Undersea Warfare collaboration efforts in conjunction with carrier task force (CTF) 12. Supported Pacific Rim (RIMPAC) exercise. Developed transitionable advanced DII-COE applications for conducting a major integrated demonstration of real-time planning and execution capabilities in conjunction with Command Control Communication Computers, Intelligence (C4I)/Combat System Advanced Concepts-21 (ADCON-21) demonstration. Evaluated information timeliness, consistency, and quality of service from multiple sensor-shooter perspectives. In conjunction with Navy and Joint programs, integrated advanced C4I suite for conducting in-flight demonstration of real time coordination software for special warfare planning and pilot rescue in H-60R at Navy Strike and Air Warfare Center, Fallon, Nevada. Identified and incorporated advanced correlation, fusion, and video registration tools to demonstrate a tactical display for integration of real-time Intelligence, Surveillance, and Reconnaissance (ISR) sources for shore sites and surface combatants. The display provides data from real-time classified information sources, off-board communications links, and improved information integration to support over-the-horizon targeting in Joint littoral operations.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

2. (U) FY 1999 PLAN:

- (U) ($19,524) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Complete design and begin fabrication and testing of UHF/L/K/Q Band Planar Phased Array SATCOM antennas. Complete construction of lightweight, low signature Multi-function Electromagnetic Radiating System (MERS) antenna that integrates into a compact design the functions of the existing UHF line of sight (LOS) Communications, Joint Tactical Information Distribution System (JTIDS), Combat Direction Finding (DF), and Identification Friend/Foe (IFF) apertures to permit platform space for Cooperative Engagement Concept (CEC). Conduct sea trials and transition. Develop a design for an advanced multifunction RF system which will enable all RF functions Radar, Communications, and Electronic Warfare to be integrated into common apertures.

- (U) ($1,276) Distributive Collaborative Planning and Execution: This area supports the Navy's need for increased speed and accuracy in collaborative planning and execution, conduct of distributed maritime operations with reduced staffs, and improved Joint service situational assessment, planning, and execution. Conduct in-flight demonstration and complete documentation and transition of the real-time ground/air coordination software for special warfare planning and pilot rescue. Perform analysis of further C4ISR architectures based on recent technology advances in computer and sensor technologies.

3. (U) FY 2000 PLAN:

- (U) ($1,245) High Assurance Systems: The focus of this technology is verification & validation of mission critical systems. Develop, assess and demonstrate software tools and techniques to provide software process improvements, and network/system enhancements to improve existing and provide for additional network centric warfighting capability. With Carnegie Melon collaboration develop a synchronized, reliable, real time, simultaneous upgrade capability for systems software on multiple tactical units.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

• (U) ($20,777) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Complete full UHF/INMARSAT-B/GBS/EHF SATCOM antenna fabrication, performance land-based testing and develop a ship installation package. Continue the development of the multifunction receive aperture for the multifunction radio frequency system.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.
(U) RELEATED RDT&E:
(U) PE 0301567G (Computer Security Program)
(U) PE 0303140N (Information Systems Security Plan)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602232N (Space and Electronic Warfare (SEW) Technology
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0604231N (Tactical Command Systems)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2239 Advanced Targeting	8,276	928	1,786	6,487	3,848	3,562	6,246	6,540	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As addressed in the Director of Defense, Research and Engineering's Global Surveillance and Communications Thrust, the Precision Sigint Targeting System (PSTS) is a Joint Service/Defense Agency effort to develop and demonstrate the capability to provide tactical users with near-real-time precision targeting information and sensor-to-shooter target updating. The proposed system will enhance the tactical utility and application of existing national assets to provide the tactical commander involved in future conflicts with significant performance improvements resulting in a total surveillance network which is more responsive to changing world economic and political threats in terms of targeting accuracy, targets of interest and timeliness. PSTS will develop Joint Service/Defense Agency cooperative precision targeting site enhancements and Global Concept of Operations (CONOPS) for optimal asset cooperative utilization and minimal operational impact. Technical challenges include development of advanced signal processing, data fusion algorithms, exploitation of multiple signal characteristics for target detection and precision geo-location, and modeling and simulation to assure optimal resource allocation for cooperative precision targeting and primary mission performance.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: R2239
Project Title: Advanced Targeting

- (U) ($5,156) DEMONSTRATION 5: Developmental Test 1 (DT1) was conducted in CONUS in May 1998 to determine system status prior to shipping equipment to Korea. Demonstration 5 was conducted in Korea with the goal of demonstrating all PSTS capabilities. Additional refinements and upgrades to the signal processing and data fusion algorithms based on the results from previous demonstrations were integrated into the processing system.
- (U) ($2,455) SYSTEMS ENGINEERING: Requirements analysis, operations concept development, test planning and test procedures, and scheduling for Demonstration 5 were completed. System engineering studies required to meet Demonstration 5 and to support technology transition were completed.
- (U) ($665) TECHNOLOGY TRANSFER: Completed documentation and configuration management of final PSTS systems including the tactical testbed.

2. (U) FY 1999 PLAN:

- (U) ($909) LOGISTICS SUPPORT: Provided engineering, operations and maintenance support for deployed PSTS systems.

- (U) ($19) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

- (U) ($900) LOGISTIC SUPPORT: Provide engineering, operations and maintenance support for deployed PSTS systems.

- (U) ($886) ADVANCED MULTIFUNCTION RADIO FREQUENCY SYSTEM: Design the advanced multifunction radio frequency system including all apertures, resource allocation manager and other subsystems. The initial test-bed is focused on the 1 to 5 GHz band including functions such as volume search radar, theater ballistic missile discrimination, Challenge Athena, receive noise jamming, deceptive jamming, and high probability of intercept electronic surveillance. Initial development will begin.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: R2239
Project Title: Advanced Targeting

The approach, which is applicable to functions at lower and higher frequencies, will provide the Navy with a low cross-section and low life cycle cost approach to the proliferation of apertures and antennae on Naval platforms.

3. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Available above SECRET level of classification.
(U) RELATED RDT&E: Available above SECRET level of classification.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1772 Training Systems Development	8,896	13,651	13,128	13,154	13,716	13,948	14,254	14,571	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the Training Joint Support Area, as well as most Joint Mission Areas (JMAs) and Joint Chiefs of Staff Future Joint Warfighting Capabilities, all of which depend on high quality training to ensure mission success. The project responds to requirements for effective and affordable education, training and mission rehearsal capability by applying advanced simulation technology and innovative instructional concepts to the design of individual and team training methods and systems. It applies operations research, modeling and simulation, and instructional, cognitive, and computer sciences in order to address requirements for improving (a) training through put, efficiency and affordability necessary for "right-sizing" both the operational forces and the training infrastructure; (b) the effectiveness of training for increasingly complex weapons systems employed in littoral warfare, under fast-paced and stressful conditions, and with limited opportunities for "real-world" practice; and (c) training assessment and training system feedback capabilities for maximizing training responsiveness to operational requirements. Examples of JMA requirements supported by tasks in this project include: training for near-real-time targeting (Strike); training operators and decision makers to respond to data received and processed at increasing speeds (Command, Control, Communications, Computers & Information Warfare); and training personnel to deal with target sets that are variable and difficult to identify as friendly or hostile (Intelligence, Surveillance, Reconnaissance).

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

2. (U) FY 1998 PLAN:

- ($1,237) Initiations:
  - (U) Initiated development of Deployable Sonar Operator/Tactician Training (DSOT) using Interactive Multisensor Analysis Training (IMAT) methodology. IMAT methods are being generalized for sonar and tactical-planning

training for on-board use in submarine pre-deployment and exercise training. DSOT also supports advanced training for submarine Acoustic Rapid Commercial-Off-The-Shelf Insertion (A-RCI).

($550) Initiations:
- (U) Initiated the development and demonstration of an automated, deployable, multimedia system for training tactical knowledge and decision making skills. Selected an authoring tool for the creation of multimedia training materials and lessons in the area of tactical decision-making (TDM) in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction.

- ($2,221) Continuations:
  - (U) Implemented and continued development/demonstration/evaluation of IMAT technologies. IMAT uses advanced scientific visualizations of physics-based models for acoustic and electromagnetic/electro-optical properties of threat platforms and weapons, environmental effects on energy propagation, and sensor/processor systems, to build conceptual training for air, surface, and subsurface shore and at-sea enlisted and officer training in undersea warfare. Evaluations to date show that IMAT greatly improves school performance and reduces training development costs. Conducted at-sea training for submarine, surface, and air anti-submarine warfare (ASW) exercises; results showed that IMAT training provided significant improvements in performance.

- ($3,048) Continuations:
  - (U) Demonstrated component technologies for a Transportable Strike/Assault Rehearsal System (TSTARS) for precision strike. Continued development and adaptation of physics based models for Forward Looking Infrared Radar, radar, and night vision devices for real time training applications. Evaluated training mission rehearsal requirements, simulation components and supporting databases.
  - (U) Training Effectiveness Assessment Methodology (TEAM) - Demonstrated an automated performance recording system to greatly improve deployable tactical training and decision making. Continued development of human performance models in order to automate performance assessment of individual and team skills.

- ($320) Completions:
  - (U) Implemented Virtual Environment Training for Engineering (VET-E) prototype training program at surface warfare officer's school (SWOS), Newport, for schoolhouse test and evaluation. Provided on-site user support and technical documentation to the SWOS instructors, evaluators, and students. Collected, evaluated, and analyzed beta test data and document results. Conducted initial cost-benefit analysis for Integrated Logistic Support package. Drafted and finalized life cycle management plan.

- ($1,520) Completions:

- (U) Implemented improved virtual environment training for a submarine piloting system (VESUB) in order to provide better training to reduce the potential of ship-handling errors and save lives and property. Conducted training effectiveness evaluations at two submarine training facilities. Demonstrated connection to ship handling trainer for team training.
- (U) Implemented vastly improved shipboard instructor training support (SITS) based on new technology onboard a ship in support of afloat training and Battle Force Tactical Training in order to improve tactical team training and complex decision making.

2. (U) FY 1999 PLAN:

- ($1,377) Initiations:
  - (U) Initiate the development of Conning Officer Virtual Environment (COVE) modular training technologies for teaching shiphandling knowledge and skills for various classes of ships. The technology demonstrator will deliver initial, intermediate, advanced, and remedial, "seaman's eye," shiphandling instruction and practice which alternatively tests and remediates until mastery is complete for a wide variety of shiphandling tasks.
  - (U) Initiate the development of PCM, a system that supports planning and real-time control and modification of learning-based scenarios in large-scale modeling and simulation training environments.

- ($3,052) Initiations:
  - (U) Initiate the development of Computer Simulation Based Training System with Intelligent Tutoring Components (CSITS). This project provides quality-reasoning skills about circuits and troubleshooting of systems.

- ($3,800) Continuations:
  - (U) Conduct DSOT development and evaluation, including on-board data collection. For evaluation purposes, prototype systems will be built for test and evaluation aboard ship. Scenario-based performance exercises will be constructed to include opportunities for users to develop search plans and propose tactics to deal with particular sonar or environmental circumstances. Evaluation methods for user planning and tactical knowledge will be developed.

- ($3,195) Continuations:
  - (U) Demonstrate authoring tool for the creation of multimedia training materials and lessons in the area of TDM in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction.
  - (U) Continue development of required technology components and demonstrate TSTARS for precision strike using validated training mission rehearsal requirements, simulation components and supporting databases.

- ($1,000) Completions:

- (U) Complete IMAT development and evaluation in shore school based Undersea Warfare training and at-sea ASW exercises.

• ($1,200) Completions:
- (U) Implement TEAM automated performance recording and assessment of individual and team skills in order to greatly improve deployable tactical training and decision making.

• (U) ($27) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN:

• ($1,100) Initiations:
- (U) Initiate the development of Computer-based Automated Training Effectiveness Evaluation System (CATEES).

