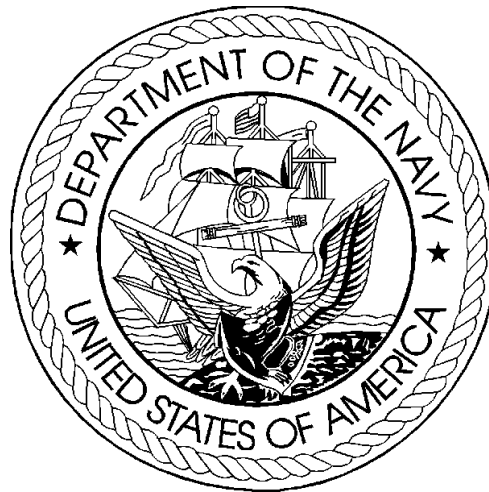


DEPARTMENT OF THE NAVY  
FY 1999 AMENDED BUDGET ESTIMATES



JUSTIFICATION OF ESTIMATES  
FEBRUARY 1998

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

UNCLASSIFIED

Department of the Navy  
FY 1999 RDT&E,N Program

Exhibit R-1

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

DATE: February 1998

R-1 Line Number	Program Element Number	Item Nomenclature	Budget Activity	Millions of Dollars			Security Classification
				FY 1997	FY 1998	FY 1999	
1	0601152N	In-House Independent Lab Research	1	14.175	14.248	14.734	U
2	0601153N	Defense Research Sciences	1	331.431	324.495	347.945	U
		Total Basic Research		345.606	338.743	362.679	
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	32.112	28.379	37.140	U
4	0602121N	Surface Ship Technology	2	48.790	48.865	43.177	U
5	0602122N	Aircraft Technology	2	21.931	24.553	23.229	U
6	0602131M	Marine Corps Landing Force Technology	2	16.016	13.458	12.132	U
7	0602228N	Historically Black Colleges & Univer/Minority Institutions	2	0.000	0.000	4.699	U
8	0602232N	C3 Technology	2	53.967	54.814	65.033	U
9	0602233N	Readiness Training & Env Quality Tech	2	49.837	38.079	29.722	U
10	0602234N	Materials, Electronics & Computer Technology	2	85.881	70.174	77.617	U
11	0602270N	EW Technology	2	18.274	21.164	23.849	U
12	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	44.442	44.578	50.619	U
13	0602315N	MCM, Mining & Special Warfare Technology	2	40.958	41.451	45.928	U
14	0602435N	Ocean & Atmospheric Technology	2	70.661	71.491	56.722	U
15	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	31.413	36.616	34.856	U
16	0602805N	Dual Use Application Program Total Applied Research	2	0.000	0.000	20.000	U
				514.282	493.622	524.723	
17	0603217N	Air Systems & Weapons Advanced Technology	3	36.870	34.562	48.143	U
18	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	61.610	54.319	58.306	U
19	0603270N	Advanced EW Technology	3	14.072	16.635	17.169	U
20	0603508N	Ship Propulsion System	3	31.064	48.261	39.264	U
21	0603640M	MC Advanced Technology Demo	3	19.646	58.780	41.931	U
22	0603706N	Medical Development (Advanced)	3	55.593	68.151	18.728	U
23	0603707N	Manpower, Pers, & Training Adv Tech Demo	3	18.002	21.834	21.042	U
24	0603712N	Environmental Quality & Logistics Adv Tech	3	37.701	25.462	20.919	U
25	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	45.697	44.772	56.827	U
26	0603782N	Shallow Water MCM Demos	3	40.847	36.876	41.710	U
27	0603792N	Advanced Technology Transition	3	69.110	83.510	74.392	U
28	0603794N	C3 Advanced Technology	3	31.790	21.619	22.294	U
		Total Advanced Technology Development		462.002	514.781	460.725	
		Total Science and Technology (S&T)		1,321.890	1,347.146	1,348.127	

UNCLASSIFIED

Department of the Navy  
FY 1999 RDT&E,N Program  
Alphabetic Listing

Exhibit R-1

APPROPRIATION: 1319n Research, Development, Test and Evaluation, Navy ..... DATE: February 1998

R-1 Line Number	Program Element Number	Item Nomenclature	Budget Activity	Millions of Dollars			Security Classification
				FY 1997	FY 1998	FY 1999	
19	0603270N	Advanced EW Technology	3	14.072	16.635	17.169	U
27	0603792N	Advanced Technology Transition	3	69.110	83.510	74.392	U
17	0603217N	Air Systems & Weapons Advanced Technology	3	36.870	34.562	48.143	U
5	0602122N	Aircraft Technology	2	21.931	24.553	23.229	U
28	0603794N	C3 Advanced Technology	3	31.790	21.619	22.294	U
8	0602232N	C3 Technology	2	53.967	54.814	65.033	U
2	0601153N	Defense Research Sciences	1	331.431	324.495	347.945	U
16	0602805N	Dual Use Application Program	2	0.000	0.000	20.000	U
24	0603712N	Environmental Quality & Logistics Adv Tech	3	37.701	25.462	20.919	U
11	0602270N	EW Technology	2	18.274	21.164	23.849	U
18	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	61.610	54.319	58.306	U
7	0602228N	Historically Black Colleges & Univer/Minority Institutions	2	0.000	0.000	4.699	U
1	0601152N	In-House Independent Lab Research	1	14.175	14.248	14.734	U
23	0603707N	Manpower, Pers, & Training Adv Tech Demo	3	18.002	21.834	21.042	U
6	0602131M	Marine Corps Landing Force Technology	2	16.016	13.458	12.132	U
10	0602234N	Materials, Electronics & Computer Technology	2	85.881	70.174	77.617	U
21	0603640M	MC Advanced Technology Demo	3	19.646	58.780	41.931	U
13	0602315N	MCM, Mining & Special Warfare Technology	2	40.958	41.451	45.928	U
22	0603706N	Medical Development (Advanced)	3	55.593	68.151	18.728	U
14	0602435N	Ocean & Atmospheric Technology	2	70.661	71.491	56.722	U
9	0602233N	Readiness Training & Env Quality Tech	2	49.837	38.079	29.722	U
26	0603782N	Shallow Water MCM Demos	3	40.847	36.876	41.710	U
19	0603508N	Ship Propulsion System	3	31.064	48.261	39.264	U
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	32.112	28.379	37.140	U
4	0602121N	Surface Ship Technology	2	48.790	48.865	43.177	U
12	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	44.442	44.578	50.619	U
25	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	45.697	44.772	56.827	U
15	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	31.413	36.616	34.856	U
Total Science and Technology (S&T)				1,321.890	1,347.146	1,348.127	

RDT&E, Navy  
Program and Financing (in Thousands of dollars)

Identification code	17-1319-0-1-051	Budget Plan (amounts for RESEARCH, DEV, TEST & EVAL actions programed)			Obligations		
		1997 actual	1998 est.	1999 est.	1997 actual	1998 est.	1999 est.
Program by activities:							
Direct program:							
00.0101	Basic research	345,606	338,743	362,679	347,232	321,791	361,241
00.0201	Applied Research	514,282	493,622	524,723	538,520	510,049	522,858
00.0301	Advanced technology development	462,002	514,781	460,725	526,719	488,623	463,967
00.0401	Demonstration/validation	1,904,375	2,219,002	2,358,359	1,948,060	2,132,484	2,350,003
00.0501	Engineering and manufacturing development	2,153,911	2,227,348	2,063,281	2,121,481	2,232,406	2,073,125
00.0601	Management support	681,340	551,033	616,973	707,119	555,438	613,016
00.0701	Operational system development	1,822,845	1,535,383	1,722,183	1,843,010	1,630,193	1,710,973
00.9101	Total direct program	7,884,361	7,879,912	8,108,923	8,032,141	7,870,984	8,095,183
01.0101	Reimbursable program	121,287	110,000	110,000	132,938	112,515	110,000
10.0001	Total	8,005,648	7,989,912	8,218,923	8,165,079	7,983,499	8,205,183
Financing:							
Offsetting collections from:							
11.0001	Federal funds(-)	-113,073	-110,000	-110,000	-110,978	-110,000	-110,000
14.0001	Non-Federal sources(-)	-8,214			-16,820		
17.0001	Recovery of prior year obligations				-33,145		
Unobligated balance available, start of year:							
21.4002	For completion of prior year budget plans				-605,401	-472,982	-479,395
21.4003	Available to finance new budget plans	-4,500	-53,879		-4,500	-53,879	
21.4009	Reprogramming from/to prior year budget plan	-12,643					
22.1001	Unobligated balance transferred to other acco		13,879			13,879	
22.2001	Unobligated balance transferred from other ac	-4,590			-4,590		
Unobligated balance available, end of year:							
24.4002	For completion of prior year budget plans				472,982	479,395	493,135
24.4003	Available to finance subsequent year budget	53,879			53,879		
25.0001	Unobligated balance expiring	355			355		
39.0001	Budget authority	7,916,862	7,839,912	8,108,923	7,916,862	7,839,912	8,108,923
Budget authority:							
40.0001	Appropriation	7,993,455	8,115,686	8,108,923	7,993,455	8,115,686	8,108,923
40.3601	Appropriation rescinded (unob bal)	-4,500	-40,000		-4,500	-40,000	
40.7601	Reduction pursuant to P.L. 105-56 (-), 8035		-251,265			-251,265	
40.7901	Line item veto cancellation (-)		-6,000			-6,000	
41.0001	Transferred to other accounts (-)	-182,207	-43,160		-182,207	-43,160	
42.0001	Transferred from other accounts	110,114	64,651		110,114	64,651	
43.0001	Appropriation (adjusted)	7,916,862	7,839,912	8,108,923	7,916,862	7,839,912	8,108,923

RDT&E, Navy  
Program and Financing (in Thousands of dollars)

Identification code	17-1319-0-1-051	Budget Plan (amounts for RESEARCH, DEV, TEST & EVAL actions programed)			Obligations		
		1997 actual	1998 est.	1999 est.	1997 actual	1998 est.	1999 est.
Relation of obligations to outlays:							
71.0001	Obligations incurred				8,037,281	7,873,499	8,095,183
72.1001	Orders on hand, SOY				-156,141	-146,613	-146,613
72.4001	Obligated balance, start of year				4,310,635	4,003,286	4,251,788
74.1001	Orders on hand, EOY				146,613	146,613	146,613
74.4001	Obligated balance, end of year				-4,003,286	-4,251,788	-4,372,794
77.0001	Adjustments in expired accounts (net)				-82,345		
78.0001	Adjustments in unexpired accounts				-33,145		
90.0001	Outlays (net)				8,219,612	7,624,997	7,974,177

RDT&E, Navy  
Object Classification (in Thousands of dollars)

Identification code	17-1319-0-1-051	1997 actual	1998 est.	1999 est.
-----				
Direct obligations:				
Personnel compensation:				
111.101	Full-time permanent	43,779	44,428	43,112
111.301	Other than full-time permanent	2,923	2,625	2,469
111.501	Other personnel compensation	1,494	1,563	1,527
111.801	Special personal services payments	27	27	28
		-----	-----	-----
111.901	Total personnel compensation	48,223	48,643	47,136
112.101	Personnel Benefits: Civilian personnel	10,194	10,653	10,207
113.001	Benefits for former personnel	522	484	441
121.001	Travel and transportation of persons	27,419	27,995	28,583
122.001	Transportation of things	544	556	567
123.201	Rental payments to others	3,256	3,324	3,394
123.301	Communications, utilities, and miscellaneous charges	4,895	4,998	5,103
124.001	Printing and reproduction	391	399	408
125.101	Advisory and assistance services	247,090	223,455	225,165
125.201	Other services with the private sector	11,212	235,465	95,918
Purchases goods/services (inter/intra) Fed accounts				
125.301	Purchase of goods/services from other Fed agencies	650,577	664,239	678,188
125.303	Purchases from revolving funds	2,385,085	2,077,579	2,183,869
125.401	Contract O&M of facilities including GOCOS	168	172	176
125.501	Research & Development Contracts	4,622,015	4,552,040	4,794,605
125.701	Contract O&M of equip. including ADP hard/software	1,706	1,742	1,779
126.001	Supplies and materials	7,767	7,930	8,097
131.001	Equipment	10,693	10,918	11,147
132.001	Land and structures	384	392	400
		-----	-----	-----
199.001	Total Direct obligations	8,032,141	7,870,984	8,095,183
Reimbursable obligations:				
Personnel Compensation:				
211.101	Full-time permanent	36,444	40,327	41,966
211.301	Other than full-time permanent	2,440	2,534	2,553
211.501	Other personnel compensation	977	899	937
		-----	-----	-----
211.901	Total personnel compensation	39,861	43,760	45,456
212.101	Personnel Benefits: Civilian Personnel	7,611	8,554	8,801
213.001	Benefits for former personnel	15		
221.001	Travel and transportation of persons	4,248	4,300	4,350
222.001	Transportation of things	227	240	251
223.201	Rental payments to others	1,647	1,702	1,735
223.301	Communications, utilities, and miscellaneous charges	1,826	1,880	1,890
224.001	Printing and reproduction	269	280	291

RDT&E, Navy  
Object Classification (in Thousands of dollars)

Identification code	17-1319-0-1-051	1997 actual	1998 est.	1999 est.
225.201	Other services with the private sector		2,515	
	Purchases goods/services (inter/intra) Fed accounts			
225.301	Purchase of goods/services from other Fed agencies	263	270	278
225.501	Research & Development Contracts	62,207	33,789	31,603
226.001	Supplies and materials	10,586	10,945	11,030
231.001	Equipment	4,178	4,280	4,315
299.001	Total Reimbursable obligations	132,938	112,515	110,000
999.901	Total obligations	8,165,079	7,983,499	8,205,183

Comparison of FY 1997 Financing as reflected  
in FY 1998 Budget with 1997 Financing as  
Shown in the FY 1999 Budget

(\$ in Thousands)

	<b>Financing per FY 1998 Budget</b>	<b>Financing Per FY 1999 Budget</b>	<b>Increase (+) or Decrease (-)</b>
Program Requirements (Total)	7,855,754	7,884,361	+28,607
Program Requirements (Service Account)	(7,855,754)	(7,884,361)	(+28,607)
Program Requirements (Reimbursable)	121,831	121,287	-544
<b>Appropriation (Adjusted)</b>	<b>7,977,585</b>	<b>7,916,862</b>	<b>+28,063</b>

Explanation of Changes in Financing  
(\$ in Thousands)

The Fiscal Year 1997 program has changed since the presentation of the FY 1998 budget as noted below:

1. Program Requirements (Total). There has been a net increase to the appropriation (adjusted) of +\$28,063, 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 +\$28,607. These changes included: a rescission to the FY 1997 program approved in the FY 1998 DoD Appropriations Act (-\$40,000); an Emergency Supplemental Appropriation based on reduced inflation rates to finance Bosnia contingency costs (-\$9,600); reductions reflected on the FY 1997 DoD Omnibus Reprogramming Action to specific programs (-\$1,232); reductions to finance Military Personnel, Navy (MPN) shortfalls (-\$10,270); and three transfers into the appropriation from a DoD central transfer account to support the RDT&E Counter Drug program (+\$23,774). Additionally, a number of Internal Reprogrammings were effected which reclassified funding between DoD and DoN appropriations to more properly align it into the correct programs for execution: (1) V-22 EMD (\$68,400--from APN); (2) Defense Finance and Accounting Service (DFAS)(\$9,240--from O&MN); (3) Large Area Tracking Radar (LATR) (-\$4,226--to OPN); (4) F-14 TARPS (+\$4,887--from APN); (5) Environmental Test Bed (+\$3,813--from Army); (6) Southeast Regional Network (SRN)(-\$2,300--to O&MN); (7) DDG-51 TBMD/CEC (-\$13,879).
  