• ($11,464) Continuations:
- (U) Continue DSOT development and evaluation Phase II, including A-RCI interface and further at-sea test and evaluation.
- (U) Design and develop initial software components for the COVE intelligent tutoring system, instructor/operator system, and marine simulation. Conduct task analysis for shiphandling tasks.
- (U) Continue the development of an authoring tool for the creation of multimedia training materials and lessons in the area of tactical decision making (TDM) in the AEGIS environment, and a delivery tool for the actual presentation and management of instruction. Conduct a training effectiveness evaluation.
- (U) Continue CSITS development and initiate controlled experiments on cognitive processing, misconceptions and instructional strategies.
- (U) Continue PCM development, focusing primarily on designing and developing common data structures to enable distributed databases to act in a collaborative manner.

• ($564) Completions:
- (U) Implement TSTARS for precision strike using validated training mission rehearsal requirements, physics based sensor models for Forward Looking Infrared Radar and night vision goggles, correlated sensor displays, and supporting data bases.

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

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

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

PROJECT NUMBER: R1772
PROJECT TITLE: Training Systems Development

(U) RELATED RDT&E: This project adheres to Tri-Service Reliance Agreements on Training Systems technology. Work is related to and fully coordinated with efforts in:

(U) PE 0601152N (In-House Independent Laboratory Research)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Readiness, Training & Environmental Quality Technologies)
(U) PE 0603216A (Synthetic Flight Simulator Devices Development)
(U) PE 0604703N (Personnel, Training, Simulation, and Human Factors)
(U) PE 0603007A (Human Factors, Personnel, and Training Advanced Technology)
(U) PE 0603227F (Personnel, Training, and Simulation Technology)
(U) PE 0605798D (Joint Services Manpower and Personnel Technology)

D. (U) SCHEDULE PROFILE: Not applicable

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

PROJECT NUMBER: R1772
PROJECT TITLE: Training Systems Development

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	14,661	17,026	18,513	17,815	19,790	20,279	21,385	22,059	CONT.	CONT.
R2206 Environmental Requirements Advanced Technology (ERAT)	3,160	4,254	5,222	4,698	6,209	6,353	6,506	6,662	CONT.	CONT.
R2337 Smart Base	5,931	0	0	0	0	0	0	0	0	24,586
R2380 Proton Exchange Membrane Fuel Cell	1,676	0	0	0	0	0	0	0	0	1,676
R2384 Visualization of Technical Information	1,899	98	74	0	0	0	0	0	0	2,071
R2498 Visualization of Technical Information	0	1,995	0	0	0	0	0	0	0	1,995
TOTAL	27,327	23,373	23,809	22,513	25,999	26,632	27,891	28,721	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element funds the Navy's advanced technology development core efforts in environmental quality and logistics. The focus is on Navy-unique aspects of these technologies. The Logistics Engineering Advanced Demonstrations (LEAD) project supports, maintains and upgrades Navy systems and processes. It extends systems life cycles and streamlines processes to increase reliability and reduce operations. In FY 1995, an environmental quality project (Environmental Requirements Advanced Technology (ERAT)) began, that is aimed at demonstrating ways to reduce shipboard pollution, remediation of harbors and shore facilities, and improve industrial treatment processes. Ongoing environmental quality efforts funded under LEAD transitioned to this project. Program response to affordability requirements includes research and development on antifouling hull coatings, waterfront structures, amphibious logistics,

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

maintenance, electronics logistics and replenishment. The FY 1998 Congressional plus up, the Visualization of Technical Information project develops an automated process for converting page-oriented technical manuals into a revisable database format.

(U) The Navy S&T program includes projects that focus and have attributes that enhance the affordability of warfighting systems.

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

(U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget:	25,462	20,919	26,008
(U) Appropriated Value:	-	22,919	-
(U) Adjustments from FY 1999 PRESBUDG:	+1,865	+2,454	-2,199
(U) FY 2000 President's Budget Submission:	27,327	23,373	23,809

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 change reflects actual update adjustments (+$2,062) and Small Business Innovative Research reduction (-$197). FY 1999 changes reflect actual update adjustment (+$552), Congressional undistributed reductions (-$98), and Congressional Plus-up for Visualization of Technical Information (+$2,000). FY 2000 changes reflect

program balance adjustments (-$2,392). Navy Working Capital Fund rate adjustments (+$355), non pay inflation adjustment (-$344) and civilian pay rate adjustments (+$182).

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	14,661	17,026	18,513	17,815	19,790	20,279	21,385	22,059	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops technologies to support vital and integral logistics aspects of Joint Mission Areas, specifically in Support & Infrastructure and Readiness. Science and Technology investment in logistics assures affordable technologies that provide rapid deployment, replenishment, and sustainment of Naval and other combat forces in peacetime and wartime operations. Other needs addressed include reducing life cycle and maintenance costs while increasing system capability and readiness. This project also responds to several Defense Technology Area Plan (DTAP) goals, including Materials & Process and Ground & Sea Vehicles. This project responds to Defense Science & Technology Strategy Areas including: Affordability, Dual Use, and Strong Technology Base. The LEAD project improves weapon system readiness and supportability through development of advanced logistics technology. Tasks in this project typically fall into the following categories per the Defense Logistics Agency: Supply, Maintenance, Transportation, and Engineering. This project facilitates transition of concepts from Applied Research to higher development categories or directly to the fleet.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

- (U) ($2,000) Condition Based Maintenance (CBM):
  - (U) Continued advanced development of material for CBM oil analysis and machinery diagnostics.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($2,200) Affordability:
  - (U) Affordable High Lethality Green Energetic Materials will demonstrate propellents and explosives which can lower the life-cycle cost of ordnance systems by reducing the waste and pollution created during manufacture and loading of the materials and by reducing the waste and pollution associated created during the demilitarization of the propellants and explosives at the end of the useful life of ordnance.

- (U) ($292) Commander in Chief (CINC) Support:
  - (U) Obtained evaluations and feedback from Fleet/Force CINC Commands on selected "mature" technologies.

- (U) ($2,661) Sustainable Hardware and Affordable Readiness Practices (SHARP):
  - (U) Demonstrated advanced electronic packaging cooling and interconnect techniques for support of high performance electronics. Tasks include high temperature packaging, advanced thermal interconnects, advanced convection cooling, dual use advanced photonics technology and high throughput interconnects.
  - (U) Continued development/technology insertion and demonstration of "AA" low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) Developed/evaluated commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) Continued to demonstrate improved repairability and logistics support in cost efficient and timely, transportable techniques and processes for replacing nonprocurable/unreliable electronic circuit assemblies.
  - (U) Evaluated the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.

- (U) ($100) Next Generation Test Generator (NGTG):

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Developed and demonstrated the capability to perform fault diagnostics using neural network technology to develop test program set software for electronic systems.

- (U) ($1,280) Advanced Lighterage for High Sea State Operations:
  - (U) Continued effort to demonstrate and evaluate improved lighterage platforms and connector systems.

- (U) ($1,048) Waterfront Structures Repair and Upgrading:
  - (U) Continued effort to demonstrate improved performance of new technology for waterfront structures.

- (U) ($900) Real Time Infrared (RTIR):
  - (U) Continued optics upgrade fabrication, and performed system integration for Real Time Infrared Test Set.

- (U) ($1,078) Battery Charger/Analyzer:
  - (U) Developed battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.

- (U) ($70) Water Mitigators for Ordnance Facilities:
  - (U) Developed design criteria for water mitigators in ordnance facilities. Reduced exposure of personnel and property to unacceptable risk of injury and damage from accidental explosions.

- (U) ($1,087) D-Day Mobile Fuel Distribution:
  - (U) Developed and demonstrated light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($895) Low Cost Radio Frequency (RF) Power Measurement Devices:
  - (U) Produced RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.

- (U) ($600) Naval Total Asset Visibility (NTAV):
  - (U) Demonstrated the concepts of wide-area asset visibility using radio frequency identification (RFID) technology and interoperability with logistics command and control systems.

- (U) ($450) Laser Weld:
  - (U) Completed demonstration of a laser repair cell utilizing a 3-dimensional telerobotic manipulator.

2. (U) FY 1999 PLAN:

- (U) ($2,000) CBM:
  - (U) Continue advanced development of material for CBM oil analysis and machinery diagnostics.

- (U) ($1,212) RTIR:
  - (U) Continue optics upgrade fabrication, and performed system integration for RTIR Test Set.

- (U) ($1,099) Battery Charger/Analyzer:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.

- (U) ($1,236) D-Day Mobile Fuel Distribution:
  - (U) Develop and demonstrate light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.

- (U) ($1,400) Low Cost RF Power Measurement Devices:
  - (U) Produce RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.

- (U) ($1,206) NTAV:
  - (U) Continue to demonstrate the concepts of wide-area asset visibility using (RFID) technology and interoperability with logistics command and control systems.

- (U) ($400) Water Mitigators for Ordnance Facilities:
  - (U) Continue design criteria for water mitigators in ordnance facilities.

- (U) ($900) Advanced Logistics Configuration Management System:
  - (U) Demonstrate advanced mission-specific and uniquely-tailored capabilities for cost effective, real-time capture and display of 3D space configuration for use in design, alteration, modernization and logistics.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($3,600) Affordability:
  - (U) Affordable High Lethality Green Energetic Materials will demonstrate propellents and explosives which can lower the life-cycle cost of ordnance systems by reducing the waste and pollution created during manufacture and loading of the materials and by reducing the waste and pollution associated created during the demilitarization of the propellants and explosives at the end of the useful life of ordnance.

- (U) ($1,100) Technology Assessment Management Tool
  - (U) Develop a comprehensive capability to proactively manage all aspects of support and sustainment of military systems whether the system or support is government derived or commercial. (This task was formerly under the "SHARP" heading in the previous submission.

- (U) ($405) Arc Fault Wire Protection
  - (U) Develop the ability to detect a 400Hz power wire insulation failure which could ignite a fire on the ground or in the air. This affordable arc fault detection would reduce the maintenance time to find the damaged wire to be repaired by 35%. This tasks was under the "SHARP listing in the previous submission.

- (U) ($600) Autonomous Marine Booster Pump
  - (U) Develop a reliable, automated pressure boosting mechanism to permit ship-to-shore transfer of bulk liquids from extended standoff distances during the assault phase of an amphibious operation.

- (U) ($600) Pier Lateral Stability
  - (U) Develop non-destructive diagnostic techniques coupled with computer modeling to rapidly assess pier capacity to resist lateral loads imposed by berthing impact, wind, and current on berthed vessels, or by earthquakes.

- (U) ($1,000) High Sea State Shipboard Crane Technology
  - (U) Develop enhanced capabilities and reduced training requirements for advanced shipboard crane to facilitate loading/unloading operations in sea states 3 and above.

- (U) ($174) Waterfront Structures Repairs and Upgrades
  - (U) Complete demonstration of improved performance of new technology for waterfront structures.

- (U) ($94) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

2. (U) FY 2000 PLAN:

- (U) ($2,000) CBM:
  - (U) Continued advanced development of material for CBM oil analysis and machinery diagnostics.

- (U) ($1,100) Technology Assessment Management Tool
  - (U) Develop a comprehensive capability to proactively manage all aspects of support and sustainment of military systems whether the system or support is government derived or commercial.

- (U) ($800) Arc Fault Wire Protection
  - (U) Develop the ability to detect a 400Hz power wire insulation failure which could ignite a fire on the ground or in the air. This affordable arc fault detection would reduce the maintenance time to find the damaged wire to be repaired by 35%.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R1910
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) ($800) Battery Charger/Analyzer:
  - (U) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.
- (U) ($400) D-Day Mobile Fuel Distribution:
  - (U) Develop and demonstrate light weight, high strength, collapsible, fluid containers and rapid fluid transfer mechanisms to provide the capability for expeditious ship-to-shore movement of fuel and other liquids during the initial stages of an amphibious assault.
- (U) ($500) Water Mitigators for Ordnance Facilities:
  - (U) Complete design criteria for water mitigators in ordnance facilities.
- (U) ($650) Low Cost RF Power Measurement Devices:
  - (U) Produce RF power measurements devices to achieve improved affordability by reducing initial acquisition cost, reducing logistics manpower, minimizing life-cycle cost of power measurement equipment, improving maintenance techniques and processes, and reducing personnel injury/material damage.
- (U) ($1,708) Collaborative Infrastructure Assessment Tool:
  - (U) Develop technology to determine the applicability of artificial intelligence blackboard systems with multiple expert agents to assist human decision-makers in the preparation of plans, budgets, and facilities capabilities assessments to support present and projected CINC mobilitization requirements.
- (U) ($2,055) Electroset Desktop Manufacturing of Spare Parts:

- (U) Develop electroset technology with a desktop computer to inexpensively manufacture spare and replacement polymeric parts on demand at sea.

- (U) ($2,000) Built-In Calibration (BIC) for Micro Electro Mechanical Systems (MEMS) Sensors:
  - (U) Develop and demonstrate BIC technology for MEMS sensors.

- (U) ($850) Advanced Logistics Configuration Management System:
  - (U) Demonstrate advanced mission-specific and uniquely-tailored capabilities for cost effective, real-time capture and display of 3D space configuration for use in design, alteration, modernization and logistics.

- (U) ($1,850) Advanced Shipboard Crane Technology:
  - (U) Develop technology to enhance ship-mounted crane control technology in order to increase crane performance capabilities in higher sea states and reduce overall life cycle costs.

- (U) ($1,300) Autonomous Marine Booster Pump:
  - (U) Develop technology for a reliable, automated pressure boosting mechanism to permit the ship-to-shore transfer of bulk liquids from extended stand-off distances during the assault phase of an amphibious operation.

- (U) ($1,100) Seabased Logistics Modeling & Simulation:
  - (U) Develop a sea-based logistics technology assessment tool with intelligence.

- (U) ($1,400) Submersible Cache:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R1910 PROJECT TITLE: Logistics Engineering Advanced Demonstration (LEAD)

- (U) Develop a near shore submersible fuel and dry cargo cache to provide immediate moveable logistics facility, extend range of Sea Base transporters, and provide uninterrupted supply for troops ashore.

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

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2206 Environmental Requirements Advanced Technology (ERAT)	3,160	4,254	5,222	4,698	6,209	6,353	6,506	6,662	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops enabling technologies to support vital and integral Joint Mission Areas, specifically in Support & Infrastructure and Readiness for environmental protection. Science and Technology (S&T) investment in environmental technologies assures lowering operational costs, minimizing future adverse environmental impacts, enhancing deployment capabilities and attaining acceptable environmental standards in the production and use of platforms. Only by reducing or eliminating hazardous materials and those processes that generate hazardous by-products can the Department of Defense begin to lower overall compliance and cleanup costs. This project also addresses Defense Technology Area Plan (DTAP) concerns relating to restriction on peacetime Naval operations and the cost of complying with environmental protection laws. This project is essential to fulfilling the DTAP goals including: reducing the volume of shipboard and facility hazardous waste disposal by 50 percent by the year 2000; demonstrating advanced biological treatment of organic wasteto reduce costs by 50 percent and accurately monitoring and predicting noise impacts on marine species by the year 2002; and eliminating all polluted waste water discharges from ships and exceeding Marine Pollution (MARPOL) criteria worldwide by the year 2005.

(U) This project supports near-term advances in support of the four Project Reliance environmental quality pillars: Pollution Prevention, Clean-up, Conservation, and Compliance. Primary focus will be on minimizing shipboard pollution, remediation of harbors and shore facilities, and improved methods of industrial waste treatment.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R2206 PROJECT TITLE: Environmental Requirements Advanced Technology

- (U) ($700) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Continued development of multi-national program for full scale pierside treatment demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($766) Marine Mammal Mitigation:
  - (U) Continued development of mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($962) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) Continued development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($732) Thermoacoustic Cooling:
  - (U) Continued development and demonstration of a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

2. (U) FY 1999 PLAN:

- (U) ($843) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Demonstrate multi-national program for full scale pierside demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($735) Marine Mammal Mitigation:

- (U) Demonstrate mitigation technologies for minimizing impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($843) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) Continue development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($1,105) Thermoacoustic Cooling:
  - (U) Demonstrate a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

- (U) ($728) Innovative Coatings Husbandry Technologies:
  - (U) Demonstrate a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

3. (U) FY 2000 PLAN:

- (U) ($500) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) Demonstrate multi-national program for full scale pierside demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.

- (U) ($1,965) Marine Mammal Mitigation:
  - (U) Demonstrate mitigation technologies for minimizing impact of Navy acoustic operations on protected marine mammals and begin development of safety criteria for the impact of environmental sound on marine mammals.

- (U) ($880) Automated Underwater Hull Maintenance/Monitoring System:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT NUMBER: R2206 PROJECT TITLE: Environmental Requirements Advanced Technology

- (U) Continue development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.

- (U) ($638) Thermoacoustic Cooling:
  - (U) Demonstrate a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

- (U) ($1,239) Innovative Coatings Husbandry Technologies:
  - (U) Demonstrate a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

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

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602121N (Surface Ship Technology)
(U) PE 0602233N (Human Systems Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2384 Visualization of Technical Information	1,899	98	74	0	0	0	0	0	0	2,071

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Develop a cost-effective automated system to convert existing page-oriented (digital and paper) technical manuals into a revisable data base format. This technology is a component of the Computer Aided Acquisition and Logistic Support (CALS) program, which is a joint Department of Defense-Industry initiative for making cost-effective use of computer technology and interoperability.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS: (Congressional Plus-up)

- (U) (1,899) Developed recognition and decomposition techniques to analyze and categorize technical information contained in Navy technical manuals in order that it may be used to populate the Interactive Electronic Technical Manual data base in accordance with the Content Data Model (CDM) specified in Military Specification MIL-D-87269.

2. (U) FY 1999 PLAN:

- (U) (98) Conduct a large scale demonstration of a cost-effective, production-capable prototype which can be transitioned to a production system to be used to convert an entire weapon system's suite of technical manuals.

3. (U) FY 2000 PLAN:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R2384
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Visualization of Technical Information

- (U) (74) Complete a large scale demonstration of a cost-effective, production-capable prototype which can be transitioned to a production system to be used to convert an entire weapon system's suite of technical manuals.

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

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R2384
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Visualization of Technical Information

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FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2497 Joint Warfighting Experimentation	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.
TOTAL	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.

*Was executed in Program Element 0603727D8Z in FY 1998.
**$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Chairman of the Joint Staff's Joint Vision (JV) 2010, the Services' 21st Century visions and the Revolution in Military Affairs (RMA) all stress the critical role technology will play in achieving full spectrum force dominance. On 15 May 1998 the Secretary of Defense appointed the Command in Chief, United States Atlantic Command (CINCUSACOM) as the Department of Defense Executive Agent for Joint Experimentation effective 1 October 1998. This program element directly supports that initiative. New operational concepts, doctrine, organizations, and training enabled by technology will need to be explored and experimented with to understand the new capabilities needed to achieve the next century's military objectives. This program element provides funding to begin developing, analyzing and experimenting with those concepts. The program element funds three separate but related efforts: a Joint Advanced Warfighting/Revolution in Military Affairs (JAW/RMA) analysis activity, a transition activity, and a Joint Warfighting Experimentation program. The JAW/RMA activity will meet the need for analytical support for the development of candidate Joint Vision 2010 and RMA advanced systems and joint warfighting concepts. This capability, which will include advanced simulation and analysis tools, will provide the catalyst for joint warfighting hypotheses based on revolutionary and evolutionary joint warfighting concepts enabled by advanced technologies.

(U) The Joint Warfighting Experimentation program funds the field experiments and supporting simulation to evaluate potential systems and concepts and their contribution toward achieving the JV 2010 and RMA objectives. It provides the capability to rapidly incorporate new and emerging systems with advanced concepts, doctrine, organizations, and technology, and experiment

with them to prove their value. Initially, this effort will be focused on the development and execution of Information Superiority experiments which will be fundamental to achieving Dominant Maneuver (DM), Precision Engagement (PE), Full Dimensional Protection (FDP) and Focused Logistics (FL). The Advanced Battlespace Information System (ABIS) Task Force produced the most comprehensive assessment, vision and strategy to date for achieving the requisite grid, technologies, and concepts to make JV 2010 possible. The 1998 edition of the Joint Warfighting Science and Technology Plan (JWSTP) provided to Congress in compliance with the Fiscal Year 1997 Defense Authorization Act (Section 270) presents the technology investment plan consistent with JV 2010 and the ABIS recommendations. The JWSTP defines and maps the requisite technology development and advanced concept technology demonstrations to enable Information Superiority. The effort funded in this program element enables the joint warfighter and evolving Federated Joint Battle Laboratory to work as an integrated team with the objective to experiment with and quantify the impact of information technologies and concepts, along with commercial off the shelf (COTS) and government off the shelf (GOTS) products and to co-evolve organization and doctrine to optimize the Joint and Service Warfighting mission. We will establish and deploy this integrated environment with COTS hardware and existing software (COTS, GOTS, and applications), incurring minimal cost in set-up and operation.

(U) Industry has recognized that business processes must be changed to take full advantage of new information technologies. Lessons learned from earlier service experiments point out the importance of having a firm conceptual basis upon which to build experiments. In order to develop non-parochial revolutionary concepts, we have established the Joint Advanced Warfighting Program (JAWP). This organization of senior civilian and military people support Atlantic Command (ACOM), the Joint Staff, and the Office of the Secretary of Defense.

(U) The joint experiments will be very dependent on advanced distributed simulation or on limited live command post exercises that are being driven by simulations. Therefore, it is critical the Defense Modeling and Simulation Office (DMSO) insure that the simulations that are being developed are consistent with the department's long term simulation goals. Distributed simulations also require a robust network to interconnect the various sites. Often times, these simulations press the state of the art in networking capability. To support joint experiments and other bandwidth intensive applications such as video teleconferencing and high definition television, an Information Technology Backplane (ITB) has been established. The ITB is a virtual network capitalizing on existing physical networks such as the Defense Information System Network (DISN), the Defense Information Systems Agency (DISA)-Defense Advanced Research Project Agency (DARPA) Leading Edge Services Network, and the experimental ATD net. The 21st Century Challenges roadmaps prepared by the Joint Staff identify a number of existing

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

technical efforts that have the potential to feed joint experiments. These resources provide the means to change the scope of a technical demonstration to support experiments.

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

(U) This program element is in direct response to the FY 1997 Authorization Act Report 104-267, which calls for "…a process to ensure that the emerging long-term visions of each of the Services will be melded into an affordable, coordinated series of operational concepts that will drive the JWSTP developed in the office of the Director, Defense Research and Engineering (DDR&E)." and FY 1998 Authorization Act Report 105-29 requests a Joint Experimentation Plan to address: "how the fielding of advanced technologies are being synchronized across the military services" and "…how Command, Control, Communications, and Computers (C4) and Intelligence, Surveillance and Reconnaissance (ISR) capabilities are being integrated jointly to achieve information superiority." The National Defense Authorization Act for Fiscal Year 1999 (105-261) directed the Secretary of Defense to implement a "process of joint experimentation to investigate and test technologies and alternative forces and concepts in field environments."

B. (U) PROGRAM CHANGE FOR TOTAL Program Element:

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	*8,761	0	0
Adjustments from FY 1999 President's Budget	0	**30,000	41,840
FY 2000 President's Budget Submission	*8,761	**30,000	41,840

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

* Was executed in Program Element 0603737D8Z in FY 1998.
**$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1999 adjustments reflect $14,100 being executed in OSD P.Es 0603727D8Z,and 0208049J, and an above threshold reprogramming of $15,900. FY 2000 adjustments reflect transfer of funds and responsibility for this program from OSD (+$42,445); and Non Pay Inflation adjustment (-$605).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2497 Joint Warfighting Experimentation	*8,761	**30,000	41,840	46,181	52,257	62,435	62,783	63,229	CONT.	CONT.