3. Program Requirements (Reimbursable). There has been a net decrease to the appropriation of -\$544, as a result of changes in reimbursable program requirements (-\$544).



Comparison of FY 1997 Program Requirements as reflected  
in the FY 1998 Budget with FY 1997 Program Requirements  
as shown in the FY 1999 Budget

Summary of Requirements (\$ In Thousands)

	<b>Total Program Requirements per FY 1998 Budget</b>	<b>Total Program Requirements per FY 1999 Budget</b>	<b>Increase (+) or Decrease (-)</b>
01 - Basic Research	352,102	345,606	-6,496
02 - Applied Research	534,593	514,282	-20,311
03 - Advanced Technology Development	492,863	462,002	-30,861
04 - Demonstration and Validation (DEM/VAL)	1,937,283	1,904,375	-32,908
05 - Engineering and Manufacturing Development (EMD)	2,143,579	2,153,911	+10,332
06 - RDTE Management Support	540,473	681,340	+140,867
07 - Operational Systems Development	1,854,861	1,822,845	-32,016
<b>Total Fiscal Year Program</b>	<b>7,855,754</b>	<b>7,884,361</b>	<b>+28,607</b>

Explanation by Budget Activity  
(\$ In Thousands)

01. Basic Research (-\$6,496) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$430) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$5,884), and other changes in program requirements which required minor reprogrammings (-\$182).

02. Applied Research (-\$20,311) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$654) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$7,186), and other changes in program requirements which required minor reprogrammings (-\$12,471).

03. Advanced Technology Development (-\$30,861) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$609) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$8,200), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (-\$21,872).
04. Demonstration and Validation (DEM/VAL) (-\$32,908) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$2,358) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$25,625), reductions to finance MPN shortfalls (-\$270), a reduction reflected on the FY 1997 DoD Omnibus Reprogramming Action (-\$1,232), a transfer from the Army for Environmental Test Bed at Puget Sound (+\$3,813) and from APN for the F-14 TARPS program (+\$4,887), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (-\$12,123).
05. Engineering and Manufacturing Development (EMD) (+\$10,332) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$2,633) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$45,752), reductions to finance MPN shortfalls (-\$500), transfers from APN for the V-22 (EMD) program (+\$68,400) and to SCN for the DDG-51 TBMD/CEC program (-\$13,879), three transfers into the appropriation from a DoD central transfer account to support the RDT&E Counter Drug program (+\$23,774), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (-\$19,078).
06. RDTE Management Support (+\$140,867) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$658) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (+\$118,218), reductions to finance MPN shortfalls (-\$1,000), transfers from O&MN to properly fund the Defense Finance and Accounting Service (DFAS) program in RDT&E (+\$9,240), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (+\$15,067).
07. Operational Systems Development (-\$32,016) - Changes to this budget activity resulted from an Emergency Supplemental Appropriation rescission to finance Bosnia contingency costs (-\$2,258) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-\$25,571), reductions to finance MPN shortfalls (-\$8,500), transfers to OPN for the Large Area Tracking Radar (LATR) program (-\$4,226) and to O&MN for the Southeast Regional Network (SRN) program (-\$2,300), and other changes in program requirements which required minor reprogrammings, budget activity realignments and accounting updates (+\$10,839).

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

(\$ In Thousands)

	<b>Financing per FY 1998 Budget</b>	<b>Financing Per FY 1999 Budget</b>	<b>Increase (+) or Decrease (-)</b>
Program Requirements (Total)	7,611,022	7,879,912	+268,890
Program Requirements (Service Account)	(7,611,022)	(7,879,912)	(+268,890)
Program Requirements (Reimbursable)	125,000	110,000	-15,000
<b>Appropriation (Adjusted)</b>	<b>7,736,022</b>	<b>7,989,912</b>	<b>+253,890</b>

Explanation of Changes in Financing  
(\$ in Thousands)

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

1. Program Requirements (Total). There has been a net increase to the appropriation (adjusted) of +\$268,890, 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 +\$268,890, resulting from changes in program requirements as a result of Congressional appropriation changes in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$4,607)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$23,400)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$121,735)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$101,523) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$18,000). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 148 specific initiatives) resulted in a net increase of +\$517,064. Congress also transferred +\$9,500 from SCN for Fast Patrol Boats and +\$45,000 for a SWATH Ship. Also, appropriation changes include: a correction from APN for +\$5,600 for the H-1 helicopter program (which was not effected); transfers from APN for the F/A-18 E/F program (+\$26,000); to Military Personnel, Navy (MPN) to fund program shortfalls (-\$28,700); a transfer to Ballistic Missile Defense Organization (BMDO) for Theater Missile Defense (-\$25,000); a reprogramming to fully fund minimum Major

Ranges and Test Facilities Base (MRTFB) costs (+\$16,000)(only +\$3,851 is transferring into RDT&E,N--the balance is from sources within RDT&E,N); and a transfer for the Chemical-Biological Defense program (-\$4,160).

3. Program Requirements (Reimbursable). There has been a net decrease to the appropriation of -\$15,000, as a result of changes in reimbursable program requirements (-\$15,000).

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

Summary of Requirements (\$ in Thousands)

	<b>Total Program Requirements per FY 1998 Budget</b>	<b>Total Program Requirements per FY 1999 Budget</b>	<b>Increase (+) or Decrease (-)</b>
01 - Basic Research	382,117	338,743	-43,374
02 - Applied Research	490,273	493,622	+3,349
03 - Advanced Technology Development	433,305	514,781	+81,476
04 - Demonstration and Validation (DEM/VAL)	2,135,069	2,219,002	+83,933
05 - Engineering and Manufacturing Development (EMD)	2,085,768	2,227,348	+141,580
06 - RDTE Management Support	595,265	551,033	-44,232
07 - Operational Systems Development	1,489,225	1,535,383	+46,158
<b>Total Fiscal Year Program</b>	<b>7,611,022</b>	<b>7,879,912</b>	<b>+268,890</b>

Explanation by Budget Activity  
(\$ in Thousands)

01. Basic Research (-\$43,374) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$15)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$32)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$5,226)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$4,358) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$772). Specific FY 1998 Congressional adjustments resulted in a net reduction of -\$32,971.

02. Applied Research (+\$3,349) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$192)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$430)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$7,670)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$6,395) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$1,134). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 19 specific initiatives) resulted in a net increase of +\$18,250. Additionally, changes in program requirements required minor reprogrammings (+\$920).

03. Advanced Technology Development (+\$81,476) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$463)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$693)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$7,862)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$6,552) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$1,163). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 30 specific initiatives) resulted in a net increase of +\$89,640. Congress also transferred +\$9,500 from SCN for Fast Patrol Boats. Additionally, changes in program requirements required minor reprogrammings (-\$931).

04. Demonstration and Validation (DEM/VAL) (+\$83,933) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$1,258)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$2,211)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$34,422)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$28,699) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$5,092). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 35 specific initiatives) resulted in a net increase of +\$160,391. Also included is a transfer to MPN (-\$2,000). Additionally, changes in program requirements required minor reprogrammings (-\$2,776).

05. Engineering and Manufacturing Development (EMD) (+\$141,580) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$129)

(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$9,239)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$34,619)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$28,866) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate) (-\$5,111). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 41 specific initiatives) resulted in a net increase of +\$222,586. Congress also transferred +\$45,000 from SCN for a SWATH Ship. Also included are transfers to MPN (-\$22,700) and to BMDO for TBMD (-\$25,000), as well as a correction from APN for +\$5,600 for the H-1 helicopter program (which was not effected). Additionally, changes in program requirements required minor reprogrammings (-\$5,942).

06. RDTE Management Support (-\$44,232) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$2,362)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$6,547)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$8,491)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$7,077) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$1,258). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 8 specific initiatives) resulted in a net decrease of -\$26,606. Also included are a reprogramming to fully fund minimum Major Ranges and Test Facilities Base (MRTFB) costs (+\$16,000)(only +\$3,851 is transferring into RDT&E,N--the balance is from sources within RDT&E,N) and a transfer for the Chemical-Biological Defense program (-\$4,160). Additionally, changes in program requirements required minor reprogrammings (-\$3,731).

07. Operational Systems Development (+\$46,158) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1998 DoD Appropriations Act. These changes included: an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-\$188)(Section 8035), an undistributed reduction for Contract Advisory and Assistance Services (CAAS)(-\$4,248)(Section 8041), a general undistributed RDT&E and procurement reduction of 1.5 percent (-\$23,445)(Section 8043) to finance flying hours and readiness, a general undistributed RDT&E reduction of 1.25 percent (-\$19,576) to finance National Missile Defense (NMD)(Section 8048), and a general reduction for revised economic assumptions (lower inflation rate)(-\$3,470). Specific FY 1998 Congressional adjustments (to start, continue or discontinue 13 specific initiatives) resulted in a net increase of +\$79,774. Also included is a transfer from APN for the F/A-18 program (+\$26,000). Additionally, changes in program requirements required minor reprogrammings (-\$8,689).

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Ocean Sciences	568	570	589	597	614	631	650	CONT.	CONT.
Advanced Materials	1,823	1,852	1,768	1,902	1,952	2,007	2,070	CONT.	CONT.
Information Sciences	1,126	1,140	1,179	1,178	1,210	1,243	1,283	CONT.	CONT.
Sustained Programs	10,658	10,686	11,198	12,003	12,287	12,631	13,047	CONT.	CONT.
TOTAL	14,175	14,248	14,734	15,680	16,063	16,512	17,050	CONT.	CONT

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the missions of the Naval Warfare Centers 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) thrusts in Ocean Sciences, Advanced Materials, Information Sciences, and its Sustaining Program. This program reflects the integration of efforts both within Warfare Centers and among other research performers. Research efforts are proposed and selected by the Warfare Centers, and reviewed after the fact for the quality of science produced and for relevance to the naval mission.

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Budget Item Justification  
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DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

(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 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 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 1997 ACCOMPLISHMENTS:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

- (U) (\$568) Ocean Sciences responded to the Littoral Warfare JMA by investigating very-shallow-water (VSW) physics as it relates to the performance of mine countermeasure sensors.
- (U) (\$1,823) Advanced Materials responded to the Strategic Mobility and Strike JMA's by investigating shock induced damage and failure mechanisms, at the atomic level, in metals used in warheads and in armor.
- (U) (\$1,126) Information Sciences (signal processing and statistical sciences) responded to the Readiness JMA by using advanced time-frequency analysis techniques in conditioned based monitoring of shipboard machinery to better diagnose and maintain the surface and submarine fleet and responded to Strike JMA by developing new signal and imaging processing algorithms to improve effectiveness of autonomous target recognition/guidance.
- (U) (\$10,658) Sustaining Programs responded to Strike JMA by studying supersonic turbine engine combustion technology and improved energetic materials; responded to the Joint Readiness, and Joint Support and Infrastructure JMA's by researching biomedical methods for disease prevention and treatment, wound repair, blood loss, hemorrhagic and septic shock, transplantation, and musculoskeletal injury; and responded to the Littoral Warfare JMA by developing advanced processing technologies for mine countermeasure operations in SW and VSW.

## 2. (U) FY 1998 PLAN:

- (U) (\$570) Ocean Sciences will respond 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 contribute to improved sonar performance in shallow water
- (U) (\$1,852) Advanced Materials will respond 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.

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DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

- (U) (\$1,140) Information Sciences will respond 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) (\$10,686) Sustaining Programs will respond to the Strategic Mobility and Strike JMAs by investigating drag reducing hull forms, improved maneuvering performance of ships and subs in littoral waters, developing expanded capabilities in computational fluid dynamics for the improved efficiency, maintainability and reliability of naval propulsors and turbomachinery, and the detection of wake signatures.

### 3. (U) FY 1999 PLAN:

- (U) (\$589) 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) (\$1,768) Advanced Materials will respond to the Strike and Littoral Warfare JMA's 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) (\$1,179) 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's, with enhanced detection probability and diminished tracking time in cluttered environments and in the presence of false targets.
- (U) (\$11,198) 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.

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DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	14,683	15,834	16,236
(U) Appropriated Value:	-	14,683	-
(U) Adjustments from FY 1998 PRESBUDG:	-508	-1,586	-1,502
(U) FY 1999 President's Budget Request:	14,175	14,248	14,734

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect Revised Economic Assumptions (-\$18); and Actual Execution updates (-\$490). FY 1998 adjustments reflect Congressional Undistributeds (-\$403), Economic Assumptions (-\$32); and Fiscal Constraint Reductions (-\$1,151). FY 1999 adjustments reflect minor Science and Technology (S&T) adjustments (-\$1,255), Navy Working Capital Fund (NWCF) adjustments (-\$119), Commercial Purchases Inflation adjustment (-\$258); and Military and Civilian pay rate adjustment (+\$130).

(U) Schedule: Not applicable.

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BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601152N

PROGRAM ELEMENT TITLE: In-House Laboratory Independent Research

(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)

D. (U) SCHEDULE PROFILE: Not applicable.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Ocean Sciences	129,938	125,916	135,989	144,148	147,031	149,972	152,971	CONT.	CONT.
Advanced Materials	55,635	58,339	62,714	65,850	67,167	68,510	69,880	CONT.	CONT.
Information Sciences	44,520	40,611	44,672	47,352	48,773	50,236	51,743	CONT.	CONT.
Sustaining Programs	101,338	99,629	104,570	106,809	108,054	109,707	110,888	CONT.	CONT.
TOTAL	331,431	324,495	347,945	364,159	371,025	378,425	385,482	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 as noted below to the science and technology (S&T) requirements from the Department of the Navy (DON) Joint Mission Areas/Joint Support Areas (JMA/JSA) 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

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PROGRAM ELEMENT TITLE: Defense Research Sciences

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 JSAs 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 JSAs.

(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.

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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 towards increasing knowledge and understanding in broad fields directly related to long-term Department of the Navy (DON) needs.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$129,938) Ocean Sciences responded to Innovation in Naval Warfare/Engagement and Littoral Warfare JMAs by breaking the sound barrier underwater for the first time, paving the way for development of high speed projectiles for quick destruction of shallow water mines in preparation for an amphibious assault; by developing new in situ instruments for more accurate measurement of ocean optical properties such as spectral backscatter, allowing improved systems for mine detection and classification; and by incorporating microencapsulated phase change material into diving garments for significantly improved thermal protection for Navy Special Warfare divers. It responded to the Strike and Support/Infrastructure JMA/SAs requirements through improved models of the hurricane vortex in dynamical forecasts so crucial to plans for force movement and protection of shore facilities.
- (U) (\$55,635) Advanced Materials responded to Intelligence/Surveillance/Reconnaissance JMA requirements by discovering a piezo-electric material potentially ten times more effective for Navy sonars, allowing smaller and more sensitive detectors operating at longer ranges against quieter submarines; by developing a process (lateral epitaxial overgrowth) for synthesizing high quality, large area films of gallium nitride, significantly improving its effectiveness as a high power microwave amplifier, and by using pulsed laser deposition of ferroelectric thin films to produce a new class of tunable microwave electronic devices at significant savings in size, weight, and power consumption.
- (U) (\$44,520) Information Sciences responded to C4/Information Warfare JMA requirements by producing a solid state injection laser with extremely low injection current and 100,000 times less power consumption than previous lasers,

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DATE: February 1998

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PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

for significantly increased computer speed; and to Strike and Littoral Warfare JMAs by testing on-line learning of coordination strategies by mobile robotic agents for application to underwater countermining activities; by applying Markov models to improve mine detection using geometrical information within sensor images; by demonstrating significantly reduced false alert rate in submarine detection through combined use of environmental multipath analysis algorithms and multivariate echo structure statistics; and by designing micro-miniaturized components critical to fielding of a smaller torpedo.

- (U) (\$101,338) Sustaining Programs responded to the Strike and Intelligence/Surveillance/Reconnaissance JMAs by developing a neural network using dolphin-like active sonar emissions that identify objects buried in ocean sediment with .97 detection probabilities; by producing nanometer scale structures, lithographically patterned in nickel films, with enhanced magnetic densities that promise terabit memories in small electronic devices; and by designing and testing silicon chips that emulate the computational capability of biological neural systems like the eye and the ear, for enhanced performance of autonomous robotic systems. Biomedical investigators responded to Readiness JSA requirements through improved techniques for freeze drying that promise longer shelf life for blood platelets; and demonstrated orally administered therapy that prevents the toxic effects of hemorrhagic shock. The Sustaining Program provided for Support and Infrastructure JSA requirements by development of science leading to a new biofilter capable of removing over 90 percent of volatile organic compounds from Navy paint booth operations; and use of metal-biota interaction research sampling probes as potential alternatives to costly bioassays required for discharge permits at naval facilities.

2. (U) FY 1998 PLAN:

- (U) (\$125,916) Ocean Sciences will respond to Littoral Warfare requirements by undertaking experiments to identify and understand processes unique to marginal and semi-enclosed seas (e.g., Red Sea, Mediterranean, Okhotsk, 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.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

- (U) (\$58,339) Advanced Materials will respond to Innovation in Naval Warfare/Engagement requirements through investigations into improved materials for air frames and radomes; and to requirements for Support/Infrastructure JSA through exploration of thermal spray nanoscale coatings for wear, corrosion, and thermal barrier applications. Reflects the Congressional plus-up for Molecular Design Institute.
- (U) (\$40,611) Information Sciences will respond 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 will respond to Strategic Mobility through development of mathematical and computational tools for analysis, estimation, and prediction of oceanographic and meteorological environmental conditions on the regional scale.
- (U) (\$99,629) Sustaining Programs will respond to Strike 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 will respond 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.

### 3. (U) FY 1999 PLAN:

- (\$135,989) 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.
- (\$62,714) Advanced Materials will respond to Support/Infrastructure JSA 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

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PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

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.

- (\$44,672) Information Sciences will respond to Strike requirements by exploring adaptive non-linear control for integrated flight propulsion avionics, and to Support/Infrastructure JSA 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.
- (\$104,570) 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.

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DATE: February 1998

BUDGET ACTIVITY: 1

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

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	337,419	366,283	383,397
(U) Appropriated Value:		334,463	
(U) Adjustments from FY 1998 PRESBUDG:	-5,988	-41,788	-35,452
(U) FY 1999 President's Budget Submission:	331,431	324,495	347,945

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect a Small Business Innovative Research (SBIR) reduction (-\$5,884); Revised Economic Assumptions (-\$412); and updates to reflect Actual Execution (+\$308). FY 1998 adjustments reflect a Fiscal Constraint reduction (-\$39,820); Congressional Undistributed reduction (-\$9,968); and funding for Molecular Design Institute (+\$8,000). FY 1999 adjustments reflect S&T adjustments (-\$25,756); Navy Working Capital Funds (NWCF) adjustments (-\$4,545); transfer of NRL Satellite Human Resources Office Stennis Space Center (-\$70); Commercial Purchases Inflation Adjustment (-\$6,096); and Military and Civilian Pay Rates (+\$1,015).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:

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

R-1 Line Item 2

Budget Item Justification  
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# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 1

PROGRAM ELEMENT: 0601153N

PROGRAM ELEMENT TITLE: Defense Research Sciences

(U) PE 0601102F (Air Force Defense Research Sciences)  
(U) PE 0601152N (In House Laboratory Independent Research)  
(U) PE 0602111N (Air and Surface Launched Weapons Technology)  
(U) PE 0602121N (Ship, Submarine & Logistics Technology)  
(U) PE 0602122N (Aircraft Technology)  
(U) PE 0602234N (Materials, Electronic & 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.

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R-1 Line Item 2

Budget Item Justification  
(Exhibit R-2, page 8 of 8)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
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Air and Surface Launched Weapons Technology

	32,112	28,379	37,140	38,064	40,153	40,429	40,952	CONT.	CONT.
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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 relating to the Strike and Littoral Warfare Mission areas. Specifically:

(U) The Strike Mission Area includes technology issues in weapons disciplines relating to real-time targeting and retargeting, surgical lethality, platform survivability, and Battle Damage Indication. Programs include mission planning, missile and propulsion technology, advanced explosives and warheads, and precision targeting.

(U) The Littoral Warfare Mission Area includes technology issues in air and surface battlespace dominance relating to ship defense, air superiority, Naval Surface Fire Support. Programs include low cost missile guidance and control, high firepower guns and guided projectiles, airborne and shipboard fire control, missile propulsion, and feasibility investigations of innovative weapon system concepts.

(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..

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 1 of 13)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

(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.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$6,432) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Continued:
    - (U) Test and evaluation of breadboard low cost, lightweight, Infrared Focal Plan Array (IRFPA) test-bed tracker.
    - (U) Precision track Radio Frequency (RF) technology; Refine candidate system concepts, system simulation and modeling, and solid state transmitter/receiver module evaluation.
    - (U) Low altitude fuze development by modeling high power short pulse laser Target Detection Device (TDD) for improved performance in low visibility aerosol and smoke conditions.
    - (U) Ram Accelerator technology by conducting preliminary design studies for high pressure gas management and computational fluid dynamic modeling of in-bore high pressure combustion processes.
    - (U) Reactive materials warhead investigation by testing baseline warhead design and conducting gas gun test to facilitate development of shock induced reaction models.
  - (U) Completed:
    - (U) Miniature RF Guidance technology development effort by demonstrating, via simulation, the terminal accuracy of a Strapdown W-band Seeker in a track via projectile mode, sized for a 60mm projectile.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 2 of 13)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

-- (U) IRFPA test bed tracker effort by field testing tracker and innovative non-uniformity compensation technique.

- (U) (\$3,486) INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY (IHRPT) (includes \$946 FY 1997 Congressional Plus-up):

This effort continues work initiated with the FY96 Congressional plus-up. All tactical rocket propulsion technology efforts previously described under Air Superiority directly support the IHRPT national goals as well as Navy goals for tactical missile propulsion technology and will hence forth be described under the IHRPT heading.

- (U) Initiated:

-- (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) Continued:

-- (U) Combustion instability investigation by conducting motor tests to validate instability models.

-- (U) Propellant formulation investigations expanding ingredients base to include CL-20 and poly gamma Cyclodextrin Nitrate (CDN).

- (U) (\$2,627) AIR SUPERIORITY:

- (U) Continued:

-- (U) Aerodynamic advanced prediction code development for transonic high angle of attack applications including non-axisymmetric body configurations and nonlinear modes. Aero prediction codes in this regime needs further development especially for high angles of attack.

-- (U) RF Guidance-Integrated Fuse (GIF), high range resolution breadboard hardware for improved air-to-air missile lethality in high speed encounters.

-- (U) Diamond dome strength improvement and polishing demonstration.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 3 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) Completed:
  - (U) Investigation of coherent fiber bundle scene transformation techniques for Infrared (IR) scene generation by completing projector assembly and final testing.
  - (U) IR GIF investigation by demonstrating passive sensor processing algorithms to provide real time estimates of warhead firing commands under a range of air to air weapon encounters.
  - (U) Off axis fire control architecture investigation with design of off axis IR/RF fire control sensor suite.
- (U) (\$9,125) STRIKE AND ANTI SURFACE WARFARE (ASUW) WEAPONRY:
  - (U) Initiated:
    - (U) High speed missile propulsion technology studies and development for time critical targets.
    - (U) Development of Automatic Target Recognition (ATR)/Bio-Vision technology for strike.
    - (U) Data compression techniques for battle damage imaging video.
    - (U) Affordable Seeker Concepts: using concurrent engineering techniques to reduce time and cost; complete requirements analysis, design, development and begin fabrication of a strike seeker for test and evaluation.
    - (U) Air and surface explosives technology development to include CL-20 applications.
  - (U) Continued:
    - (U) High speed, small, low power processors for automatic, near real time, high resolution image processing for real time retargeting and rapid mission planning for cruise missiles.
    - (U) Adaptive warhead concept studies by conducting scale evaluations of advanced explosive materials.
    - (U) Assessment of lifting body airframe technology with emphasis on subsonic strike weapon applications and initial assessment of supersonic concepts.
    - (U) Empirical modeling of detonation process for reactive materials for solid fuel air explosive warhead.
    - (U) Parallel distributed processing techniques for routing and mission planning applications with transition to PE 0603217N, for captive flight test evaluations.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 4 of 13)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) Land battle damage indication Synthetic Aperture Radar (SAR) testing and change detection algorithms.
- (U) Completed:
  - (U) Documentation of bistatic SAR high frequency band brassboard.
- (U) (\$4,771) Naval Surface Fire Support (NSFS):
  - (U) Initiate:
    - (U) Mission planning and fire control studies to identify needed technology solutions for future NSFS weapon systems.
    - (U) Incorporate results of Long Range projectile efforts in technology development in gun propellant, explosives, and advanced projectile concepts initiated with FY96 Congressional plus-ups.
    - (U) Hypersonic rocket motor design.
    - (U) Feasibility assessment of high strength composite barrels for Naval gun applications.
    - (U) Feasibility assessment of advances in relative Global Positioning System (GPS) targeting concepts that will lead to increased target location accuracies.
    - (U) Long range projectile aerodynamic studies.
  - (U) Continued:
    - (U) Assessment of strapdown IR imaging seeker architecture for low cost gun launched projectile.
    - (U) Gun launched rocket technology development by fabricating an advanced motor and conducting structural and performance evaluations.
- (U) (\$5,671) FREE ELECTRON LASER (FEL) CONGRESSIONAL PLUS-UP:
  - (U) Continued:
    - (U) Design, fabricate, and activate a 1 Kilowatt average power FEL operating in the IR spectrum.
    - (U) Evaluate the suitability of the FEL for Navy Anti-Ship Missile Defense.

2. (U) FY 1998 PLAN:

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Budget Item Justification  
(Exhibit R-2, page 5 of 13)

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) (\$6,410) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Initiate:
    - Testing and measurements for low altitude propagation by remote sensors for sensor adaptation.
  - (U) Continue:
    - (U) Precision track RF technology; solid state transmitter/receiver module evaluation.
    - (U) Low altitude fuze development through experiments using a high power short pulse laser TDD for improved performance in low visibility aerosol and smoke conditions.
    - (U) Terminate Ram Accelerator technology development.
    - (U) Reactive materials warhead investigation by testing baseline warhead design and conducting gas gun test to facilitate development of shock induced reaction models and identifying materials for upcoming ATD (risk reduction).
  - (U) Complete:
    - (U) IRFPA test bed tracker effort by field testing tracker and by demonstrating non uniformity signal processing compensation technique.
  
- (U) (\$2,912) AIR SUPERIORITY:
  - (U) Initiate:
    - (U) Joint technology development effort with the Air Force for next generation air to air missile.
  - (U) Continue:
    - (U) RF GIF high range resolution hardware evaluation.
    - (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) Aerodynamic advanced prediction code development for transonic high angle of attack applications including non-axisymmetric body configurations and nonlinear modes.
    - (U) Propellant formulation investigations started in FY96 with IHPRT Congressional plus-up funding and expand ingredients base to include CL-20 and poly gamma CDN.
  - (U) Complete:

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 6 of 13)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) Diamond dome strength improvements and polishing demonstrations.
- (U) Combustion instability investigations and demonstrations of motor tests to validate instability models.
- (U) (\$2,622) IHRPT:
  - (U) Initiate:
    - (U) Investigation of ammonium dinitramide (ADN) ingredient for Phase II propellant formulation (Phase II goal - 7% increase in specific impulse).
    - (U) Investigation for a light weight on-command pintle thrust magnitude control (TMC) system to demonstrate 40:1 turn down ratio and 30% reduction in weight and volume over state-of-the-art multiple pulse rocket motor systems.
    - (U) Investigation into low erosion, oxidation resistant nozzle throat entrance and exit cones to reduce weight (15-25%) and improve delivered impulse (2-5 sec).
  - (U) Continue:
    - (U) Propellant formulation investigations started in FY96 with IHRPT Congressional plus-up funding and expand ingredients base to include CL-20 and poly gamma CDN.
  - (U) Complete:
    - (U) CL-20/Al and CL-20/ADN Phase I propellant formulation efforts with sub scale motor tests.
    - (U) Three-axis thrust vector control concept demonstrating a supersonic flex-seal nozzle.
- (U) (\$8,990) STRIKE AND ASUW WEAPONRY:
  - (U) Continue:
    - (U) Adaptive warhead concept studies by conducting scale evaluations of advanced explosive materials developed under PE 0602314N.
    - (U) Assessment of lifting body airframe technology for supersonic strike weapon applications.
    - (U) Affordable Seeker Concepts: Analysis of requirements and design for a strike seeker using concurrent engineering techniques to reduce design and prototype fabrication times.
    - (U) Data compression techniques for video images of battle damage.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 7 of 13)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) High speed weapon propulsion, guidance and control, and airframe investigations for time critical targets.
- (U) Technology development in ATR/signal processing to include bio-vision techniques.
- (U) Complete:
  - (U) Parallel distributed processing techniques for routing and mission planning applications with transition to PE 0603217N, for captive flight test evaluations.
- (U) (\$7,445) NSFS:
  - (U) Continue:
    - (U) Assessment of strapdown IR imaging seeker and high resolution/clutter simulation.
    - (U) Gun launched rocket technology development by fabricating an advanced motor and conducting structural and performance evaluations; fin control system testing.
    - (U) Long range projectile aerodynamic studies.
    - (U) NSFS warhead design development to include advanced energetic explosive formulations and new shaped liner technology for unitary warheads in order to defeat next generation armor on the battlefield.
    - (U) Technology development in new propellant, explosives, and advanced projectile concepts.
    - (U) Mission planning and fire control studies.
    - (U) Feasibility assessment of advances in relative GPS targeting concepts that will lead to increased target location accuracies.