* Was executed in Program Element 0603727D8Z in FY 1998.
**$14,100 is being executed in OSD P.E. 0603727D8Z and 0208049J in FY 1999.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Chairman of the Joint Staff's Joint Vision 2010, the Services' 21st Century visions and the Revolution in Military Affairs (RMA) all stress the critical role technology will play in achieving full spectrum force dominance. New operational concepts, doctrine, organizations, and training enabled by technology will need to be explored and experimented with to understand the new capabilities needed to achieve the next century's military objectives. This program element provides funding to begin developing, analyzing and experimenting with those concepts. The program element funds three separate but related efforts: a Joint Advanced Warfighting/Revolution in Military Affairs (JAW/RMA) analysis activity, a transition activity, and a Joint Warfighting Experimentation program. The JAW/RMA activity will meet the need for analytical support for the development of candidate Joint Vision 2010 and RMA advanced systems and joint warfighting concepts. This capability, which will include advanced simulation and analysis tools, will provide the catalyst for joint warfighting hypotheses based on revolutionary and evolutionary joint warfighting concepts enabled by advanced technologies

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER: R2497
PROJECT TITLE: Joint Experimentation

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

(U) In FY 1998 this program was funded by PE 0603727D8Z Office of Under Secretary of Defense OUSD (Acquisition and Technology (A&T)) Joint Warfighting program. A joint effort had been established among the Office of the Secretary of Defense (OSD), Joint Staff, Joint Battle Center, Joint Warfighting Center, Joint Warfare Analysis Center, Services and Agencies led by the Director, Defense Research & Engineering (DDR&E), J6 and J7. A detailed roadmap of a series of experiments was developed which supports information superiority as well as the four operational capabilities of Dominance Maneuver (DM), Precision Engagement (PE), Focused Logistics (FL), and Full Dimensional Protection (FDP). The roadmap documents the flow of these experiments so that later initiatives build upon previous lessons learned. Joint warfighters and acquisition personnel will experiment with both operational concepts and technologies in order to determine improved operational capabilities via field experiments, system integration laboratory efforts, modeling, simulation, visualization, or other techniques. A management and test plan will be initiated for the first Joint Warfighting Experiment (JWE) to be conducted as an embedded experiment in a joint training exercise in the year 2000 to determine progress, improve advanced joint warfighting concepts and evolve future operational architectures.

(U) ($1,500)
(U) The Joint Advanced Warfighting Program (JAWP) was established in April 1998. The JAWP works with Office of the Secretary of Defense (SECDEF), the Joint Staff, the United States Atlantic Command (USACOM) and their subordinate activities in support of Joint Vision 2010 implementation and have: (1) identified key elements of the joint warfighting experimentation process; (2) developed prototype experimentation plans; and (3) conducted research and seminars to classify notable works on future operational concepts and future security environments that are relevant to joint experimentation.

(U) ($3,605)
(U) The Joint Experimentation Program got off to a successful start in FY 1998 culminating with Information Superiority Experiment 1.1. Leveraging the U. S. Air Force Expeditionary Force Experiment (EFX-98), USACOM working in

concert with the Joint Staff J-6, tested and assessed time critical targeting sensor-to shooter technologies, applications, doctrine and concepts. The experiment utilized modeling and simulation events in the development of primary and alternative hypotheses prior to experimentation in a live environment. Analysis of data is ongoing and will be concluded in FY 99. Additionally, advanced planning and modeling and simulation activities have begun for USACOM Joint Experiment-1 (JE-1). JE-1 is a preliminary event required to support other joint experiments and will eventually lead to a future "Olympic Event" (OE-1) that will generate empirical data, supporting this effort. JE-1 will be conducted 4th quarter FY 99.

(U) ($956)
(U) Information Technology (IT) Backplane compliant with the Joint Technical Architecture, and the Advanced Battlespace Information Structure (ABIS) were integrated and put in place, thereby providing an environment of existing information technology components into which prototype and other emerging products can be inserted, exercised and evaluated with respect to interoperability and joint warfighting potential. The IT Backplane builds on existing networks and complements, not duplicates, similar efforts by Defense Information System Agency (DISA), Defense Advance Research Project Agency (DARPA), and Naval Research Laboratory (NRL).

(U) ($2,700)
Extended emerging network protocols to the IT Backplane. These included Asynchronous Transfer Mode (ATM) Local Area Network Emulation (LANE) and Multiple Protocol Over ATM (MPOA). Began work in a number of technical areas: (1) mapping legacy application flows to ATM traffic types such as Constant Bit Rate (CBR) and Variable Bit Rate (VBR) to achieve desired performance through Quality-of-Service (QoS); (2) measuring data flows to automatically trigger Virtual Circuit (VC) shortcuts to eliminate traffic bottlenecks; (3) developing JAVA-based Private-Network-to-Network Interface (PNNI) topology mapping to update the network state; (4) investigating dynamic path allocation to improve call-setup performance; and (5) implementing end-to-end authentication of assets using security protocols based on Kerberos Version. Began to evaluate and further develop single-protocol network devices such as Voice-Over-ATM (VOA) telephony workstations and hubs. Support was given to USACOM to provide input to their implementation plan and advise on internal network design as well as developing future IT backplane requirements to meet Joint Experimentation objectives identified by Atlantic Command (ACOM). These study activities will determine bandwidth requirements,

hardware requirements, and assess future technology to support joint experiments.

2. (U) FY 1999 PLAN:

(U) ($14,980)
The FY 99 objectives will be laid out in the USACOM Joint Experimentation Campaign Plan 99 (CPLAN 99). The Campaign provides a methodology for laying out a schedule and implementation plan for identified subjects to be considered in future Joint Warfighting Experiments. The events chosen for the first full year of the Joint Warfighting program will evaluate the technologies and means to validate the Desired Operational Capabilities (DOCs) identified in the Joint Vision 2010 Implementation plan. Additionally the planned activities will focus on identifying Future Operational Capabilities (FOCs) which will be critical to Joint Warfighting. These experiments are product of a future warfighting Concepts Conference which was sponsored by USACOM in October 1998. This conference attended by Battle Laboratory representatives from all the services, the Joint Staff and Unified CINCs nominated 46 future warfighting experiments. USACOM subsequently identified 8 concepts which are schedule for initiation in FY 99. These concepts will leverage on going service demonstrations/experiments, ACTDs and ATDs. They will include experiments which evaluate the following concepts: Attack Operations Against Critical Military Targets, Future Collaborative Information Environment, Joint Contingency Force Operations, Focused Logistics, Common Relevant Operational Picture, Adaptive Joint Command and Control, Interoperable Combat ID and Surveillance and Fires From Space. These eight concepts will form the basis of the experimentation process USACOM will initiate in FY99. This effort has also supported the independent assessment of the Joint Advanced Warfighting Program (JWAP). The results from JWAP have been considered by and integrated into the overarching USACOM Joint Experimentation program.

(U) ($2,849) Expansion of the on going technical work development of the Information Technology Backplane (ITB). Particular attention will be paid to linking the capabilities of several ACTDs including joint logistics, joint planning, rapid battlespace visualization, battlefield awareness data dissemination and Synthetic Theatre of War (STOW). Support will be given to implementers at USACOM and the individual Military Services to assist in the design and execution of information superiority and warfighting experiments.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER: R2497
PROJECT TITLE: Joint Experimentation

(U) ($3,050)
Experimentation Feeder Support: Experimentation Feeder Support provides resources to ensure that the joint experimentation program is consistent with the high level architecture and Defense Modeling and Simulation Office (DMSO's) simulation roadmap and existing on-going demonstrations with the potential for enhancing military operational capability or cost effectiveness to participation in joint experiments.

(U) ($9,121)
The USACOM Joint Experimentation Implementation Plan (I-Plan) dated 14 July 98 is CINCUSACOM's concept and plan for executing the SECDEF Charter for Joint Experimentation. It establishes the experimentation process and describes how USACOM will task organize to accomplish the mission. Leveraging existing resources and work accomplished by the Joint Staff and Joint Warfighting Center, USACOM's FY 99 experimentation focus will be to test and subsequently refine the "Proof of Concept" envisioned for the experimentation process by conducting Joint Experiment Number 1 (JE-1). JE-1 will test emerging concepts and joint doctrine by utilizing advanced simulations, virtual environments, and wargames. In concert with JE-1, USACOM will host a "Futures Program" consisting of workshops, seminars and symposiums as part of the experimentation process. The Futures Program will explore future Doctrine, Organization. Training and Education, Materiel, Leadership, People (DOTML-P) issues by reviewing emerging technologies and concepts that support doctrine, organizations, training, materiel, leadership and people by bringing together warfighters, futurists, academics, and industry. The Futures Program will explore use of wargames, modeling and simulation and virtual environments in developing future concepts for experimentation. JE-1 and the Futures Program will leverage the existing Information Technology (IT) Backplane to conduct experiments. However, it is envisioned that robust experimentation will require continued development of the existing IT Backplane capabilities.

3. (U) FY 2000 PLAN:

(U) ($30,740) This funding will support continued activities by USACOM as the Executive Agent for Joint Experimentation in the execution and assessment of two USACOM generated Joint Warfighting Experiments, five Major Leveraged Military

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER: R2497
PROJECT TITLE: Joint Experimentation

Service events and seven Minor Leveraged Military Service experiments and demonstrations. Additionally USACOM will continue to sponsor the ongoing series of Future Seminars and Warfighter reviews of technologies and operational concepts, which examine the developments and prospects for technological innovation and their relationships to mid-term and future operational concepts. USACOM will also sponsor other technological-operational concept development studies and required Red Team technology vulnerability assessments. Specific experimental technologies which are relevant to the operational issue, including prototypes, advanced technologies, surrogates and required integration materials will be used to support these integration efforts. Modeling and simulation and wargames will continue to be an integral element of the FY 00 plan to develop, assess and generate new concepts and identify new technologies suitable for experimentation.

(U) ($8,600) Coordination of scheduled Joint Experimentation initiatives with the results of scheduled Military Service warfighting experiments and concept demonstrations and those of other Unified CINCs. This will include identification and inclusion of relevant Military Service and Defense Agency science and technology initiatives which might support USACOM's overarching experimentation process.

(U) ($2,500) Advanced planning and support for development and coordination of scheduled FY 01 and FY 02 experiments will be conducted in parallel with on going FY 00 experiments.

(The growth between FY 99 and FY 00 is the result of the increased number of Joint Experiments and the coordination with the associated service and other Unified CINC experiments and demonstrations.

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

(U) RELATED RDT&E:

- (U) PE 0601153N Defense Research Sciences
- (U) PE 0602111N Air and Surface Launched Weapons Technology
- (U) PE 0602121N Ship, Submarine and Logistics Technology

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BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

PROJECT NUMBER: R2497
PROJECT TITLE: Joint Experimentation

- (U) PE 0602122N Aircraft Technology
- (U) PE 0602232N Communications, Command and Control, Intelligence, Surveillance and Reconnaissance (C3ISR)
- (U) PE 0602233N Human Systems Technology
- (U) PE 0602234N Materials, Electronics and Computer Technology
- (U) PE 0602270N Electronic Warfare Technology
- (U) PE 0602314N Undersea Warfare Surveillance Technology
- (U) PE 0602435N Oceanographic and Atmospheric Technology
- (U) PE 0602633N Undersea Warfare Weapon Technology
- (U) PE 0603750D Advanced Concept Technology

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	39,624	43,222	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.
R2381 LCAC GPU-5 Gunpod	728	0	0	0	0	0	0	0	728	728
R2499 ALISS	0	998	0	0	0	0	0	0	998	998
TOTAL	40,352	44,220	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore.

(U) This Program Element (PE) transitions technologies responding to high-priority Naval Expeditionary Warfare mission requirements. The emphasis is on simulating and testing prototypes of technologies with the potential for providing Naval capabilities in six major areas:

- Mine Countermeasure (MCM) techniques for clandestine surveillance and reconnaissance; organic minehunting and clearance; and organic ship protection.
- Offensive Sea Mining
- Battlefield surveillance, reconnaissance, and targeting.
- Naval fire support.
- Command, control, communications, information processing, and mission planning supporting land battles.
- Force mobility and survivability.

(U) Task ADVANCED DEGAUSSING was begun in FY 1993, and is designed to enhance current and future ship passive mine self-defenses by lowering the magnetic signatures of the ship. Four main areas of improvement are: advanced deperming to reduce

the vertical magnetic signature by 50% over current capabilities, advanced degaussing by using 3-axis sensing coils and controllers to reduce magnetic signatures by 75%, closed loop degaussing to maintain magnetic signatures in real-time, and secondary field signature reductions due to corrosion-related magnetic fields. ADVANCED DEGAUSSING is currently scheduled for completion in FY 1999 and will be transitioned to Amphibious Transport Dock (LPD-17) baseline design, PE 0603502N for the MCM ships, and PE 0603513N for steel-hulled ships.