3. (U) FY 1999 PLAN:

- (U) (\$7,865) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Initiate:
    - (U) Multi-sensor threat evaluation and weapon assessment system for ship-based defense.
    - (U) Surface launched propulsion investigations for increasing missile average velocity.
  - (U) Continue:

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 8 of 13)

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (U) Measurements of low altitude propagation and major demonstrations supporting interactive adaptation of radar sensors.
- (U) Precision track RF technology; refine candidate system concepts, system simulation and modeling, and solid state transmitter/receiver module evaluation.
- (U) Low altitude fuze development by demonstration and field testing of high power short pulse laser TDD for improved performance in low visibility aerosol and smoke conditions.
- (U) Reactive materials warhead investigation by testing baseline warhead design and conducting gas gun tests to facilitate development of shock induced reaction models and evaluate new lethal mechanisms.
- (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 design studies for high pressure gas management and computational fluid dynamic modeling of in-bore high pressure combustion processes
- (U) (\$4,377) AIR SUPERIORITY:
  - (U) Continue:
    - (U) Development of technology efforts begun in FY98 supporting the Joint Common Missile program 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) Complete:
    - (U) Aerodynamic advanced prediction code development for applications including non-axisymmetric body configurations, nonlinear modes and core aeroprediction studies.
- (U) (\$2,868) IHRPT:
  - (U) Initiate:
    - (U) Evaluation of  $\text{NF}_2$  as an ingredient for Phase II propellant formulations (Phase II goal - 7%

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 9 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- increase in specific impulse).
- (U) Plans to develop and demonstrate a small, light weight (80% weight reduction) retractable thrust vector control (TVC) system using jet vanes, jet tabs or other similar type of thrust deflection mechanism that can be retracted when not in use have been discontinued due to funding reductions.
- (U) Continue:
  - (U) Phase I propellant formulation efforts by downselecting formulation of FY00 subscale motor tests.
  - (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) Plans to continue ADN Phase II propellant ingredient investigation, advanced nozzle technology investigation, and on-command pintle thrust magnitude control have been discontinued due to funding reductions.
  - (U) Advanced nozzle technology investigation.
  - (U) On-command pintle thrust magnitude control.
- (U) (\$11,830) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    - (U) Thermal management technology development for high speed missiles
  - (U) Continue:
    - (U) Affordable Seeker Concepts: using concurrent engineering techniques to reduce time and cost; complete requirements analysis, design, development and begin fabrication of a strike seeker for test and evaluation.
    - (U) High speed weapon propulsion, guidance and control, and airframe investigations for time critical targets.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 10 of 13)

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (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) Complete:
  - (U) Selection and demonstrations of advanced explosive materials for adaptive warhead concept.
  - (U) Assessment of lifting body airframe technology for subsonic and supersonic strike weapon applications.
- (U) (\$10,200) NSFS:
  - (U) Initiate:
    - (U) Integration of miniaturized GPS/Electronics Counter Counter Measures (ECCM) concept into new projectile design, including fabrication and testing
    - (U) Investigation into high strength, long wearing, and light weight materials for future naval long life gun barrels.
  - (U) Continue:
    - (U) Technology development in gun propellant, explosives, and advanced projectile concepts
    - (U) Feasibility assessment of advance relative GPS targeting concepts that will lead to increased target location accuracies.
    - (U) Design and validation of models for strapdown IR imaging seeker technology.
    - (U) NSFS warhead design development to include advanced energetic explosive formulations and new shaped liner technology for unitary warheads in order to defeat next generation armor on the battlefield.
    - (U) Mission planning and fire control studies.
  - (U) Complete:
    - (U) Long range aerodynamic studies.
    - (U) Gun launched rocket technology development by conducting motor structural and performance evaluations and fin control system tests.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 11 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

B. (U) PROGRAM CHANGE SUMMARY

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY1999</u>
(U) FY 1998 President's Budget:	31,913	32,273	38,833
(U) Appropriated Value:	-	29,273	-
(U) Adjustments from FY 1998 PRESBUDG:	+199	-3,894	-1,693
(U) FY 1999 President's Budget Submission:	32,112	28,379	37,140

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect Small Business Innovation Research (SBIR) transfer (-\$87); Revised Economic Assumptions (-\$39); and actual execution update (+\$325). FY 1998 adjustments include Congressional Undistributed reductions (-\$894); and a Fiscal Constraint reduction (-\$3,000). FY 1999 adjustments reflect Navy Working Capital Fund (NWCFF) adjustments (+620); Science and Technology (S&T) reduction (-\$1,889); Commercial Purchases Inflation (-\$652); and Military and Civilian Pay rates (+\$228).

(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:

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(Exhibit R-2, page 12 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N

PROGRAM ELEMENT TITLE: Air and Surface Launched Weapons Technology

- (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.

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 3

Budget Item Justification  
(Exhibit R-2, page 13 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Surface Ship Technology	48,790	48,865	43,177	44,775	46,656	48,066	49,292	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

R-1 Line Item 4

Budget Item Justification  
(Exhibit R-2, Page 1 of 23)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

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.

(U) Environmental quality technologies enable sustained Navy operations, world wide, 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.

## B. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

### 1. (U) FY 1997 ACCOMPLISHMENTS:

(U) (\$2,754) SURFACE SHIP STRUCTURAL SYSTEMS:

(U) INITIATED:

- (U) Corrosion, producibility, cost, and performance studies of advanced double hull structure using non-magnetic stainless steel. (Hull Structures)

(U) CONTINUED:

- (U) Physical modeling studies of hull features versus seaway loading. (Hull Structures)

R-1 Line Item 4

Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of dynamic loading method for composite hull structures. (Hull Structures)
- (U) COMPLETED:
  - (U) Development of analytically based design tool to predict weapons loading and structural response of hulls to non-contact underwater explosions. (Weapons Effects)
- (U) (\$1,252) SURFACE SHIP POWER AND AUTOMATION:
  - (U) CONTINUED:
    - (U) Development of advanced damage control sensors to measure flow rates of air and water. (Damage Control)
    - (U) Demonstration of non-chemical acting alternative to HALON 1301 with zero ozone depletion potential. (Damage Control)
  - (U) COMPLETED:
    - (U) Development of damage control algorithms that will predict vertical fire and smoke movement. (Damage Control)
    - (U) Ship power generation feasibility studies for diesel fed fuel cells. (Mechanical Power and Auxiliary Systems)
- (U) (\$6,669) SURFACE SHIP SIGNATURE CONTROL:
  - (U) INITIATED:
    - (U) Development of wake signatures prediction capabilities for low-observable (LO) platforms. (Topside Signature Reduction)
  - (U) CONTINUED:
    - (U) Development of Low Radar Cross Section (RCS) and Infrared (IR) signature stack suppression system concepts. (Topside Signature Reduction)
    - (U) Development of performance prediction RCS algorithms for LO structures. (Topside Signature Reduction)
    - (U) Development of propeller tip vortex suppression techniques. (Underwater Signature Reduction)
  - (U) COMPLETED:
    - (U) Transition of advanced rudder design to Naval Sea Systems Command (NAVSEA) for full-scale evaluation. (Underwater Signature Reduction)

R-1 Line Item 4

Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) (\$1,892) SURFACE SHIP MANEUVERING AND SEAKEEPING:

- (U) CONTINUED:
- (U) Development and assessment of a Vertical Axis Propulsor concept. (Advanced Propulsor Concepts)
- (U) COMPLETED:
- (U) Powering tests of Vertical Axis Propulsor. (Advanced Propulsor Concepts)
- (U) Evaluation of dynamic intact stability code. (Seaway Operability and Survivability)

(U) (\$3,121) SUBMARINE SIGNATURE CONTROL:

(U) INITIATED:

- (U) Development of technology to predict in real-time, far-field acoustic signature from on-board measurements. (Structural Acoustics)
- (U) Development of prediction capability and methods to reduce appendage noise. (Hydroacoustics)

(U) CONTINUED:

- (U) Development of design tools for radiated noise prediction. (Structural Acoustics)
- (U) Assessment of in-situ methods to characterize extrude-in-place special hull treatments. (Structural Acoustics)
- (U) Demonstration of proof-of-concept for control of far-field Electromagnetic (EM) signatures. (EM Signature Reduction)
- (U) Development of final design for transparent sonar bow dome. (Structural Acoustics)
- (U) Develop integrated model for prediction of noise associated with advanced propulsor. (Hydroacoustics)

(U) COMPLETED:

- (U) Validation of EM performance of mobile deep range. (EM Signature Reduction)
- (U) Design of low self-noise hybrid composite sonar dome. (Structural Acoustics)

(U) (\$2,303) SUBMARINE STRUCTURAL SYSTEMS:

(U) INITIATED:

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of strengthening options and joint flexibility concepts for shock attenuation in machinery support structures. (Advanced Structures)
- (U) Development of equipment emulators for shock testing of loaded machinery support structures. (Advanced Structures)
- (U) Evaluation of tangential attachments and advanced damping concepts for structure shock attenuation. (Advanced Structures)
- (U) COMPLETED:
  - (U) In-water testing and measurement of radiated noise on quarter-scale, ring-stiffened cylindrical model with NSSN-like coating. (Advanced Structures)
- (U) (\$2,152) SUBMARINE POWER AND AUTOMATION:
  - (U) INITIATED:
    - (U) Development of Particle Image Laser Velocimetry methods for dynamic velocity field measurements and validation of design tools for internal fluid systems. (Machinery)
  - (U) CONTINUED:
    - (U) Evaluation of power and response time performance of electrically powered actuator technologies for reduced cost and improved reliability steering and diving systems. (Electrical)
    - (U) Evaluation of broadband pump noise quieting using multi-degree-of-freedom magnetic bearing control. (Machinery)
    - (U) Verification of electric motor design and analysis tools with 2 horsepower experimental motors. (Electrical)
    - (U) Validation of magnetic field prediction model for quiet electric motor design tools. (Electrical)
  - (U) COMPLETED:
    - (U) Demonstration of pump tonal noise quieting using multi-degree-of-freedom magnetic bearings control. (Machinery)
    - (U) Design, fabrication and testing of Power Electronic Building Block (PEBB) based motor controller. (Electrical)
- (U) (\$2,545) SUBMARINE MANEUVERING AND SEAKEEPING:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) CONTINUED:

- (U) Development of technology to predict propulsor side forces for maneuvering impact. (Maneuvering and Control)
- (U) Selection of jam resistant maneuvering concepts for further development. (Maneuvering and Control)
- (U) Radio controlled model experimentation to validate physics-based maneuvering tools. (Maneuvering and Control)
- (U) Development of second generation full-stern/integrated propulsor concept, based upon first generation concept performance. (Advanced Propulsors)
- (U) Development of Computational Fluid Dynamics (CFD) models to predict near-field downstream flow features from hull feature inflow conditions. (Maneuvering and Control)

(U) COMPLETED:

- (U) Transition unsteady flow analysis to evaluate non-acoustic wake signatures into CFD codes at Hydrodynamic/Hydroacoustic Technology Center. (Maneuvering and Control)

(U) (\$9,091) POWER ELECTRONIC BUILDING BLOCK (PEBB):

(U) CONTINUED:

- (U) Development of second-generation PEBB modules for demonstration of form and function. (Advanced Concept Electrical Systems)
- (U) Development of computational testbed for simulating advanced concept electrical systems. (Advanced Concept Electrical Systems)

(U) COMPLETED:

- (U) Proof of concept for first-generation PEBB modules for demonstrating multifunctionality of a PEBB. (Advanced Concept Electrical Systems)
- (U) Transition of first-generation PEBB modules to PE 0603508N for technology application demonstrations. (Advanced Concept Electrical Systems)

(U) (\$5,669) PEBB TECHNOLOGY CONGRESSIONAL PLUS-UP:

(U) COMPLETED:

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Complete computational design and analysis for a virtual testbed to simulate whole ship electrical systems. (Advanced Concept Electrical Systems)
- (U) (\$946) VISION TECHNOLOGY (SHIP TECHNOLOGY AUTOMATED SYSTEMS MONITORING) CONGRESSIONAL PLUS-UP:  
(U) COMPLETED:
  - (U) Incorporation of state-of-the-art video processing hardware and software into Interactive Electronic Technical Manuals (IETM)
- (U) (\$946) NATURAL LANGUAGE PROCESSING (COMPUTER BASED MAINTENANCE AIDS) CONGRESSIONAL PLUS-UP:  
(U) COMPLETED:
  - (U) Demonstration of natural language processing in IETM.
- (U) (\$4,725) SURFACE SHIP COMPOSITE MATERIAL CONGRESSIONAL PLUS-UP:  
(U) COMPLETED:
  - (U) Testing of four half-scale composite corvette mid-ship sections.
- (U) (\$946) POWER NODE CONTROL CENTERS CONGRESSIONAL PLUS-UP:  
(U) COMPLETED:
  - (U) Development of power node control centers for advanced integrated distribution system fault detection, switching, reconfiguration, and control. (Advanced Concept Electrical Systems)
- (U) (\$3,779) LANDING SHIP/CAUSEWAY CONGRESSIONAL PLUS-UP:  
(U) COMPLETED:
  - (U) Development of an ocean-going, self-contained, self-deployable pierhead and causeway to shore for rapid cargo delivery where permanent port facilities do not exist. (Landing Ship Quay/Causeway)

2. (U) FY 1998 PLAN:

- (U) (\$5,090) SURFACE SHIP STRUCTURAL SYSTEMS:  
(U) INITIATE:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Future combatant topside structural concepts. (Topside Structures)
- (U) Fire suppression and flooding prediction for automated damage control. (Damage Control)
- (U) CONTINUE:
  - (U) Demonstration and evaluation of dynamic failure prediction tools for composite hull structures. (Hull Structures)
  - (U) Development of advanced double hull joint detail concepts using stainless steel. (Hull Structures)
  - (U) Model test studies of the effects of DD-21 hull features on seaway induced loads. (Hull Structures)
- (U) (\$1,343) SURFACE SHIP POWER AND AUTOMATION:
  - (U) INITIATE:
    - (U) Smart, survivable machinery control system concepts. (Advanced Electrical Systems)
  - (U) COMPLETE:
    - (U) 10kW 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) (\$4,459) SURFACE SHIP SIGNATURE CONTROL:
  - (U) INITIATE:
    - (U) Develop mathematical and physical scale model scattering prediction capabilities of surface ship resonance's at HF frequencies. (Topside Signature Reduction)
  - (U) CONTINUE:
    - (U) Evaluation of high-performance ship hull concepts, which meet low-observable requirements. (Topside Signature Reduction)
    - (U) Development of lightning protection system concepts for non-metallic structures. (Electromagnetic Compatibility)
  - (U) COMPLETE:
    - (U) Development of Low IR signature exhaust concepts for stack suppression system. (Topside Signature Reduction)

R-1 Line Item 4

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of performance prediction RCS algorithms for LO structures. (Topside Signature Reduction)
  - (U) Development of composite structure integration concepts for communication sensors. (Electromagnetic Compatibility)
  - (U) Development of EM compatibility analysis models and interference reduction techniques for ultra-wide band and wide band radio frequency systems. (Electromagnetic Compatibility)
- (U) (\$1,965) SURFACE SHIP MANEUVERING & SEAKEEPING:
- (U) INITIATE:
- (U) Development of dynamic damage stability method. (Seaway Operability and Survivability)
  - (U) Development of ship motion display guidance. (Seaway Operability and Survivability)
- (U) COMPLETE:
- (U) Development and assessment of a Vertical Axis Propulsor concept. (Advanced Propulsor Concepts)
- (U) (\$4,049) SUBMARINE SIGNATURE CONTROL:
- (U) INITIATE:
- (U) Development of Advanced Degaussing methodology based on foreign technologies. (Electromagnetic Silencing)
- (U) CONTINUE:
- (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) Development of prototype laser doppler vibrometer technology to characterize acoustic coating effectiveness in-situ. (Acoustic Materials)
  - (U) Demonstration of proof-of-concept for control of far-field EM signatures for deep and shallow water. (EM Signature Reduction)
- (U) COMPLETE:
- (U) Testing and evaluation of acoustically transparent sonar bow dome concept; transition concept and design methodology to NAVSEA. (Structural Acoustics)

R-1 Line Item 4

Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) (\$3,259) SUBMARINE STRUCTURAL SYSTEMS:

(U) INITIATE:

- (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) CONTINUE:

- (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) COMPLETE:

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

(U) (\$2,387) SUBMARINE POWER AND AUTOMATION:

(U) INITIATE:

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

(U) CONTINUE:

- (U) Development of flow visualization and design tools for internal fluid systems. (Machinery)
- (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 Reliability)
- (U) Development and verification of quiet electric motor analysis and design tools. (Electrical)

(U) (\$3,113) SUBMARINE MANEUVERING AND SEAKEEPING:

(U) CONTINUE:

- (U) Laboratory demonstrations of maneuvering concepts with improved control authority and jam resistance. (Maneuvering and Control)
- (U) Development of prediction methods of propulsor side forces. (Maneuvering and Control)

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Budget Item Justification  
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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Develop integrated model for advanced propulsor noise. (Hydroacoustics)
- (U) COMPLETE:
- (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 CFD codes to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering and Control)
  - (U) Design and construction of second generation advanced stern model. (Advanced Propulsors)
  - (U) Demonstration of improved ability to simulate maneuvering in extreme conditions. (Maneuvering and Control)
  - (U) Advanced stern performance evaluation. (Advanced Propulsors)
- (U) (\$4,865) PEBB:
- (U) INITIATE:
- (U) Development of third generation PEBB demonstration modules for form, fit, and function. (Advanced Concept Electrical Systems)
- (U) CONTINUE:
- (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) (\$7,060) LOGISTICS:
- (U) INITIATE:
- (U) Development of a microelectromechanical system diagnostic sensor net. (Maintenance)
- (U) CONTINUE:

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of magnetostrictive actuators for cargo/weapons elevator doors. (Replenishment)
  - (U) Development of metrology for high-speed optical interconnections. (Maintenance)
  - (U) Development of an array of metal oxide-based gas sensor elements capable of distinguishing different gases in a gas mixture. (Maintenance)
  - (U) Development of infrared 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)
  - (U) Development of advanced lighter operation and control. (Amphibious Logistics)
- (U) COMPLETE:
- (U) Development of electroset desktop manufacturing of parts. (Amphibious Logistics)
  - (U) Development of rapid nearshore geotechnical survey technology. (Amphibious Logistics)
- (U) (\$3,026) ENVIRONMENTAL QUALITY TECHNOLOGY:
- (U) INITIATE:
- (U) Development of oil pollution control technology for submarine external systems. (Environmentally Compliant Platforms)
  - (U) Development of non-fouling membrane technology for shipboard 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)

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of submarine heat exchanger fouling control technologies. (Environmentally Compliant Platforms)
- (U) CONTINUE:
- (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 magnetostrictive actuators for cargo/weapons elevator doors. (Replenishment)
  - (U) Development of metrology for high-speed optical interconnections. (Maintenance)
  - (U) Development of an array of metal oxide-based gas sensor elements capable of distinguishing different gases in a gas mixture. (Maintenance)
  - (U) Development of infrared focal plane array test set. (Maintenance)
  - (U) Development of super/sub critical fluid extraction technology for advanced treatment of shipboard bilgewater. (Environmentally Compliant Platforms)
  - (U) Development of automated dry dock ship paint application, overspray control and collection technologies. (Environmentally Compliant Shore Facilities)
  - (U) Development of decontamination cleaning of surfaces technology for 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) COMPLETE:
- (U) Development of electroset desktop manufacturing of parts. (Amphibious Logistics)
  - (U) Development of vertical launch system rearming mechanism. (Replenishment)
  - (U) Development of rapid nearshore geotechnical survey technology. (Amphibious Logistics)
- (U) (\$5,822) PEBB TECHNOLOGY CONGRESSIONAL PLUS-UP:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(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) (\$1,456) 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) (\$971) UNDERWATER VEHICLE DERIVED CONTROL TECHNOLOGY CONGRESSIONAL PLUS-UP:

(U)COMPLETED:

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

3. (U) FY 1999 PLAN:

(U) (\$5,414) SURFACE SHIP STRUCTURAL SYSTEMS:

(U) INITIATE:

(U) Development of hull fitness for service based structural maintenance guidelines. (Hull Structures)

(U) CONTINUE:

- (U) Development of improved design criteria and tools for analysis of composite primary hulls. (Hull Structures)
- (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.
- (U) Development of Stainless Steel Advanced Double Hull concepts. (Hull Structures)
- (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)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Advanced damage control -flooding prediction- sensor technology. (Damage Control)
- (U) (\$1,428) SURFACE SHIP POWER AND AUTOMATION:  
(U) INITIATE:
- (U) Simulation of machinery plant control system. (Advanced Electrical Systems)
  - (U) Development of advanced concepts in damage control/ firefighting. (Damage Control)
- (U) COMPLETE:
- (U) Development of advanced damage control sensors to measure flow rates of air and water. (Damage Control)
  - (U) Demonstration of non-chemical acting alternative to HALON 1301 with zero ozone depletion potential. (Damage Control)
  - (U) Hybrid prediction model for heat and smoke transport. (Damage Control)
  - (U) Validate analytical model for smoke movement in ship compartment. (Damage Control)
- (U) (\$4,742) SURFACE SHIP SIGNATURE CONTROL:  
(U) INITIATE:
- (U) Development of virtual EM environment modeling and visualization capability. (Electromagnetic Compatibility)(U) CONTINUE:
  - (U) Development of LO RCS shroud concept for stack suppression system. (Topside Signature Reduction)
  - (U) Development of the prediction and control of scattering resonances at HF frequencies. (Topside Signature Reduction)
- (U) COMPLETE:
- (U) Development of lightening protection concepts for non-metallic structures. (Electromagnetic Compatibility)
- (U) (\$2,090) SURFACE SHIP MANEUVERING & SEAKEEPING:  
(U) INITIATE:
- (U) Development of analytical methods for predicting ship maneuvers. (Seaway Operability and Survivability)
  - (U) Development of a low signature advanced hull concept (Advanced Hull Form Concepts)
- (U) COMPLETE:

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development and validation of dynamic damage stability method. (Seaway Operability and Survivability)
- (U) Development and validation of ship motion display guidance. (Seaway Operability and Survivability)
- (U) (\$4,305) SUBMARINE SIGNATURE CONTROL:
- (U) INITIATE:
  - (U) Development of coating concepts to reduce submarine detection from active acoustic interrogation. (Structural Acoustics)
- (U) CONTINUE:
  - (U) Assess first generation experimental results and revise concept and analysis methods for hull structural concepts with intrinsic acoustic benefit. (Structural Acoustics)
  - (U) Demonstration of proof-of-concept for controlling near-field electromagnetic signatures in shallow water. (EM Signature Reduction)
  - (U) Development of methods to predict reduction of acoustic noise due to flow over appendages. (Hydroacoustics)
- (U) COMPLETE:
  - (U) Development of technology to predict far-field acoustic signature in real-time from on-board measurements; transition to NAVSEA. (Structural Acoustics)
  - (U) Development of prototype laser Doppler vibrometer technology to characterize acoustic materials and transition to NAVSEA. (Structural Acoustic)
  - (U) Develop integrated model for advanced propulsor noise. (Hydroacoustics)
  - (U) Evaluation of the control methodologies for far-field EM signatures in deep and shallow water. (EM Signature Reduction)
- (U) (\$3,466) 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)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) (\$2,538) SUBMARINE POWER AND AUTOMATION:

(U) CONTINUE:

- (U) Technology assessment and development of alternative emergency power 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) COMPLETE:

- (U) Validation of analysis and design tools for quiet electric motors; transition to NAVSEA. (Electrical)
  - (U) Transition adaptive self-energized magnetic bearing technology to NAVSEA. (Electrical)
- (U) Development of measurement techniques for electrical motor dynamics. (Electrical)

(U) (\$3,310) SUBMARINE MANEUVERING AND SEAKEEPING:

(U) INITIATE:

- (U) Development of maneuvering effectors to increased control authority at low speeds. (Maneuvering Systems)

(U) CONTINUE:

- (U) Demonstration of jam resistant maneuvering concepts using radio controlled model tests. (Maneuvering and Control)
- (U) Evaluation of acoustic and powering performance for low cost concept. (Advanced Propulsors)
- (U) Development and validation of design and analysis for full-stern concepts from second generation experimental data. (Advanced Propulsors)

(U) COMPLETE:

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

(U) (\$5,170) PEBB:

(U) INITIATE:

- (U) Development of advanced PEBB fast turn off modules. (Advanced Concept Electrical Systems)

(U) CONTINUE:

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PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Evaluation of third-generation modules to demonstrate form, fit, and function of PEBB. (Advanced Concept Electrical Systems)
- (U) COMPLETE:
- (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 Reconfigurable Ship demonstration (Advanced Concept Electrical Systems)
- (U) (\$7,500) 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) Investigate the application of fiber optic strain gage technology to synthetic fiber ropes. (Infrastructure)
  - (U) Development of a digital sensor architecture interoperable with a broad range of sensor technologies needed by the Navy. (Maintenance)
  - (U) Develop and demonstrate a low cost, low power, wireless, small, smart sensor for incipient damage detection. (Maintenance)
  - (U) Develop an imaging system that provides images of adequate quality to monitor the condition of structures. (Maintenance)
  - (U) Develop fiber optic sensors which will have built-in self diagnostic and self-calibrating features. (Maintenance)
- (U) CONTINUE:
- (U) Development of a high power microwave built-in test set. (Maintenance)
  - (U) Development of a collaborative infrastructure assessment tool. (Infrastructure)
  - (U) Development of a geomorphic site selection technology. (Infrastructure)
- (U) COMPLETE:
- (U) Development of magnetostrictive actuators for cargo/weapons elevator doors. (Replenishment)

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (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)
- (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 advanced lighter operation and control during high sea state. (Amphibious Logistics)

(U) (\$3,214) ENVIRONMENTAL QUALITY TECHNOLOGY:

(U) INITIATE:

- (U) Development of submarine waste management technology. (Environmentally Compliant Platforms)
- (U) Develop in-situ treatment technologies for contaminated marine sediments. (Environmentally Compliant Shore Facilities)
- (U) Develop technology for on-board treatment of oil/water separator sludge. (Environmentally Compliant Platforms)

(U) CONTINUE:

- (U) Development of shipboard waste treatment system control technology. (Environmentally Compliant Platforms)
- (U) Development of advanced non-fouling membrane technology. (Environmentally Compliant Platforms)
- (U) Development of oil pollution control technology for submarine external systems. (Environmentally Compliant Platforms)
- (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) COMPLETE:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

- (U) Development of enhanced methodology for alternative approach to meet copper discharge regulations; transition to Naval Facilities Engineering Command (NAVFAC) for implementation. (Environmentally Compliant Shore Facilities)
- (U) Electrochemical pre/post treatment technology development for ship no-oily wastewater; transition to EQ DEM/VAL program for advanced development. (Environmentally Compliant Platforms)
- (U) Technology development of super/subcritical fluid extraction for shipboard bilgewater treatment; transition to EQ DEM/VAL program for advanced development. (Environmentally Compliant Platforms)
- (U) Development of technologies for Industrial Wastewater Treatment Plants (IWTP); transition to NAVFAC for integration and implementation. (Environmentally Compliant Shore Facilities)
- (U) Development of environmentally acceptable marine lubricants for aircraft carrier catapult systems; transition to Naval Air Systems Command (NAVAIR) PMA 25, for qualification and implementation. (Environmentally Compliant Platforms)
- (U) Development of decontamination cleaning technology for PCB's; transition to NAVFAC (ISR) and NAVSEA (07) for advanced development and implementation. (Environmentally Compliant Shore Facilities)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	51,399	46,859	47,353
(U) Appropriated Value:	-	50,359	-
(U) Adjustments from FY98 PRESBUD:	-2,609	-2,006	-4,176
(U) FY 1999 President's Budget Request:	48,790	48,865	43,177

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 changes reflect SBIR adjustment (-\$624); revised economic assumptions (-\$63); and actual execution update (-\$1,922). FY 1998 changes reflect economic assumptions (-111); fiscal constraint reduction (-\$5,000); Congressional Undistributeds (-\$1,383); and Congressional Plus-up for PEBB (+\$6,000); Power Node Control Centers (+\$1,500); and Underwater Vehicle Control Technology (+\$1000). FY 1999 reduction reflects Navy Working Capital Fund (NWCF) adjustments (-\$155); an S&T realignment for Project M (-\$938); and a realignment of the Affordability program to match the changing warfare and mission priorities (-\$2,500); Commercial Purchase inflation adjustment (-\$762); and Military and Civilian pay rates (+\$179).

(U) Schedule: Not applicable.

(U) Technical: Logistics and Environmental Quality efforts have been realigned into this PE.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

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PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

(U) OTHER APPROPRIATION FUNDS: Not applicable.

(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 (ARPA 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.

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PROGRAM ELEMENT: 0602121N

PROGRAM ELEMENT TITLE: Ship, Submarine & Logistics Technology

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Aircraft Technology	21,931	24,553	23,229	22,735	23,850	23,979	24,907	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 plant 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 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 the manned airborne platform 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 technology gaps that are in the United States Air Force, Army, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency and industry programs, which if successfully demonstrated, would meet Navy aviation needs.