(U) Task ADVANCED SURVEILLANCE/RECONNAISSANCE was begun in FY 1996 and is designed to utilize National Technical Means more efficiently in support of MCM operations and amphibious assaults. The focus is upon improving algorithms for detection of mines, minefields, and essential elements of information, together with improving the methods and types of data acquisition in a timely manner.

(U) Task MODELING AND SIMULATION is a continuing effort, designed to determine project utility via simulations, wargames, and system studies. Initially focused on mine warfare, the focus of the modeling and simulation effort is on the assessment of potential Expeditionary Warfare technologies (specifically those associated with naval surface fire support). The methodology is to utilize warfighter-technologist interactions and warfighter driven simulation/visualization based technology assessment to explore current and proposed advanced technologies in tandem with relevant concepts of operations.

(U) The JOINT COUNTERMINE ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (JCM ACTD) began in FY 1995 with funds provided by the Office of the Secretary of Defense under another PE. Funding support was transferred to this PE in FY 1996. The JCM ACTD is a joint Army-Navy program with significant participation by the Marine Corps. The ACTD will integrate emerging new technologies with those already existing in the field to demonstrate seamless sea-to-shore mine countermeasure/countermine operations with heavy emphasis on clandestine surveillance and reconnaissance in support of expeditionary warfare objectives. Major demonstrations were conducted in FY 1997 and FY 1998. Following completion of the demonstrations, selected "residuals" of new equipment will remain with field forces until FY 2000 to facilitate "user" feedback, refine the concept of operations, and develop tactical doctrine. A Joint Countermine Operational Simulation and a Command, Control, Communications, Computers and Intelligence appliqué will be developed to facilitate system integration, allow for mission planning, and provide improved displays for operational commanders.

(U) Task ADVANCED AIRBORNE TARGET DESIGNATOR was begun in FY 1996 and is designed to improve targeting of precision guided munitions (PGM) from over-the-horizon (OTH) battlefield objects in support of Naval Surface Fires (NSF). Efforts include laser target rangefinding and laser designation from unmanned and manned platforms, rapid reporting of targets in existing and compatible formats.

(U) Task EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING was begun in FY 1996 and is designed to improve the connectivity between sea and land forces, particularly in support of NSF and for OTH operations. Concepts to be examined will include: prototype ship-to-shore, high data rate, digital, dynamically controlled network for timely sensor-to-shooter connectivity supporting littoral operations such as close air support, and Naval fire support including existing or planned systems for linking organic and theater surveillance assets such as Joint Surveillance Target Attack Radar System, EP-3, ES-3, and Airborne Warning and Control System. High Frequency (HF)/Very HF (VHF) /Ultra HF(UHF), cellular, and satellite communications

systems such as Joint Tactical Information Distribution System, Common High Bandwidth Datalink, Military Strategic and Tactical Relay, and wideband line-of-sight tactical video will be included. Prototypes to be considered should be interoperable with the Improved Data Modem and Automated Target Handoff System and be capable of transitioning to the Navy's Communication Support System.

(U) Task SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE was begun in FY 1996 and is designed to improve the Navy's ability to monitor and survey the land battlespace for PGM from OTH in all-weather conditions from either manned or unmanned vehicles in support of NSF.

(U) Task MINE IDENTIFICATION was begun in FY 1998 and is designed to provide the capability to conduct rapid mine identification. Rapid mine identification has been identified as crucial to improving mine countermeasures timelines and for organic mine countermeasures. This effort focuses on the application of commercial off the shelf (streak tube technology for underwater imaging for mine identification.

(U) Task LITTORAL SEA MINE begins in FY 1999 and is designed to provide the technologies for development of an affordable littoral sea mine. The focus of this effort is on the development and demonstration of technologies for a wide area, littoral sea mine with remote control.
(U) Task VERY SHALLOW WATER (VSW)/EXPLOSIVE ORDNANCE DISPOSAL RECONNAISSANCE begins in FY 1999 and is designed to provide technologies to improve the capability to conduct MCM operations in VSW. The near term objective of this task is to improve the efficiency of our current diver operations in VSW through the demonstration and transition of improved diver technologies and Unmanned Underwater Vehicle (UUV) technologies which improve the efficiency of current VSW diver operations. The long term goal of this task is to demonstrate and transition technologies which fully replace the functions which are currently performed by divers.

(U) Task ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES begins in FY 1999 and is directed at providing the technologies for transition of naval MCM capabilities from dedicated to organic.

(U) Task SZ NEUTRALIZATION OF MINE AND OBSTACLES begins in FY 1999 and is directed at developing and demonstrating small, autonomous minehunting vehicles capable of detection, classification, identification and neutralization of small mines in surf zone environments.

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

(U) The Navy Science and & Technology program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity because it encompasses design, development, simulation, or experimental testing or prototype hardware to validate

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

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technological feasibility and concept of operations and reduce technical risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	$36,876	$41,710	$48,930
(U) FY 1999 Appropriated Value:		$42,710	
(U) Adjustments from 1999 PRESBUDG:	$ 3,476	$2,510	$ -219
(U) FY 2000 President's Submission	$40,352	$44,220	$48,711

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1998 increase is due to Actual Execution Update (+3,476). The FY 1999 increase is due to Execution Update (+2,000), Revised Economic Assumptions (-98), Civilian Personnel Underexecution (-70), Contract Advisory and Assistance reduction (-295), FFRDC (-27) and Congressional Plus-up for ALISS (+1000). FY 2000 decreases reflect adjustments for NWCF Rates, Civilian Pay Rates, and Inflation (-219).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	39,624	43,222	48,711	45,869	46,873	48,030	49,167	50,339	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities enabling Naval Expeditionary Forces to influence operations ashore.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1.(U) FY 1998 ACCOMPLISHMENTS:

- (U) ($6,500) ADVANCED MINE AND OBSTACLE CLEARANCE: Demonstrated 1/5 scale beach zone (BZ) array (inert) and deployment system for neutralization of BZ mines. Transitioned beach zone array deployment technology to program element (PE) 0603502N. Demonstrated inert explosive line charges, Surf Zone (SZ) array, and Landing Craft, Air Cushion fire control in Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD) as part of Maritime Combined Operational Training (MARCOT98)/Unified Spirit (a combined Canadian/North Atlantic Treaty Organization (NATO) exercise).

- (U) ($4,400) ADVANCED MINE SWEEPING: Completed integration of acoustic spark gap source and conductively cooled, low temperature superconducting magnetic subsystems on demonstration platform. Conducted final tests of both systems and performed field tests. Demonstrated Advanced Lightweight Influence Sweep System

technologies in the JCM ACTD as part of MARCOT98/Unified Spirit (a combined Canadian/NATO exercise). Transitioned magnetic and acoustic technologies to PE 0603502N.

- (U) ($5,100) ADVANCED DEGAUSSING: Completed tests of first generation closed-loop degaussing algorithms, advanced deperming, and stray field minimization technologies. Initiated transition of degaussing technologies to PE 0603513N, PE 0603502N, and to the Amphibious Transport Dock (LPD-17) program.

- (U) ($4,200) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continued utilizing advanced sensors to measure critical battle space parameters and quantify their effectiveness. Demonstrated surveillance and reconnaissance of beach defense obstacles in the JCM ACTD demonstration. Began focused efforts to develop algorithms for determining beach topography, off-shore currents, and surf conditions in real-time.

- (U) ($1,224) MODELING AND SIMULATION: Initiated modeling and simulation to conduct concept based assessment of potential Mine and Expeditionary Warfare technologies. The effort has emphasized warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and proposed advanced technologies in tandem with relevant concepts of operations (e.g. Operational Maneuver From The Sea, Sea Dragon).

- (U) ($7,300) JCM ACTD: Completed analysis of JCM ACTD demonstration I data. Conducted second JCM ACTD demonstration as part of MARCOT98/Unified Spirit military exercise (combined Canadian/NATO exercise in Newfoundland, Canada). The JCM ACTD demonstration II included the demonstration of 10 novel mine countermeasures technologies plus demonstration of Joint Countermine Operational Simulation (JCOS) and JCM Command, Control, Communications, Computer and Intelligence (C4I) appliqué. Began post exercise analysis of JCM ACTD demonstration II. Began support for "residual" equipment to be left with operational forces for further evaluation.

- (U) ($1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Conducted field tests of airborne target designator with live fires to determine accuracy of targeting to resulting fire locations. Completed documentation of field test results and quantification of localization accuracy. Initiated efforts to improve navigational accuracy of airborne test bed.

- (U) ($1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Conducted communication system interoperability tests in a laboratory and range environment. Demonstrated the shipboard integration and operation of advanced high capacity radio frequency links between ships at sea, as well as ship to an objective ashore. Began analysis and assessment of high capacity radio linkages between ships and ship to objective ashore.

- (U) ($3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Demonstrated emerging commercial off the shelf (COTS) technologies for real-time management and visualization of the Littoral Battlespace. Initiated analysis to assess potential increase in effectiveness and commensurate reduction of vulnerabilities of expeditionary forces.

- (U) ($4,300) MINE IDENTIFICATION: Initiated effort to develop a prototype underwater imager, using COTS Streak Tube technology for rapid identification of mines from Air Mine Countermeasures helicopters and remote minehunting systems. Completed preliminary design review of Streak Tube Imaging Laser (STIL) mine identification prototype. Initiated laboratory testing of receiver and laser optical components.

2. (U) FY 1999 PLAN:

- (U) ($3,770) ADVANCED DEGAUSSING: Complete all efforts in advanced deperming, closed loop degaussing, and algorithm development. Complete documentation of algorithms and demonstration results. Complete transition of degaussing technologies to PE 0603513N, PE 0603502N, and the LPD-17 construction program.

- (U) ($3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused efforts on environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious assaults. Continue transitioning critical battle space products to the Naval Oceanographic Office. Demonstrate littoral remote sensing products during Fleet Battle Experiment (FBE) Echo (Kernal Blitz).

- (U) ($1,500) MODELING AND SIMULATION: Continue simulation based concept based assessment focusing on assessment of technologies for naval surface fire support. The effort will continue to emphasize warfighter-technologist interaction and warfighter driven simulation based technology assessment to explore in detail current and advanced technologies in tandem with relevant concepts of operations. Initiate concept visualization of naval surface fire support technologies.

- (U) ($2,700) JCM ACTD: Complete post exercise analysis of JCM ACTD Demonstration II. Document demonstration results. Continue logistics support for ACTD "residual" equipment left with operational forces. Complete JCOS and C4I documentation. Demonstrate C4I and JCOS during FBE-Echo (Kernal Blitz) as part of the residual phase. Incorporate "user" comments into final ACTD documentation.

- (U) ($1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete field tests and demonstrations with live fires to determine accuracy of targeting to resulting fire locations. Continue documentation of field test results and quantification of localization accuracy. Initiate transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and Unmanned Aerial Vehicles (UAVs).

- (U) ($1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue demonstration of advanced high capacity radio frequency links between ships at sea, focusing on beyond line of sight communications between ships and objectives ashore. Complete assessment of high capacity radio technologies between ships at sea.

- (U) ($3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Initiate development of component technologies for demonstration of a low cost, high speed guided projectile for Naval guns. Begin development of actuated aerodynamic control surfaces for control of high velocity projectiles. Begin development of an ultracompact, high G (>40,000 G) Global Positioning System/Inertial Measuring Unit (GPS/IMU) guidance package for guidance of high velocity naval ordnance.

- (U) ($5,213) MINE IDENTIFICATION: Begin integration of component technologies together in the laboratory. Begin fabrication of final design suitable for tow-body configuration. Begin integration and performance of final design. Conduct tank tests of preliminary system.

- (U) ($4,531) LITTORAL SEA MINE: Initiate design of littoral sea mine technology demonstration model. Initiate fabrication/testing of individual components. Begin development of data fusion algorithms and assured communication algorithms.