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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), incorporating technology integration: 20% reduction in production cost; 20% reduction in development costs; 20% reduction in support costs; 10% increase in lift-to-drag; 20% reduction in weight fraction; 10% increase in longitudinal agility and 10% increase in lateral directional agility.

(U) Aircraft Technology also addresses the Rotary Wing Vehicle (RWV). Subarea goals in Aeromechanics, Flight Control, Subsystems and Structures. The following reflects the joint Subarea Level goals for cargo rotary wing air vehicles for the year 2000 (baseline V-22 & UH-60): 13% reduction in structural weight/Hover-Out-of-Ground Effect weight ratio; 9% increase in rotorcraft maximum lift/drag ratio; 10% reduction in development time; 13% reduction in procurement cost/pound structural weight; 25% reduction in maintenance costs/flight hour/installed shaft horsepower; 25% reduced vulnerability to threats.

(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. Aircraft Power (by year 2000; baseline F-18E/F & F-22): Eliminate hydraulic system; 10 times increase in reliability; other DTAPs addressed by Aircraft Technology: 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. 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).

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

(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 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 1997 ACCOMPLISHMENTS:

- (U) (\$6,098) PROPULSION & POWER:

(U) Initiated:

- (U) Development of Phase III turbine components for integration into an 6.3 Advanced Turbine Engine Gas Generator demonstrator.
- (U) Fabrication of the internal starter/generator demonstrator which contributes to meeting the sea-based support objective of reducing peculiar support equipment volume by 10% by FY-2000.

(U) Continued to:

- (U) Design Phase III Joint Technology Demonstrator Engine (JTDE) fan, when integrated into the 6.3 JTDE will double current Thrust-to-Weight capability.
- (U) Design the Phase III Advanced Gas Generator/JTDE combustor.
- (U) Design advanced corrosion resistant mechanical components to reduce dynamic seal leakage and increase rotor speed capability to reduce fuel consumption and meet Phase III goals.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Evaluate advanced electrical concepts/architectures to reduce system weight, volume and cost for future naval aircraft.

(U) Completed:

- (U) Design of electronic engine control system. The system design will utilize ruggedized optic connectors and combine optics and electronics on one chip to minimize size and weight.

- (U) Fabrication and integration into a 6.3 demonstrator engine, of additional Integrated High Performance Turbine engine Technology (IHPTET) Phase II advanced fan, compressor, combustor, high/low turbine, augmentor, bearings, and controls technologies. This will be transferred to the 6.3 engine demonstration of 60% improvement on thrust/weight and 30% reduction in fuel consumption over a YF-119 engine.

- (U) Testing and data analysis of a forward swept JTDE fan. The fan performance improves efficiency 4% above baseline levels and reduces parts count by 30%.

- (U) System level testing of the Management & Distribution of a More Electric Aircraft (MADMEL) demonstrator and identify potential flight test components. This effort supports the objective of eliminating the aircraft hydraulic system by FY 2000.

- (U) Delivery of an electrically driven Integrated Power Unit (IPU) demonstrator to Wright Laboratory, to support the objective of increasing reliability of the electrical power system by 2.5x by FY-2000.

• (U) (\$2,265) AFFORDABLE NAVY AIR VEHICLES:

(U) Initiated:

- (U) Development of repair techniques for highly curved, composite aircraft structures applicable to aircraft inlet duct and exhaust nozzle structures.

- (U) Development of structural life enhancement techniques applicable to both new and aging aircraft, to support FY-2000 objective of increasing fatigue life by 25%.

- (U) Design studies for future uninhabited strike naval aircraft reducing future air vehicle operations and support costs.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Continued to:

- (U) Improve capability, during the Applied Research phase, in the evaluation of the life cycle cost and affordability impact of technology advances for use in the development of future aircraft concepts. Efforts to be coordinated with Strike Fighter (SF) Program, F/A-18E/F, V-22, other Services and industry.
- (U) Develop a combined Computational Fluid Dynamics/Finite Element Model (CFD/FEM) design/analysis tool for accurately predicting aerodynamic loads of and designing the structure for aircraft empennages.

(U) Completed:

- (U) Demonstration of composite low cost integral stiffener concept with improved load carrying capability. Supports objectives for FY-2000 to reduce aircraft structure fabrication costs by 35% and weight by 15% while increasing fatigue life by 25%.
- (U) Antenna and Radar Cross Section (RCS) measurement of the conformal Very High Frequency/Ultra High Frequency (VHF/UHF) antenna radome.
- (U) Demonstration of composite substructure to reduce manufacturing cost.

- (U) (\$7,800) AIRCRAFT COMBAT SITUATIONAL AWARENESS (includes Congressional plus-ups):

(U) Initiated:

- (U) Development 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 to provide necessary control variables (Biofeedback) in order to reduce fatalities while increasing mission effectiveness.
- (U) Affordability program to develop advanced common electronic modules (ACEMs) consisting of common sensor interfaces acquiring data directly from sensors, and digital processing computing nodes sustaining increased performance in processing, communication input/output bandwidth and latency. ACEMs reduces costs, weight and power requirements by means of implementing digital mission function processing in place of analog electronics.

(U) Continued to:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Develop algorithms and complete analyses and simulations of vehicle data bus networks in support of an Intelligent Vehicle Management System concept and Smart Component integration.
- (U) Demonstrate hardware and software for advanced high definition, flat panel Helmet Mounted Displays for sensor fusion and precision real time retargeting, threat warning, and extended aircraft/aircrew vision under adverse attitude, maneuvering, and environmental conditions. Contributes to the goal of demonstrating a single seat all-weather strike cockpit by FY-2005.

- (U) (\$2,063) AIR VEHICLE DYNAMIC CONTROL:

(U) Initiated:

- Real-Time Hardware in-the-loop demonstration of On-Board Expert Diagnostic System with projected cost savings of \$320-500M for fleet F-18C/D aircraft
- (U) Laboratory demonstration of an advanced air data acquisition sensor.
- (U) Investigation of control augmentation systems most appropriate to compensate for aircraft operational deficiencies in degraded environmental conditions.

(U) Continued to:

- (U) Develop and evaluate control laws to assist the pilot in outer-loop control functions (i.e., control of acceleration, as well as other dynamic aspects of the air vehicle).
- (U) Develop techniques for performing detailed two-dimensional and three-dimensional analyses for evaluating high lift aerodynamic concepts.

- (U) (\$ 3,705) OXIDE PURPLE:

- (U) Classified.

2. (U) FY 1998 PLAN:

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) (\$8,460) PROPULSION & POWER:  
(U) Continue to:
  - (U) Develop JTDE fighter/attack fan.
  - (U) Develop the Phase III Advanced Gas Generator/JTDE affordable combustor to expand flight envelope.
  - (U) Develop advanced corrosion resistant mechanical components to reduce dynamic seal leakage and reduce operating costs.
  - (U) Develop life/durability improvements in turbine system components.
  - (U) Develop techniques to improve control of rotor dynamics to reduce impact of carrier landings.
  - (U) Evaluate advanced electrical concepts/architectures to reduce system weight, volume and cost for future naval aircraft. Continue support of More Electric Aircraft Initiative.
  
- (U) Complete:
  - (U) Demonstration in a subsonic core advanced combustor and compressor components that reduce fuel consumption by 30%.
  - (U) Rig demonstration of a radial turbine blade damping concept which will reduce stresses and increase turbine durability by 50%.
  - (U) Consolidation of the MADMEL, Internal Starter/Generator (ISG) (external machine) and IPU (electrically driven) into a complete, more electric "copper bird" technology demonstrator.
  
- (U) (\$5,683) INTEGRATED AVIONICS (formerly AIRCRAFT COMBAT SITUATIONAL AWARENESS):  
(U) Initiate:
  - (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 will include the development of enabling technologies such as advanced sensing and signal processing techniques, high speed image processing and particulate classification (Oil Analysis), galvanic, eddy current and ultrasonic sensing (Corrosion Detection) and computer-base training and intelligent tutoring systems.

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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) (\$2,717) PIXEL FLAT PANEL DISPLAY CONGRESSIONAL PLUS-UP:  
(U) Initiate:
  - (U) Development of the initial 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) Continue to:
  - (U) Develop an intelligent crewstation concept to unobtrusively monitor aircrew physiological functions.
  - (U) Develop fault tolerant processing and network elements based on the selected vehicle management system architecture and information flow control structure.
  - (U) Pursue multiple platform applicability demonstrations of emerging Advanced Helmet Vision systems for enhanced aircrew mission effectiveness and improved targeting accuracy.
  - (U) Develop 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 process of RF signals over a very wide frequency range (50 MHz to 45 GHz). This work is expected to transition to the 0603217N P.E.
  
- (U) (\$4,393) NAVAL AIR VEHICLE CONCEPTS (formerly AFFORDABLE NAVY AIR VEHICLES + AIR VEHICLE DYNAMIC CONTROL):  
(U) Initiate:
  - (U) System architecture for the Real-Time Battle and Mid-Air Collision Damage Identification System for flight controls reconfiguration.
  - (U) Demonstration of unitized composite structure to reduce structural weight and manufacturing cost in accordance with FY-2000 objectives of increasing fatigue life by 25%, while reducing weight by 15% and fabrication costs by 35%.
  - (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 and Uninhabited Combat Air Vehicles.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Development of smart Composite Structures which incorporate health monitoring capabilities for accurate damage identification and assessment to develop a condition based diagnostic system.

(U) Continue to:

- (U) Develop parallel viscous aerodynamic methodology for improving the fidelity of aerodynamic design and cycle time.

- (U) Refine, optimize and test control augmentation system most appropriate for compensating for aircraft operational deficiencies in degraded operational conditions.

- (U) Develop repair techniques for highly curved, composite aircraft structures applicable to aircraft inlet duct and exhaust nozzle structures.

- (U) Develop structural life enhancement techniques applicable to both new and aging aircraft to support FY 2005 objective of increasing fatigue life by 25%.

- (U) Develop design concept for uninhabited naval strike aircraft to reduce future air vehicle operation and support costs

(U) Complete:

- (U) Flight demonstration of an advanced molecular optical air data acquisition sensor.

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

- (U) Design of an exhaust impinged structural air vehicle component which requires 62% less maintenance-man hour/flight-hr (MMH/FH) than currently fielded exhaust impinged structures. It is anticipated that maintenance associated with this design will be reduced from 0.42 MMH/FH to 0.16 MMH/FH.

- (U) Manned simulations to demonstrate control augmentation system ability to compensate for control software

- (U) (\$3,300) OXIDE PURPLE:

- (U) Classified.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

## 3. (U) FY 1999 PLAN:

- (U) (\$7,900) PROPULSION & POWER:

(U) Initiate:

- (U) Testing of the Internal Starter/Generator.
- (U) Testing of the IPU Starter/Generator with gas generator.

(U) Continue to:

- (U) Develop JTDE Fighter/Attack Demonstrator Engine Fan.
- (U) Develop life/durability improvements in turbine system components.
- (U) Rig test 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) Complete:

- Design of a ceramic matrix composite combustor for subsonic and rotary applications. It will demonstrate cycle temperatures 900 degrees above the baseline for reduced fuel consumption.
- Demonstration of Fighter/Attack category engine components in a full engine configuration to increase thrust-to-weight by 60% and reduce cost by 20%.
- (U) Rig test of advanced corrosion resistant mechanical components to reduce operating costs.
- (U) Rig test of an Advanced Gas Generator/JTDE affordable combustor. Reduced weight and cost for Fighter/Attack and Vertical/Short Take Off and Landing (V/STOL) applications.
- (U) Demonstrate fuel flow metering system for afterburner and main fuel that will reduce weight, production and maintenance costs.

- (U) (\$5,829) INTEGRATED AVIONICS (formerly AIRCRAFT COMBAT SITUATIONAL AWARENESS):

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Budget Item Justification  
(Exhibit R-2, page 10 of 14)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Continue to:

- (U) Demonstrate 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) Develop the preliminary aircrew interface required to support the Aircrew Decision Aiding Interface effort.
- (U) Develop advanced maintenance and critical machinery self-diagnosis technologies, in order to transition from a time-based to a condition-based maintenance philosophy.
- (U) Investigate Advanced Multi-Mode Helmet Vision System to effectively merge real-time sensor information as well as synthetically generated environment imagery

- (U) (\$5,900) NAVAL AIR VEHICLE CONCEPTS (formerly AFFORDABLE NAVY AIR VEHICLES + AIR VEHICLE DYNAMIC CONTROL):

(U) Initiate:

- (U) Use of a recently developed advanced flow diagnostic tools that sense the state of the boundary layer and drive the modification of the surface to maintain the desired flow characteristics to enhance the maneuver and cruise performance of high performance aircraft toward reducing cruise drag by 7% and increasing maneuver lift/drag ratio by 10%.
- (U) Development of critical technologies associated with the vertical take-off and landing (VTOL) from a surface combatant of an uninhabited combat air vehicle.

(U) Continue to:

- (U) Demonstrate unitized composite structure to reduce structural weight and manufacturing costs in accordance with FY-2000 objectives of increasing fatigue life by 25% while reducing weight by 15% and fabrication costs by 35%.

(U) Complete:

- Demonstration of Nonlinear Adaptive Control Algorithms on both damaged and undamaged aircraft simulations

R-1 Line Item 5

Budget Item Justification  
(Exhibit R-2, page 11 of 14)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

- (U) Demonstration of damage identification and estimation algorithms on a high fidelity nonlinear six degree of freedom high performance aircraft simulation.
- (U) Development of methods and concepts to alleviate empennage buffet during high alpha maneuvering of fighter/attack aircraft. Contributes to FY-2000 objective of reducing twin-tail buffet by 20%.
- (U) Development of Smart Composite Structures which incorporate health monitoring capabilities for accurate damage identification and assessment to develop a condition based diagnostic system, contributing to a reduction in support costs.

- (U) (\$3,600) OXIDE PURPLE:
  - (U) Classified.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	23,748	23,590	22,860
(U) Appropriated Value:	-	25,390	-
(U) Adjustments from FY 1998 PRESBUDG:	-1,817	+963	+369
(U) FY 1999 President's Budget Request:	21,931	24,553	23,229

(U) CHANGE SUMMARY EXPLANATION:

R-1 Line Item 5

Budget Item Justification  
(Exhibit R-2, page 12 of 14)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Funding: FY 1997 adjustments reflect Small Business Innovation Research (SBIR) (-\$363) Actual Execution (-\$1,425); and Revised Economic Assumptions (-\$29). FY 1998 adjustments reflect Congressional Undistributed reduction (-\$781); Economic Assumptions reduction (-\$56); Fiscal Constraint reduction (-\$1,000); and Advanced Integration of Helmet Displays (+\$2,800). FY 1999 adjustments reflect S&T reduction (+\$510); Navy Working Capital Fund (NWCF) adjustment (+\$231); Commercial Purchases Inflation adjustment (-\$409); and Military & Civilian pay rates (+\$37).

(U) Schedule: Not Applicable.

(U) Technical: Not Applicable.

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

(U) RELATED RDT&E: This program adheres to Defense S&T Reliance Agreements on Air Vehicles (Fixed Wing & Rotary Wing), 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:

- (U) PE 0601101F (Geophysics)
- (U) PE 0601102F (Materials)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602201F (Aerospace Flight Dynamics)
- (U) PE 0602202F (Human Systems Technology)
- (U) PE 0602203F (Aerospace Propulsion)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0602234N (Materials, Electronic and Computer Technology)
- (U) PE 0602708E (Cockpit Autonomous Landing)
- (U) PE 0603003A (Rotary Wing Aircraft Technology)
- (U) PE 0603106F (Logistics Systems Technology)

R-1 Line Item 5

Budget Item Justification  
(Exhibit R-2, page 13 of 14)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N

PROGRAM ELEMENT TITLE: Aircraft 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 0603217N (Air Systems and Weapons Advanced Technology)
- (U) PE 0603231F (Crew Systems and Personnel)
- (U) PE 0603238N (Precision Strike & Air Defense Technology)
- (U) PE 0603245F (Advanced Flight Technology Integration)
- (U) PE 0603706N (Medical Development(Advanced))
- (U) PE 0603707N (Manpower, Personnel, and Training Advanced Technology Development)
- (U) PE 0603792N (Advanced Technology Transition)

(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.

R-1 Line Item 5

Budget Item Justification  
(Exhibit R-2, page 14 of 14)

# UNCLASSIFIED

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>			
BUDGET ACTIVITY <b>2 - Exploratory Development</b>				PE NUMBER AND TITLE <b>0602131M Marine Corps Landing force Technology</b>				PROJECT <b>C3100</b>		
COST <i>(In Thousands)</i>	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
C3100 Marine Corps Landing Force Technology	16016	13458	12132	10609	9948	11734	11803	Continuing	Continuing	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	
<p><b>A. (U) <u>Mission Description and Budget Item Justification:</u></b></p> <p>(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.</p> <p>(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 reorganized from eight technology thrust areas into five Warfighting Imperatives by the Science and Technology (S&amp;T) Roundtable process. These Warfighting Imperatives are: Command and Control, Maneuver, Logistics, Firepower, and Training and Education.</p> <p>(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&amp;T Roundtable process managed by MCCDC and the Office of Naval Research.</p> <p>(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.</p>										
Project C3100			Page 6 - 1 of 6 - 6 Pages				Exhibit R-2			



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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
<b>BUDGET ACTIVITY</b> <b>2 - Exploratory Development</b>	<b>PE NUMBER AND TITLE</b> <b>0602131M Marine Corps Landing force Technology</b>	<b>PROJECT</b> <b>C3100</b>
<b>(U) PROGRAM ACCOMPLISHMENTS AND PLANS:</b>		
<b>(U) FY 1997 Accomplishments:</b>		
• (U) \$	4267	Maneuver Imperative: Continued survivability development and integration into Joint DARPA/USMC/SOCOM Reconnaissance, Surveillance and Targeting Vehicle (RST/V) program as well as the Marine Corps Light Armored Vehicle (LAV). Completed Threat Oriented Survivability Optimization Model (TOSOM) development. Completed Joint Tactical Electric Vehicle (JTEV) development and testing; transitioned to RST/V. Began multi-spectral camera upgrade for mine detection. Completed shape charge mine neutralization optimization and transitioned to Joint Stand-off Minefield Breacher Program (PE 64612M) and Navy Explosive Neutralization (EN)-ATD.
• (U) \$	3379	Firepower Imperative: USMC Test, Evaluation, Assessment, Modeling, and Simulation (TEAMS) facility fully operational. Advanced Electronic Signal Monitoring (ESM) sensor prototype completed and tested. Smoke and Obscurants testbed software demonstrated. High Resolution Wind (HRW) for effects of environment on acoustic sensors demonstrated. First demonstration of sensor alignment/registration completed. Forward Observer/Forward Air Controller (FO/FAC) to Naval gun integration through Advanced Field Artillery Tactical Data System (AFATDS) demonstrated. Continued to exploit emerging technology through the Broad Area Announcement (BAA) process. Begin investigation of fire-from-enclosure for shoulder launched weapon systems. Demonstrated Advanced Heads-up Display Systems.
• (U) \$	2052	Command and Control Imperative: Demonstrated Commander Critical Information Requirements in Hunter Warrior Advanced Warfighting Experiment. Demonstrated Information Extraction Technologies with DARPA. Demonstrated Over The Horizon (OTH) Communications technologies. Established Joint Communications working group and joint OTH airborne communications relay program. Prototyped proof of concept Smart Tactical Jammer. Developed and demonstrated handheld Radio Recon Concept. Evaluated Near Term Digital Radio and developed USMC C4I S&T investment strategy. Participated in Joint Warfighting Integration Demonstration (JWID) 97 with Operational Center support demonstrations and experiments.
• (U) \$	5418	Logistics Imperative: Developed Logistics Imperative road map with emphasis on support of Logistics Information Resources (LOG IR) technologies. Supported initial equipment systems concept development for emerging Seabasing and MPF 2010 naval operational concepts. Developed Combat Service Support Operational Center (CSSOC) database and software management tool enhancements through rapid prototype, referred to as common data repository (COMDAR) and rapid request tracking system (RRTS). Both systems in early user evaluation at Marine Corps advanced warfighting experiments. Completed development of Marine Corps Combat Service Support (CSS) system analytical model. Model used for evaluation of CSS equipment systems in USMC wargaming. Continued development of technology concepts for Engineer, Supply & Services Technologies. Continued development of enhanced transportation and distribution concepts. Evaluated aerial resupply systems in conjunction with new packaging concepts for bulk liquids sustainment for small unit operations. Developed notional system concepts for an Amphibious Expeditionary Logistics Transporter (ELT). Continued research on corrosion resistant materials and coatings for USMC applications.
Project C3100	Page 6 - 2 of 6 - 6 Pages	Exhibit R-2

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Exploratory Development</b>	PE NUMBER AND TITLE <b>0602131M Marine Corps Landing force Technology</b>	
		PROJECT <b>C3100</b>
<ul style="list-style-type: none"> <li>(U) \$ 900</li> </ul>	Training and Education Imperative: Began program to develop concept for applying technology to Marine Corps training needs, specifically focusing on Modeling and Simulation. Identified technology tasks to link and integrate Service, DoD and commercial training capabilities as well as service operational systems (embedded training). Developed concepts for training while deployed and at remote sites. Began Rapid Virtual Data Base development.	
(U)Total \$ 16,016		
<b>(U) FY 1998 Planned Program:</b>		
<ul style="list-style-type: none"> <li>(U) \$ 3069</li> </ul>	Maneuver Imperative: Continue integration of survivability technology with RST/V and LAV. Complete multi-spectral camera upgrade for mine detection and processing software development; transition to Coastal Battlefield Reconnaissance (COBRA) ATD (PE 63640M) and the Joint Countermine ACTD. Begin Advanced Minefield Breaching concepts development. Initiate upfront technology analysis in support of USMC Logistics Vehicle System Rebuild (LVRS) and Medium Tacical Vehicle Replacement (MTVR) programs with focus on up-front material/corrosion technology assessment.	
<ul style="list-style-type: none"> <li>(U) \$ 2190</li> </ul>	Firepower Imperative: Continue development of sensor testbed (alignment/registration). Investigate sensor-to-shooter fire control systems integration. Demonstrate non-magnetic North - finding Azimuth systems. Investigate the integration of Advanced Medium Range Air-to-Air Missile (AMRAAM) missiles onto High Mobility Multi-Wheeled Vehicles (HMMWVs). Investigate target discrimination systems integration into AFATDS. Investigate and demonstrate technology to enhance FO/FAC capabilities. Investigate advanced small arms weapons systems. Demonstrate fire-from-enclosure technology for shoulder launched weapons systems. Continue BAA solicitation/award cycle. Begin integration of sensor technology into prototype Remote Reconnaissance Tactical Vehicle (RSTV).	
<ul style="list-style-type: none"> <li>(U) \$ 3503</li> </ul>	Command and Control Imperative: Continued efforts in developing Over The horizon (OTH) Communications capability for landing forces. User evaluation of Commander's Critical Information in Marine Corps Software Baseline and DII/COE requirements. Demonstrate/Evaluate information extraction technologies. Demonstrate OTH Communications network concept. Expand frequency capability in information warfare to include system design, breadboard testing, and prototype demonstration. Support goals of the Advanced Technology Demonstration and the Unit Operations Center acquisition program. Initiate federated database technology. Initiate network management technologies effort for digital asynchronous communications terminals. Demonstrate modular and scaleable operation center components, that improve information flow in small mobile Global Broadcast Systems that support Joint Task Force operations.	

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Exploratory Development</b>	PE NUMBER AND TITLE <b>0602131M Marine Corps Landing force Technology</b>	PROJECT <b>C3100</b>
• (U) \$ 3796	<p>Logistics Imperative: Continue rapid prototype development, demonstration, and transition of logistics information resources technologies for deployable Combat Service Support Operations Center (CSSOC) applications. Complete exploratory development of the Rapid Request Tracking System (RRTS). Continue to exploit emerging logistics related technology developments, through the BAA process, focused on Combat Service Support (CSS) for operations in the littorals and urban environments. Continue system concept modeling/simulation support and technology plan development for Advanced Amphibious Logistics (AAL)/Seabasing for Joint Expeditionary Forces under JV 2010. Investigation and incorporation of automated information technologies for asset tracking and interactive/condition based maintenance support. Provide technology assessment and concept development support for future USMC Heavy Equipment (HE) and Material Handling Equipment (MHE) procurements. Explore new technologies and concepts for high power density generators and onboard vehicle applications/integration. Develop bulk liquids technologies in support of future Seabasing concept development, focused on innovative packaging and distribution. Support transition of validated logistics equipment systems evolving through Advanced Warfighting Experiments.</p>	
• (U) \$ 900	<p>Training and Education Imperative: Continue Rapid Virtual Data Base development. Develop intelligent automated forces. Continue training and technology concept development. Begin Family of Simulators integration concept development.</p>	
(U)Total \$ 13,458		
<b>(U) FY 1999 Planned Program:</b>		
• (U) \$ 2464	<p>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 mine detection processing software development, test and transition to COBRA ATD (PE 63640M). Initiate investigation leading to the technology to enhance mobility of tactical systems. Continue corrosion and materials research and testing with insertion of technologies in LAV/MTVR/LVS.</p>	
• (U) \$ 2178	<p>Firepower Imperative: Demonstrate initial integration of sensor alignment, orientation, and fusion into AFATDS. Complete HMMWV/AMRAAM (HUMRAM) efforts. Continue advanced lightweight weapons advanced technology efforts. Continue sensor integration technology efforts. Demonstrate advanced FO/FAC technology.</p>	
• (U) \$ 3590	<p>Command and Control Imperative: Develop scaleable planning tool in support of Operations Center displays, fusion, and aids. Complete Command, Control, Intelligence, Reconnaissance (CCIR) decision aid. Demonstrate offensive information warfare capability from Tactical Combat Operations (TCO) (USMC Global Command and Control System (GCCS)). Continue OTH network concepts and frequency expansion capability for information warfare. Initiate an effort to adapt 3 dimensional volumetric display technology into combat operation centers for ground and air operations. Support near term digital radio program, commo concepts of operations and joint evaluations.</p>	
• (U) \$ 2350	<p>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 (LOG IR); Transpiration and Distribution technologies. Continue transition of rapid prototype and experimentally validated logistics equipment concepts into Marine Corps acquisition programs.</p>	
Project C3100	Page 6 - 4 of 6 - 6 Pages	Exhibit R-2

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>				
<b>BUDGET ACTIVITY</b> <b>2 - Exploratory Development</b>				<b>PE NUMBER AND TITLE</b> <b>0602131M Marine Corps Landing force Technology</b>		<b>PROJECT</b> <b>C3100</b>					
<ul style="list-style-type: none"> <li>• (U) \$ 1550 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 Family of Simulators integration development and test with Closed Loop Artillery Simulator (CLAS), Combat Vehicle Trainer (CVT) and Small Unit Tactical Trainer (SUTT). Initiate efforts in training technology.</li> </ul> <p>(U)Total \$ 12,132</p>											
<b>B. (U) <u>Project Change Summary</u></b>				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>					
(U) Previous President's Budget				16374	13043	14535					
(U) Adjustments to Previous President's Budget				-358	+415	-2403					
(U) Current Budget Submit				16016	13458	12132					
(U) Change Summary Explanation:											
<p>(U) Funding: The FY 1997 reduction consists of the transfer out of SBIR and other minor execution pricing adjustments. The FY 1998 increase represents revised Marine Corps S&amp;T development efforts. FY 1999 decrease reflects NWCF and Commercial Purchase Inflation adjustments.</p> <p>(U) Schedule: Not applicable.</p> <p>(U) Technical: Not applicable.</p>											
<b>C. (U) <u>Other Program Funding Summary</u></b> <b>(APPN, BLI #, NOMEN)</b>			<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	To	Total
Not applicable.										<u>Compl</u>	<u>Cost</u>
<b>(U) Related RDT&amp;E</b>											
(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.											
Project C3100				Page 6 - 5 of 6 - 6 Pages				Exhibit R-2			

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE
BUDGET ACTIVITY <b>2 - Exploratory Development</b>	PE NUMBER AND TITLE <b>0602131M Marine Corps Landing force Technology</b>	<b>February 1998</b> PROJECT <b>C3100</b>
<p>(U) PE 0603606A (Improved Dispersed Explosives Technology) (U) PE 0603619A (Improved Dispersed Explosives Technology) (U) PE 0603611M (Marine Corps Assault Vehicles) (U) PE 0603635M (Marine Corps Ground Cobat/Support System) (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 &amp; 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.</p> <p><b>D. (U) <u>Schedule Profile:</u></b> Not applicable.</p>		
Project C3100	Page 6 - 6 of 6 - 6 Pages	Exhibit R-3

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602228N

PROGRAM ELEMENT TITLE: Historically Black Colleges and Universities and  
Minority Institutions

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Historically Black Colleges and Universities and Minority Institutions (HBCU/MI)	*0	*0	4,699	4,777	4,764	4,807	5,004	CONT.	CONT.

\* Fiscal Year 1997 and 1998 funds were executed under Program Element (P.E.) 0602228D.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE provides infrastructure support to Historically Black Colleges and Universities and Minority Institutions in fields of science and engineering that are important to national defense. This competitive program provides support through grants or contracts for research, collaborative research, education assistance, instrumentation purchases, and technical assistance. The research grants are to further knowledge in the basic scientific disciplines through theoretical and experimental activities. Collaborative research allows university professors to work directly with military laboratories or other universities. Education assistance funds are used by the selected institutions to strengthen their academic programs in engineering, science and mathematics, thereby increasing the quality of education and the number of under-represented minorities obtaining undergraduate and graduate degrees in these fields. Funds for instrumentation allow institutions to increase their capability to educate students and perform research of interest to the Department of Defense. Technical assistance funds are used to design programs to enhance the ability of Historically Black Colleges and Universities/Minority Institutions to successfully compete for future Defense funding.