- (U) ($5,769) VERY SHALLOW WATER/EXPLOSIVE ORDNANCE DISPOSAL (VSW/EOD) RECONNAISSANCE: Initiate integration of diver-portable detection, classification, and identification technologies such as diver-portable sonar, underwater imaging Light Detection and Ranging, and autonomous underwater vehicles. Develop simulation which provides for the evaluation of the approach and effectiveness of Unmanned Underwater Vehicles (UUVs) under varying environmental conditions to perform critical Mine Countermeasure VSW missions including search and inspection. Initiate trade-off studies of technical and operational concepts to include directed versus autonomous operation, deployment, recovery, command, control and communication. Prototype low-cost acoustic and magnetic induction navigation transponders and receivers to enable localization in VSW. Begin demonstrating technologies during training exercises to assess operational effectiveness.

- (U) ($4,500) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Begin demonstration of advanced technologies for organic minehunting during Fleet training exercises to assess operational effectiveness and develop concept of operations. Demonstrate rapid, organic mine identification using electro-optic sensor (laser line scan technology) and synthetic aperture sonar during FBE Echo (Kernal Blitz). Demonstrate high speed influence minesweeping using ALISS technologies during FBE Echo (Kernal Blitz).

- (U) ($4,700) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Initiate development a system of small, autonomous minehunting vehicles capable of detection, classification, identification, and neutralization of mines and

obstacles in the SZ environments. Demonstrate navigation and communications capabilities of unmanned bottom vehicles operating in the surf zone environment. Demonstrate capability to achieve area coverage using random, programmed, and co-located group strategies.

- (U) ($439) Portion of extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 USC 638.

3. (U) FY 2000 PLAN

- (U) ($3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focused algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious operations. Continue transition of critical battle space products to the naval oceanographic office.

- (U) ($1,800) MODELING AND SIMULATION: Continue simulation based concept based assessment of technologies for naval surface fire support. Continue concept visualization of naval surface fire support technologies focusing on air space deconfliction.

- (U) ($1,500) JCM ACTD: Continue logistics support for select ACTD "residual" equipment left with operational forces for further evaluation.

- (U) ($462) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete documentation of field test results and quantification of localization errors. Complete transition of airborne target designator technology to Marine Corps Systems Command Ground Weapons for integration in UH-1N and UAVs.

- (U) ($3,000) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue evaluation of advanced high capacity communications links between ships at sea and ship to objectives ashore through assessment during Amphibious Ready Group deployments. Complete analysis and assessment of high capacity radio linkages between ships at sea and ships to objective ashore.

- (U) ($5,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, FIRE CONTROL, AND ORDNANCE: Complete development of actuated control surface for high speed projectile. Conduct wind tunnel tests. Complete development of ultracompact, high G GPS/IMU guidance package for high speed projectile. Integrate components and demonstrate guidance and control of an inert, high velocity 5 inch projectile. Begin development of composite metal fleschette and packaging and distribution warhead.

- (U) ($6,200) MINE IDENTIFICATION: Complete integration of component STIL technologies in airborne minehunting sonar (AQS-20) towbody. Initiate development of automated mine identification algorithms. Demonstrate mine identification at operational speeds from a surface ship tow. Quantify performance as a function of operational parameters. Demonstrate mine identification from a helicopter tow. Begin transition of STIL mine identification technology to PE 0603502N and PE 0604373N (Airborne Mine Countermeasures).

- (U) ($5,000) LITTORAL SEA MINE: Demonstrate and evaluate assured communications between an underwater testbed and an external surface and subsurface control authority. Demonstrate and evaluate long baseline target detection and tracking sensor hardware and algorithms against quiet underwater targets.

- (U) ($5,930) VSW/EOD RECONNAISSANCE: Develop search strategies which are optimized based on information provided by environmental survey data acquired by search and reconnaissance UUVs. Develop sensing technologies and capability to conjunctively employ sensed information between communicating platforms employing independently acquired sensed data. Demonstrate coordinated navigation and positioning in very shallow water through actual deployments of a search vehicle and inspection vehicle.

- (U) ($7,319) ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Complete analysis of Fleet Battle Experiment demonstration of advanced technologies for organic minehunting. Demonstrate and evaluate the use of a scaleable, interoperable tactical control system common to both UAVs and remote minehunting vehicles. Initiate development of a prototype H-60 compatible, conductively cooled, low temperature superconducting magnetic solenoid for organic sweeping of influence mines.

- (U) ($4,000) SZ NEUTRALIZATION OF MINES AND OBSTACLES: Demonstrate coordinated navigation and positioning in the SZ through actual deployments of an unmanned bottom crawling vehicle. Demonstrate autonomous detection and classification of threat-like bottom objects in the presence of natural and man-made clutter in the SZ. Demonstrate group search (up to 5 vehicles), report back of target information, and marking of targets.

- (U) ($5,000) BZ NEUTRALIZATION OF OBSTACLES: Initiate development of Inverse Guidance Law concept which allows guidance of air dropped ordnance with GPS position and velocity state data only. Assess performance of against conventional GPS updated inertial navigation concepts. Begin development of air delivered, reactive, intermetalic darts for neutralization of mines on the beach.

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602131M (Marine Corps Landing Force Technology)

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

PROJECT NUMBER: R2226
PROJECT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (MCM, Mining and Special Warfare Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0603502N (Surface and Shallow Water MCM)
(U) PE 0603513N (Shipboard System Component Dev)
(U) PE 0603528N (Non-Acoustic ASW)
(U) PE 0603612M (Marine Corps Mine Countermeasures)
(U) PE 0603640M (Marine Corps Advanced Technology)
(U) PE 0604373N (Airborne Mine Countermeasures)
(U) PE 0604784N (Distributed Surveillance System)

D. (U) SCHEDULE PROFILE: Not Applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1889 Advanced Technology Demonstration	68,054	64,174	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.
R2382 Fast Patrol Craft	9,500	0	0	0	0	0	0	0	0	0
R2383 High Frequency Surface Wave Radar (HFSWR)	3,795	0	0	0	0	0	0	0	0	0
R2411 SWATH Technology Development	4,745	0	0	0	0	0	0	0	0	0
R2600 SLICE Trailer	0	9,478	0	0	0	0	0	0	0	0
TOTAL	86,094	73,652	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program demonstrates high-risk/high-payoff technologies that could significantly improve the warfighting capabilities of the fleet and joint forces, and provides the opportunity to identify and move emerging technologies quickly and efficiently from the laboratory to the fleet. Advanced Technology Demonstration (ATD) programs are selected for a match between technological potential and Navy requirements which are derived from operational issues of concern to the fleet and Joint Warfighting Capabilities Assessment. Risk-reducing ATDs cover integrating and assessing technology in a realistic operational environment and are focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration is designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

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

(U) PROGRAM CHANGE FOR TOTAL PROGRAM ELEMENT (PE):

	FY 1998	FY 1999	FY 2000
FY 1999 President's Budget	83,510	74,392	76,316
Appropriated Value		73,892	
Adjustments from FY 1999 President's Budget	+2,584	-740	-681
FY 2000 President's Budget Submission	86,094	73,652	75,635

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 increase (+$2,584) reflects Actual Execution Update (+$2,777) and Small Business Innovation Research Reduction (-$193). FY 1999 decrease (-$740) reflects reductions for Revised Economic Assumptions (-$170), Civilian Personnel Underexecution (-$62), Congressional Reduction (-$10,000), Federally Funded Research and Development Center Distribution (-$8), and Congressional Add for SLICE Trailer (+$9,500). FY 2000 decrease (-$681) reflects net Navy Working Capital Fund Rate Adjustment (-$681).

(U) Schedule: Reductions have delayed initiation of Reactive Material Advanced Warhead from FY 1999 to FY 2000 and have significantly curtailed FY 1999 efforts for Advanced Linear Motor.

(U) Technical: Low Cost Missile System was terminated for high payoff technical alternatives, cost growth and lack of transition support. FY 1999 efforts are limited to documentation of progress to date.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R1889 Advanced Technology Demonstration	68,054	64,174	75,635	77,756	79,511	81,394	83,298	85,260	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program demonstrates high-risk/high-payoff technologies that could significantly improve the warfighting capabilities of the fleet and joint forces, and provides the opportunity to identify and move emerging technologies quickly and efficiently from the laboratory to the fleet. ATD programs are selected for a match between technological potential and Navy requirements which are derived from operational issues of concern to the fleet. Risk-reducing ATDs cover integrating and assessing technology in a realistic operational environment and are focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration is designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1998 ACCOMPLISHMENTS:

- (U) ($255) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Completed ATD.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($1,080) TACTICAL AIRCRAFT DIRECTED INFRARED COUNTERMEASURES (DIRCM) -- Completed ATD: conducted flight testing and field demonstrations of developed hardware and countermeasures techniques.
- (U) ($4,231) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Completed ATD: conducted final demonstration of shipboard prototype and evaluated system performance.
- (U) ($4,500) ADVANCED ELECTRONIC COUNTERMEASURES (ECM) TRANSMITTER FOR SHIP DEFENSE -- Completed ATD: completed system integration, lab and field testing, and conducted final demonstration.
- (U) ($4,500) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SUPER HIGH FREQUENCY (SHF) PHASED ARRAY ANTENNA -- Completed ATD: completed X-band antenna array fabrication; conducted demonstration.
- (U) ($3,111) SMART SKINS ARRAY -- Continued ATD: fabricated Advanced Development Model (ADM) and conducted ADM ground test/analysis.
- (U) ($4,450) COMPETENT MUNITIONS FOR THE 5" GUN -- Continued ATD: completed laboratory testing of inertial-only guidance fuse package and global positioning system/inertial guidance fuse package.
- (U) ($6,095) LOW COST MISSILE SYSTEM -- Continued ATD: completed fabrication of subsystems. Integrated subsystems, conducted aerodynamic/wind tunnel testing, hardware-in-the-loop simulation and booster insensitive munitions testing.
- (U) ($6,123) MULTIFUNCTION ELECTRONICS RADIATING SYSTEM (MERS) -- Continued ATD: completed fabrication of performance model and conducted mast mock-up performance tests; built demonstration model and performed component shipboard environmental tests.
- (U) ($5,180) BEST BUY -- Continued ATD: fabricated and tested composite airframe components; fabricated and tested high lift-to-drag airframe.
- (U) ($5,600) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Continued ATD: demonstrated a real-time voice/data link between submarine and surface vessel and a real-time slow scan video link between submarine and submarine.
- (U) ($4,000) ADVANCED COMMUNICATION INTELLIGENCE (COMINT) VOICE PROCESSING -- Continued ATD: fabricated and assembled voice processor components; conducted subsystem testing.
- (U) ($2,100) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS, AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Initiated ATD to demonstrate DNA vaccines designed to protect against complex, multistage microorganisms or against multiple simple pathogens. Performed gene cloning to produce human-use plasmids.
- (U) ($3,990) LOW OBSERVABLE MULTI-FUNCTION STACK -- Initiated ATD to demonstrate a surface ship composite exhaust stack having embedded multi-function satellite communication array antennas. Completed stack and antenna designs.
- (U) ($3,000) RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS) -- Initiated ATD to demonstrate an airborne system to detect, target, and explosively destroy near surface mines using laser directed (LIDAR) fire of a supercavitating

projectile from a helicopter mounted gun. Conducted tower demonstration of projectile lethality against key mine types.

- (U) ($4,872) AFFORDABLE ARRAY TECHNOLOGY -- Initiated ATD to demonstrate an affordable, reliable, and all-optical acoustic sensor/array technology for reconfigurable large aperture sonar arrays. Conducted lake tow test for baseline of thinline system noise.
- (U) ($2,546) ADVANCED SURFACE SITUATIONAL AWARENESS -- Classified program.
- (U) ($2,421) Selected and performed planning for FY00 start ATDs. Conducted independent reviews of on-going ATD programs.

(U) FY 1999 PLAN:

- (U) ($3,146) SMART SKINS ARRAY -- Complete ATD: conduct F/A-18 testing to demonstrate operational utility.
- (U) ($493) LOW COST MISSILE SYSTEM -- Document completed activities of terminated ATD.
- (U) ($1,446) COMPETENT MUNITIONS FOR THE 5" GUN -- Complete ATD: conduct flight testing demonstration.
- (U) ($5,418) BEST BUY -- Continue ATD: demonstrate two-piece composite projectile gun auto-loading and conduct flight test of unguided composite projectile.
- (U) ($4,446) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Complete ATD: demonstrate multi-net connectivity between submarines, ships, and aircraft.
- (U) ($4,046) ADVANCED COMINT VOICE PROCESSING -- Complete ATD: perform system integration with ES-3 aircraft and conduct flight demonstration of automated voice processing system.
- (U) ($5,046) ANTI-TORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Continue ATD, as coupled with NATO effort, with at-sea tests in realistic environments.
- (U) ($4,746) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Continue ATD: continue clinical trials, combined multi-stage DNA vaccines.
- (U) ($4,546) RAMICS - Continue ATD: demonstrate system integration/gun-sensor interface.
- (U) ($4,446) AFFORDABLE ARRAY TECHNOLOGY -- Continue ATD: perform tow and reel tests, develop array/transmitter/receiver.
- (U) ($5,146) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: fabricate stack/shroud and antenna; evaluate test articles.
- (U) ($5,546) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Initiate ATD to demonstrate full-scale plasma-arc pyrolysis system for controlled thermal destruction of shipboard wastes. Perform preliminary design.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($4,046) LONG-ENDURANCE, LOW FREQUENCY ACOUSTIC SOURCE (LELFAS)-- Initiate ATD to demonstrate a low-cost, affordable, rapidly deployable, long-endurance, low frequency acoustic source. Perform initial system design and analysis. Develop high-energy density thermal power source.
- (U) ($1,046) ADVANCED LINEAR MOTOR -- Initiate ATD: demonstrate an aircraft recovery system using linear motor technology. Develop preliminary concept and conduct design evaluations.
- (U) ($4,046) REDUCED SHIPS' CREW BY VIRTUAL PRESENCE (RSVP) -- Initiate ATD: demonstrate at sea an automated system providing environmental, machinery, structural and personnel situational awareness. Define requirements, develop system architecture, conduct feasibility demonstrations and initiate subsystem development.
- (U) ($3,846) SHIPBOARD HIGHBAND MULTIFUNCTION RECEIVE SYSTEM (HBMRS) - Initiate ATD: develop and demonstrate radar, electronic warfare and communication functions in a phased array. Perform prototype design; design, fabricate and test sub-array and transmit/receive modules.
- (U) ($1,700) Select and perform planning for FY01 start ATDs. Conduct independent reviews of on-going ATD programs.
- (U) ($1,019) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

(U) FY 2000 PLAN:

- (U) ($1,429) BEST BUY -- Complete ATD: conduct long-range firing demonstration of projectiles to validate payload capacity and the ability to dispense submunitions over target area.
- (U) ($5,030) ANTI-TORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Complete ATD with at-sea tests.
- (U) ($3,830) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Complete ATD: complete clinical trials.
- (U) ($7,530) RAMICS - Complete ATD: demonstrate system targeting on an operational platform.
- (U) ($5,130) AFFORDABLE ARRAY TECHNOLOGY -- Complete ATD: complete development of prototype array and conduct research vessel tow tests.
- (U) ($4,530) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: conduct land-based demonstration of antenna hardware. Install stack suppresser and shroud/antennas on test ship.
- (U) ($4,830) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Continue ATD: design and test feed subsystem in lab-scale reactor; demonstrate process control with various waste feed mixtures.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) ($5,530) LONG-ENDURANCE, LOW FREQUENCY ACOUSTIC SOURCE (LELFAS)-- Continue ATD: finalize system design and initiate system fabrication.
- (U) ($4,230) ADVANCED LINEAR MOTOR -- Continue ATD: complete prototype design; conduct critical component testing and complete test site design.
- (U) ($5,530) REDUCED SHIPS' CREW BY VIRTUAL PRESENCE (RSVP) -- Continue ATD: perform lab prototype system development, integration and demonstration and conduct system development Final Acceptance Tests.
- (U) ($5,831) SHIPBOARD HIGHBAND MULTIFUNCTION RECEIVE SYSTEM (HBMRS) -- Continue ATD: perform software development; fabricate and test beamformer; and conduct shared aperture system integration.
- (U) ($4,381) REACTIVE MATERIAL ADVANCED WARHEAD -- Initiate ATD: demonstrate capability of solid reactive materials to extend mission kill in air, cruise missiles and ship self-defense arenas. Characterize materials and parameterize fragment design. Develop initial warhead concept and conduct initial vulnerability tests and analyses.
- (U) ($3,030) ADVANCED SHIPBOARD CRANE MOTION CONTROL SYSTEM: Initiate ATD: develop and demonstrate a crane control system that combines recent advances in nonlinear control system technologies with existing strategic Auxiliary Crane Ship electro-hydraulic cranes.
- (U) ($4,032) BUOYANT CABLE ANTENNA FOR HIGH DATA RATE SUB COMMS: Initiate ATD: develop and demonstrate an advanced Buoyant Cable Antenna (BCA) System to provide a submerged submarine with two-way, higher data rate Ultra High Frequency Fleet Satellite Communications and line-of-sight (LOS), L-band (Iridium) and K-band communications, as well as accessory sensor functions - Global Positioning System, Video, and Radar Early Warning.
- (U) ($4,030) MULTI-PLATFORM BROADBAND PROCESSING: Initiate ATD: develop and demonstrate a common, broadband integrated processing architecture for submarine, surface ship, and weapon sonar system platforms.
- (U) ($5,032) COMPOUND HELICOPTER CONCEPT: Initiate ATD: demonstrate reduction in fatigue loads, vibration levels and maintenance requirements through use of pumpjet for forward thrust with vectoring vanes at the tail, aimed at Airborne Mine Countermeasures (MCM) towing missions.
- (U) ($1,700) Select and perform planning for FY02 start ATDs. Conduct independent reviews of on-going ATD programs.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

B. (U) PROGRAM CHANGE SUMMARY: See Total Program Change Summary for PE.

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

(U) RELATED RDT&E:

- (U) PE 0601153N Defense Research Sciences
- (U) PE 0602111N Air and Surface Launched Weapons Technology
- (U) PE 0602121N Ship, Submarine and Logistics Technology
- (U) PE 0602122N Aircraft Technology
- (U) PE 0602232N Communications, Command and Control, Intelligence, Surveillance and Reconnaissance (C3ISR)
- (U) PE 0602233N Human Systems Technology
- (U) PE 0602234N Materials, Electronics and Computer Technology
- (U) PE 0602270N Electronic Warfare Technology
- (U) PE 0602314N Undersea Warfare Surveillance Technology
- (U) PE 0602435N Oceanographic and Atmospheric Technology
- (U) PE 0602633N Undersea Warfare Weapon Technology

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
X2091 Space and Electronic Warfare (SEW) Advanced Technology	13,612	20,800	22,022	22,528	23,030	23,583	24,142	24,722	CONT.	CONT.
R2239 Advanced Targeting	8,276	928	1,786	6,487	3,848	3,562	6,246	6,540	CONT.	CONT.
R2601 Dominant Battlespace Awareness	0	2,993	0	0	0	0	0	0	0	2,993
R2602 National Technology Alliance	0	14,965	0	0	0	0	0	0	0	14,965
TOTAL	21,888	39,686	23,808	29,015	26,878	27,145	30,388	31,262	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) develops Command, Control and Communications (C^3) technologies which enhance battle targeting for naval forces in Navy, Joint and Coalition operations. The tasking of this PE is executed in accordance with the Information Technology Management Reform Act (ITMRA) of 1996. This PE is being restructured to support the Navy's high priority technology needs for Navy implementation of network centric warfare and Joint Vision 2010. Primary products include technology for dynamic, reconfigurable, secure, radio frequency networks; high data rate, radio frequency communications; multi-function apertures; high assurance systems; distributive, collaborative,

planning and execution; complex information processing support for deliberate precision weapons engagements; and algorithms for specific target identification.

(U) This PE primarily supports the following Joint Mission Areas and Support Areas: Land Attack (comprised of precision strike and naval surface fire support functions), Amphibious Warfare, Information Warfare, Anti Air Warfare, Maritime Dominance, Theater Ballistic Missile Defense and Readiness/Training. The focus is on development and demonstrations of next-generation C^3 systems with high quality and certifiable quality of service to support joint war fighting operations, involving land units, ships, aircraft, and submarines. C^3 capabilities in the 21st century are key to the success of all aspects of military operations including force level planning and rehearsal quality as well as unit level battlespace awareness and weapons engagement execution.

1. (U) SEW Advanced Technology (X2091) -- This project is pursuing work in dynamic, reconfigurable, secure, radio frequency networks; high data rate, radio frequency communications; multi-function apertures; high assurance systems; and distributive, collaborative planning and execution. Efforts will develop:

(a) Low observable, high data rate apertures. Ships, aircraft and submarines in the 21st century must have signature-controlled apertures to enhance operational effectiveness. Apertures must provide connectivity between satellites, ships, aircraft and submarines and land units as well as provide for surveillance and active and passive electronic warfare.

(b) State-of-the-art telecommunications technologies for high data rate over the air communications with low probability of intercept and robustness with regard to jamming.

(c) High capacity Radio Frequency (RF) information networks using commercially developed advanced information handling techniques such as Asynchronous Transfer Mode (ATM) or modifications thereto for multi-media communications that meet unique military data transfer requirements and environments. These systems must be able to satisfy the full range of Quality of Service requirements including certifiable low latency for weapons engagements and critical equipment control. Commercial off-the-shelf (COTs) adapted, high speed, secure local area networks (LANs) will enhance the ability to perform collaborative strike planning, battlespace awareness and time sensitive fire support execution using real-time information from sources such as the Precision Signals Intelligence (SIGINT) Targeting System (PSTS) and tactical reconnaissance and surveillance sources.

(d) Automated command, control, communications, computers, intelligence sensors and reconnaissance (C4ISR) systems to minimize manning requirements e.g. an intelligent communications resource manager capable of adjusting bandwidth/frequency to

balance system loading. Expert systems including intelligent databases and tactical decision aids, for processing, correlation and fusion of large amounts of information which can allow a single operator to be more effective. Tools for ensuring information is available when required. Modified COB collaborative software for military missions.

(e) Tools to ensure integrity, validation, and verification of COTS and other software as well as aids for development. Techniques to ensure integrity or networks and information on networks.

(U) This program will match maturing information technologies with operational warfighting requirements to procure modern C4ISR capability based on an accelerated acquisition cycle.

2. (U) Advanced Targeting (R2239) -- This project is pursuing evaluation of current and emerging technologies to improve communications, surveillance and targeting capabilities for airborne, ground, and shipbased forces.

(a) The Precision Sigint Targeting System (PSTS): Is a Joint Service/Defense Agency effort to develop and demonstrate the capability to provide tactical users with near-real-time target identification and precision targeting information,sensor to-shooter target updating, and Battle Damage Assessment. PSTS will enhance the tactical utility/applicability of existing national assets and provide the tactical commander with performance improvements in terms of targeting accuracy, targets of interest, timeliness, and target identification. Technical challenges include development of advanced signal processing and data fusion algorithms for target detection and classification; and exploitation of multiple signal characteristics for specific emitter identifications.

(b) The advanced multifunction RF system will provide the capability to radiate and receive arbitrary communications, electronic warfare, and radar waveforms from common apertures which will reduce the antenna farms on Naval platforms, reduce life cycle costs, increase stealth characteristics of platforms, and enhance the effectiveness of the RF capabilities of the platforms for warfighting.

3. (U) Dominate Battle Space Command (R2601) -- This project is pursuing evaluation of visualization software and computer technologies to improve battlespace awareness, shorten the command and control decision-making cycle and interface with existing C4ISR systems, data links, and networks. Efforts include: networks that will provide the Command and Control (C2) operator with a real time interactive 3D visualization of the battle space; timely and dynamic management of intelligent, surveillance and reconnaissance (ISR) resources; and rapid and dynamic replanning.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

4. (U) National Technology Alliance (R2602) -- This project is pursuing identification and applicability of current and emerging satellite, commercial and consumer technologies to enhance Naval warfighting systems performance and capability while reducing costs. Navy decision-makers need to understand the impact of these technologies in order to employ the best solutions, plot a technology development course, and map out procurement strategies. The end result will be to develop systems that will support joint and future naval operations in the 21st Century by providing seamless access to tailorable information for warfighters, planners, decision makers and analyst at all echelons.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the Advanced Technology Budget Activity because it encompasses design, development, simulation, or experimental testing of prototype hardware and software to validate technological feasibility and concept of operations and reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

(U) PROGRAM CHANGE SUMMARY:

	FY 1998	FY 1999	FY 2000
(U) FY 1999 President's Budget	21,619	22,294	22,922
(U) Appropriated Value		40,294	
(U) Adjustments from FY 1999 PRESBUDG	+269	+17,392	+886
(U) FY 2000 PRESBUDG Submission	21,888	39,686	23,808

(U) CHANGE SUMMARY EXPLANATION:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) Funding: FY1998 adjustments reflect a Small Business Innovative Research reduction (-277) and an actual update adjustment (+546). FY1999 adjustments reflect the Congressional Plus-Up Dominant Battlespace Command Initative (+3,000), Congressional Plus-Up National Technology Alliance Program (+15,000); Congressional undistributed reductions (-124), and execution adjustment (-484). FY2000 adjustments reflect Science & Technology rate adjustment (+884); Navy Working Capital Fund (NWCF) rate adjustment (+258); Civilian Pay Rates (+88), and Non Pay Inflation reduction(-344).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
X2091 Space and Electronic Warfare (SEW) Advanced Technology	13,612	20,800	22,022	22,528	23,030	23,583	24,142	24,722	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project demonstrates advanced technology components, subsystems and systems that will improve the Navy's management and operational use of time-critical command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) data with certifiable assurance functionality, high data rates, optimization and automation of network resources, multi-level access and security of databases and the ability to transmit and receive multi-media data (voice/data/video) over high data rate communication circuits. Capabilities realized from these efforts will contribute to the Navy's ability to maintain an accurate situation assessment and tactical picture with required accuracy and timeliness to allow all forces to have detailed knowledge of the battlespace. This project is being restructured to support the Navy's high priority technology needs for Navy implementation of network centric warfare and Joint Vision 2010. Primary technology focus areas include dynamic reconfigurable secure radio frequency networks, high data rate radio frequency communications, multi-function apertures, high assurance systems, and distributive collaborative planning and execution. The highest emphasis is currently multifunction radio frequency (RF) apertures as these are absolutely essential. As funding is available over the FYDP the issues in the other key areas will be addressed

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

- (U) ($829) High Assurance Systems: The focus of this technology is verification & validation of mission critical systems. Designed and developed an approach and an initial capability for building customized system prototypes from a systems requirements specification. This Java-coded capability was used to build two small interfaces. Developed prototype implementation of formal techniques that automatically reduce requirements specification. Developed initial capability tool for generating test sets from system requirements specifications. Analyzed requirements specifications for Programmable Embeddable INFOSEC Product (PEIP) system and began interface builder for validation.

- (U) ($3,220) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Developed elements for multi-functional multi-beam broadband antenna. Elements cover extra high frequency (EHF) Satellite Communications (SATCOM)/Global Broadcast System (GBS) two-dimensional (2D) Receive Only Antenna sub-array. Conducted ultra high frequency (UHF) SATCOM/International Maritime Satellite (INMARSAT) sub-array demonstration to include hybrid reliability study and tracking/hand-off demonstration. Continued design of UHF/L/K/Q Band Planar Phased Array SATCOM antennas

- (U) ($1,520) Dynamic Reconfigurable Secure radio frequency (RF) Networks: This activity focuses on the Navy's critical need for management of heterogeneous network environments supporting mobile forces and land units in maritime operations. Conducted operational demonstration of Asynchronous Transfer Mode (ATM) hardware and associated software on the USS Abraham Lincoln during Joint Task Force Exercises 98-1. A Java applet and Java-based server were developed in support of Advanced Digital Network System.. Initiated a remote pier-side monitoring effort to support Commander in Chief, Pacific Fleet (CINCPACFLT) and the Joint Maritime Communications System (JMCOMS). Developed an autonomous network management application to perform functions specific to the Navy's pier-side network hook-up devices and applications. Supported successfully a Joint Command Information System (JCIS) network management demonstration in support of the Sea Based Battle Lab, particularly providing management of the ATM local area networks (LANs), including multicast and flow control. Transitioned results to JMCOMS.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

- (U) ($1,012) High Data Rate RF Communications: This technology focuses on the Navy's critical need for increased RF communications throughput for planning and execution in Joint Operations aboard all platforms. Purchased and tested components of a small aperture (approx. 1 meter diameter) Ku Band SATCOM system using a Code Digital Multiplexing Analysis (CDMA) MODEM for multi-terminal networked applications, in support of the Navy's Commercial SATCOM Communication Initiative (CSCI). Identified and modified spread spectrum modems. Performed initial antenna pointing and link margin testing. Performed antenna pedestal testing on a ship motion simulator. Tested power amplifiers and transceivers. Conducted technology assessments for RF communications in network centric warfare. Developed concepts and models, and demonstrated in Global 98 War Game.

- (U) ($7,031) Distributive Collaborative Planning and Execution: This area supports the Navy's need for increased speed and accuracy in collaborative planning and execution, conduct of distributed maritime operations with reduced staffs, and improved Joint service situational assessment, planning, and execution. Developed and demonstrated leading edge information processing and display technologies in an open system, advanced, multi-modal workstation environment that supports collaborative planning staff operations, tactical decision making and information management. Delivered the Beta release of hardened collaborative software for distributed group planning. Began installation and experimentation with the Joint Maritime Command Information System (JMCIS) program office personnel in the customer segment areas of training, planning and logistics; and with Commander, Third Fleet (COMTHIRDFLT) in support of the Undersea Warfare collaboration efforts in conjunction with carrier task force (CTF) 12. Supported Pacific Rim (RIMPAC) exercise. Developed transitionable advanced DII-COE applications for conducting a major integrated demonstration of real-time planning and execution capabilities in conjunction with Command Control Communication Computers, Intelligence (C4I)/Combat System Advanced Concepts-21 (ADCON-21) demonstration. Evaluated information timeliness, consistency, and quality of service from multiple sensor-shooter perspectives. In conjunction with Navy and Joint programs, integrated advanced C4I suite for conducting in-flight demonstration of real time coordination software for special warfare planning and pilot rescue in H-60R at Navy Strike and Air Warfare Center, Fallon, Nevada. Identified and incorporated advanced correlation, fusion, and video registration tools to demonstrate a tactical display for integration of real-time Intelligence, Surveillance, and Reconnaissance (ISR) sources for shore sites and surface combatants. The display provides data from real-time classified information sources, off-board communications links, and improved information integration to support over-the-horizon targeting in Joint littoral operations.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

2. (U) FY 1999 PLAN:

- (U) ($19,524) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Complete design and begin fabrication and testing of UHF/L/K/Q Band Planar Phased Array SATCOM antennas. Complete construction of lightweight, low signature Multi-function Electromagnetic Radiating System (MERS) antenna that integrates into a compact design the functions of the existing UHF line of sight (LOS) Communications, Joint Tactical Information Distribution System (JTIDS), Combat Direction Finding (DF), and Identification Friend/Foe (IFF) apertures to permit platform space for Cooperative Engagement Concept (CEC). Conduct sea trials and transition. Develop a design for an advanced multifunction RF system which will enable all RF functions Radar, Communications, and Electronic Warfare to be integrated into common apertures.

- (U) ($1,276) Distributive Collaborative Planning and Execution: This area supports the Navy's need for increased speed and accuracy in collaborative planning and execution, conduct of distributed maritime operations with reduced staffs, and improved Joint service situational assessment, planning, and execution. Conduct in-flight demonstration and complete documentation and transition of the real-time ground/air coordination software for special warfare planning and pilot rescue. Perform analysis of further C4ISR architectures based on recent technology advances in computer and sensor technologies.

3. (U) FY 2000 PLAN:

- (U) ($1,245) High Assurance Systems: The focus of this technology is verification & validation of mission critical systems. Develop, assess and demonstrate software tools and techniques to provide software process improvements, and network/system enhancements to improve existing and provide for additional network centric warfighting capability. With Carnegie Melon collaboration develop a synchronized, reliable, real time, simultaneous upgrade capability for systems software on multiple tactical units.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT NUMBER: X2091
PROJECT TITLE: (SEW) ADVANCED TECHNOLOGY

• (U) ($20,777) Multi-function Apertures: This technology addresses a unique Navy need for improved antenna aperture, reduced radar cross-section, and reduced numbers of shipboard antennas. Complete full UHF/INMARSAT-B/GBS/EHF SATCOM antenna fabrication, performance land-based testing and develop a ship installation package. Continue the development of the multifunction receive aperture for the multifunction radio frequency system.

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.
(U) RELEATED RDT&E:
(U) PE 0301567G (Computer Security Program)
(U) PE 0303140N (Information Systems Security Plan)
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602232N (Space and Electronic Warfare (SEW) Technology
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0604231N (Tactical Command Systems)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ACTUAL	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
R2239 Advanced Targeting	8,276	928	1,786	6,487	3,848	3,562	6,246	6,540	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As addressed in the Director of Defense, Research and Engineering's Global Surveillance and Communications Thrust, the Precision Sigint Targeting System (PSTS) is a Joint Service/Defense Agency effort to develop and demonstrate the capability to provide tactical users with near-real-time precision targeting information and sensor-to-shooter target updating. The proposed system will enhance the tactical utility and application of existing national assets to provide the tactical commander involved in future conflicts with significant performance improvements resulting in a total surveillance network which is more responsive to changing world economic and political threats in terms of targeting accuracy, targets of interest and timeliness. PSTS will develop Joint Service/Defense Agency cooperative precision targeting site enhancements and Global Concept of Operations (CONOPS) for optimal asset cooperative utilization and minimal operational impact. Technical challenges include development of advanced signal processing, data fusion algorithms, exploitation of multiple signal characteristics for target detection and precision geo-location, and modeling and simulation to assure optimal resource allocation for cooperative precision targeting and primary mission performance.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: R2239
Project Title: Advanced Targeting

- (U) ($5,156) DEMONSTRATION 5: Developmental Test 1 (DT1) was conducted in CONUS in May 1998 to determine system status prior to shipping equipment to Korea. Demonstration 5 was conducted in Korea with the goal of demonstrating all PSTS capabilities. Additional refinements and upgrades to the signal processing and data fusion algorithms based on the results from previous demonstrations were integrated into the processing system.
- (U) ($2,455) SYSTEMS ENGINEERING: Requirements analysis, operations concept development, test planning and test procedures, and scheduling for Demonstration 5 were completed. System engineering studies required to meet Demonstration 5 and to support technology transition were completed.
- (U) ($665) TECHNOLOGY TRANSFER: Completed documentation and configuration management of final PSTS systems including the tactical testbed.

2. (U) FY 1999 PLAN:

- (U) ($909) LOGISTICS SUPPORT: Provided engineering, operations and maintenance support for deployed PSTS systems.

- (U) ($19) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 JSC 638.

3. (U) FY 2000 PLAN:

- (U) ($900) LOGISTIC SUPPORT: Provide engineering, operations and maintenance support for deployed PSTS systems.

- (U) ($886) ADVANCED MULTIFUNCTION RADIO FREQUENCY SYSTEM: Design the advanced multifunction radio frequency system including all apertures, resource allocation manager and other subsystems. The initial test-bed is focused on the 1 to 5 GHz band including functions such as volume search radar, theater ballistic missile discrimination, Challenge Athena, receive noise jamming, deceptive jamming, and high probability of intercept electronic surveillance. Initial development will begin.

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: R2239
Project Title: Advanced Targeting

The approach, which is applicable to functions at lower and higher frequencies, will provide the Navy with a low cross-section and low life cycle cost approach to the proliferation of apertures and antennae on Naval platforms.

3. (U) PROGRAM CHANGE SUMMARY: See total program change summary for Program Element.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Available above SECRET level of classification.
(U) RELATED RDT&E: Available above SECRET level of classification.

D. (U) SCHEDULE PROFILE: Not applicable.