(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..

R-1 Line Item 7

Budget Item Justification  
(Exhibit R-2, page 1 of 4)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602228N

PROGRAM ELEMENT TITLE: Historically Black Colleges and Universities and  
Minority Institutions

(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) This effort is aimed at increasing the participation of Historically Black Colleges and Universities and Minority Institutions and their graduates in the Navy's technology programs.

(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 1997 ACCOMPLISHMENTS: Not Applicable. Was executed under P.E. 0602228D.

2. (U) FY 1998 PLAN: Not Applicable. Was executed under P.E. 0602228D.

3. (U) FY 1999 PLAN:

• (U) (\$4,699) HBCU/MI: FY 1999 funds will be used to continue grants for education program at HBCU/MI that were selected in a FY 1998 competition and were begun in FY 1998.

B. (U) PROGRAM CHANGE SUMMARY

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY1999</u>
(U) FY 1998 President's Budget:	0	0	0
(U) Appropriated Value:	0	0	0

R-1 Line Item 7

Budget Item Justification  
(Exhibit R-2, page 2 of 4)

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602228N

PROGRAM ELEMENT TITLE: Historically Black Colleges and Universities and  
Minority Institutions

(U) Adjustments from FY 1998 PRESBUDG: 0 0 +4,699

(U) FY 1999 President's Budget Request: 0 0 4,699

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1999 adjustments reflect reprogramming to service programs (+\$4,699).

(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 0602233N (Readiness, Training and Environment Quality Technology)

(U) PE 0602228D (Historically Black Colleges and Universities and Minority Institutions)

(U) PE 0602228A (Historically Black Colleges and Universities and Minority Institutions)

(U) PE 0602228F (Historically Black Colleges and Universities and Minority Institutions)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
(Exhibit R-2, page 3 of 4)

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602228N

PROGRAM ELEMENT TITLE: Historically Black Colleges and Universities and  
Minority Institutions

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR)	53,967	54,814	65,033*	68,403	70,896	72,558	75,844	CONT.	CONT.

\*Planned transfer of 1,100 from PE 0605866N during execution to correct budgeting error. FY99 program will total 66,133.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) supports future command, control, communications (C<sup>3</sup>) and surveillance systems for surface, air, and space platforms for Naval Warfare. This program develops C<sup>3</sup> technologies necessary for the delivery of critical tactical information to decision makers in a timely manner and for the transmission, fusion, and management of information between the warrior, the command center, and National Command Authorities. Technology developments include: connectivity, networking, distributed computer processing, multilevel security, information management, information warfare, decision support and navigation. The major goal is to provide the Navy with the capacity to interconnect government and commercial telecommunication assets in a worldwide network that is responsive to regional theater challenges and the National interest. Surface/Aerospace Surveillance technology development supports theater surveillance, battle group area surveillance, ship self defense, air battle space surveillance and surveillance to support strike missions. Both C<sup>3</sup> and surveillance technology are related to the Joint Mission Areas of Strike Warfare, Littoral Warfare, and Intelligence, Surveillance, & Reconnaissance. Specifically: Strike efforts address technology issues in real-time targeting and Battle Damage Assessment (BDA). Programs include mission planning, en-route C<sup>3</sup>, precision targeting and BDA. Littoral Warfare efforts address 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. Surveillance efforts address issues of real-time targeting, connectivity, counter-jamming and deception. Program includes multi-platform radar and IR sensors for detection, identification, tracking, BDA, and timely distribution of surveillance information to all levels of command. C<sup>3</sup> efforts address information warfare Common Tactical Picture, battle management and connectivity. Programs include sensors and C<sup>3</sup> to provide timely situational awareness of the total battlespace and indications and warning of threat operations and intentions.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

(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 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 1997 ACCOMPLISHMENTS:

• (U) (\$21,410) RADAR TECHNOLOGY:

- (U) Conducted system studies and down selected best design/architecture for Ultra-Wideband phased array to support multi-function (search, track, engage) radar operation.
- (U) Performance tested horizon engagement radar in a high speed low altitude target environment and prepared transition plan for the Program Executive Officer, Theater Air Defense (PEO-TAD).
- (U) Validated two-dimensional Air Target Identification algorithms for all aspect target identification (ID) in a laboratory environment.
- (U) Developed lightweight composite rotary coupler for AN/SPS-49 Surveillance radar.
- (U) Field-tested low power ship multi-function radar system against targets of varying cross sections and flight regimes.
- (U) Conducted design studies for Ultra High Frequency (UHF) electronically steered phased array for carrier based Airborne Early Warning (AEW) aircraft and down selected for scale model hardware development.
- (U) Transitioned automatic ship classification technology to the Naval Air Systems Command (NAVAIR) for AN/APS-137 upgrade.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Developed Wideband AEW Radar test bed in support of Navy Common Support Aircraft requirements studies
- (U) Completed system studies for voltage controlled diode implementations for affordable phased arrays. Joint program with PEO-TAD and Defense Advanced Research Projects Agency (DARPA).
- (U) Conducted system studies to add Terrestrial Inverse Synthetic Aperture Mode and moving target image processing to existing Synthetic Aperture Radar (SAR) system and Joint Surveillance Targeting Acquisition and Radar System(JSTARS and AN/APS-137), joint program with United States Air Force (USAF).
- (U) Developed breadboard hardware for Very High Frequency/Ultra High Frequency (VHF/UHF) stepped frequency Ultra Wideband Radar for concealed and buried target detection and exploitation. This program is coordinated with DARPA, Army and the Defense Intelligence Agency through Defense Reliance.
- (U) Awarded contract to develop Passive Millimeter Wave radiometry for all weather, high resolution imaging for target ID and BDA in support of strike operations and for covert navigation in restricted waters in response to PEO-TAD needs.
- (U) (\$10,987) EO/IR TECHNOLOGY:
  - (U) The EO/IR technology program investment addresses Navy surveillance needs and exploits technology opportunities leading to advanced sensor and processing capabilities. The program emphasizes needs of major Navy ship and 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.
  - (U) Developed and integrated processing algorithms into real-time signal processor for Two-Color shipboard Infrared Search and Track (IRST).
  - (U) Field tested Multi Spectral Airborne EO Sensor for Surveillance of airspace and land targets for integrated air defense and strike missions (Joint with USAF).
  - (U) Awarded contract for development of surveillance IRST for AEW aircraft Theater Ballistic Missile (TBM) discrimination and tracking Naval Air assets (NAVAIR endorsement).
  - (U) Transitioned two color shipboard IRST sensor to PEO-TAD for sea demonstrations and operational utility assessments.
  - (U) Completed Infrared Analysis, Measurement and Modeling Program, and transitioned integrated IR Tool model suite for use in Fleet decision aids and to Government, academic and industrial Research and Development facilities to aid in development of IR sensor and signal processing.
  - (U) Transitioned cloud ship wake technology for high altitude platforms to Intelligence users.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Awarded contract to integrate shared aperture EO Sensor with Ballistic Missile Defense Office (BMDO) developed active laser for E-2 AEW and Theater Mission Defense (TMD) missions. Joint with BMDO.
- (U) Completed system study for distributed Aperture Infrared Imaging/Search and Track Sensor for high-resolution target detection and passive ranging. Responds to needs identified by Joint Strike Fighter (JSF) program.
- (U) (\$2,657) MULTI-SENSOR TECHNOLOGY:
  - (U) The multi-sensor technology program addresses Navy needs for integrated combat systems, all source fusion and technology opportunities for automated resource management and control. Emphasis is on technology to enable integration, fusion and autonomous control of multiple, dissimilar sensors within a platform. Resource management, data fusion and adaptive control processing utilizing research program products in artificial intelligence, neural networks and fuzzy logic are the enablers for this development.
  - (U) Developed system concepts and conducted preliminary field test of Integrated Multi-Sensor System for Unmanned Aerial Vehicle (UAV) and manned aircraft surveillance, targeting and BDA.
  - (U) Developed Data/Sensor fusion processor architecture for integration and fusion of Radar, EO and passive Electronic Support Measures (ESM) sensors for integrated air defense and strike surveillance missions.
  - (U) Multi-function radio frequency (RF) aperture concepts were developed with emphasis on reducing number of topside antennas on US Navy Ships.
- (U) (\$1,986) COMMUNICATIONS NETWORKS:
  - (U) In conjunction with civilian standards bodies such as the Internet Engineering Task Force (IETF), developed services and mechanism for a high performance transport protocol appropriate for military high speed networks. Coordinated via the Information Systems and Technology (IST) Panel of the Defense S&T Reliance.
  - (U) Developed Asynchronous Transfer Mode (ATM) network testbed architecture for comparing performance of different ATM machines. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Developed expeditionary warfare mobile communications networking architecture and simulation capability. Coordinated with and supportive of the DARPA Warfighter Internet Program.
  - (U) Refined the design of the QOS Channel Allocation Protocol (CAP) to enable resource management and admission control.

R-1 Line Item 8

Budget Item Justification  
(Exhibit R-2, page 4 of 18)

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) (\$9,618) COMMUNICATIONS:
  - (U) Continued development of key communications technologies for air, ship and submarines.
  - (U) Developed second, on-hull Extremely Low Frequency (ELF) antenna for further residual noise reduction, conducted at-sea testing of more compact, low-profile submarine antenna and assessed the more promising submarine multiband, multifunction Super High Frequency (SHF) phased array technologies for submarines.
  - (U) Analyzed conformal antenna arrays on curved surface and transitioned an automated message distribution system to naval C<sup>3</sup> aircraft.
  - (U) Analyzed alternative bandwidth-efficient modulations for UHF communications and selected an efficient design. Coordinated via the IST panel of the Defense S&T Reliance.
  - (U) Conducted at-sea experiments of high data-rate ship/air communications employing the National Aeronautics and Space Administration (NASA) Advanced Communications Technology Satellite (ACTS) and an AEGIS (CG-59) cruiser on deployment.
  - (U) Developed a laboratory demonstration breadboard of a reconfigurable slot antenna array and measured performance. Coordinated via the IST Panel of the Defense S&T Reliance.
  
- (U) (\$5,613) COMMAND SUPPORT:
  - (U) Provided a prototype Intelligent Information Subsystem for the Enhanced Common Operational Picture (ECOP) system deployed in Bosnia. The prototype included software tools, prototype intelligent agent architecture, and user ontology and data retrieval products.
  - (U) Demonstrated C3 Collaborative Workspace Beta software Version 1.0 to CINCPAC J6 OPT. The software package provided the operational user with a Web language (JAVA VRML) capable of creating and manipulating objects in a planning environment.
  - (U) Developed a working prototype of a secure flexible infrastructure using a COTS network that is resistant to traffic analysis (Anonymous Routing) and a wireless identification system that allows authorized users to unlock a computer and screen.
  - (U) Provided the Marine Corp a prototype of the Virtual Reality Workbench for the recently completed Hunter Warrior exercise. The Workbench provides 3D terrain images that were used to show placement of resources and movement of troops and objects during the exercise.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Transitioned to the Object Management Standards Group (OMG, an 800+ world-wide international standards group) real-time object oriented mechanisms that provide seamless access to variously formatted databases (i.e. flat files, relational, or object oriented).
- (U) Transitioned a Virtual Collaboratory prototype compatible with DII/COE environment to the DARPA/DISA JPO. Technologies included collaborative applications, visualization technologies and distributed resource management techniques for performing collaborative experiments and testing distributed software algorithms.

- (U) (\$1,696) NAVIGATION:

- (U) Developed and tested passive submarine terrain avoidance algorithm that makes possible Global Positioning System (GPS)-independent underwater navigation.
- (U) Fabricated and evaluated quantum-well mirrors in a breadboard gyro.
- (U) Designed/fabricated/tested high performance fiber-optic gyros.
- (U) Designed high-power light source for fiber-optic gyros.
- (U) Developed signal structure for use in reducing vulnerability of the Global Positioning System (GPS) to jamming.

2. (U) FY 1998 PLAN:

- (U)(\$20,804) RADAR TECHNOLOGY

- (U) 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) Develop multifunction shipboard radar system including a multi-frequency band, electronically steered phased array to enable search, track and engage functions from a single topside RF Aperture. This effort will also assess effectiveness of adaptive waveforms for suppressing effects of clutter and ECM on system dynamic range. Addresses PEO-TAD needs to reduce topside signatures and to reduce the number of RF apertures required for radar operations.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Fabricate 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 is Joint with DARPA and was enabled by previous Small Business Innovation Research (SBIR) program investment.
- (U) Develop 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 (PEO-TAD, N091).
- (U) Develop scale model(s) of UHF 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 are integral to the antenna and rotodome structure. Addresses PEO-T/PMA-231 needs for radar surveillance of cruise and theater ballistic missiles in littoral regions.
- (U) Upgrade Mountaintop experimental radar to enable future technology feasibility demonstrations in theater ballistic missile and cruise missile defense scenarios in conjunction with Pacific Missile Range Facility events and operations.
- (U) Develop compact UHF digital receiver for E-2C AN/APS-145 radar improvement program. Will utilize Millimeter Wave and Microwave Monolithic Integrated Circuit (MIMIC) advances in very large scale integration technology to realize a high performance direct RF to digital receiver (no down conversion) that is less than one tenth the size and weight of current E-2C receiver.
- (U) Joint program with USAF to develop 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 test ultra wideband (VHF/UHF) radar for concealed/buried target detection, location and imaging. Hyper resolution techniques are being developed to maximize image quality and to minimize false alarm. This program is coordinated with DARPA, Army and Defense Intelligence Agency.
- (U) 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. Addresses 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.

R-1 Line Item 8

Budget Item Justification  
(Exhibit R-2, page 7 of 18)



# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Develop high resolution, imaging millimeter wave radiometric sensor for covert, all weather strike targeting, target identification and battle damage assessment. Addresses Navy and Marine Corps needs identified by the Office of Naval Operations (N88) and the Commander in Chief Atlantic Fleet (CINCLANTFLT) and is also responsive to Program Executive Office, Theater Air Defense (PEO-TAD) needs for covert navigation in restricted waters.
- (U) Integrate two dimensional air target identification algorithms into roof top AN/APG-73 radar (F/A-18 radar) and conduct performance evaluation utilizing commercial and military targets of opportunity. Addresses needs identified by CINCLANTFLT, and OPNAV.
- (U) (\$11,960) EO/IR TECHNOLOGY
  - (U) Develop advanced infrared search and track (IRST) sensor and signal processing technology using spatial, temporal and spectral discriminates to detect subsonic and supersonic targets such as Anti Ship Missiles (ASMs) and Theater Ballistic Missiles (TBMs) while suppressing clutter (backlit clouds, surface reflections) and nuisance targets. Utilize DARPA-funded technology for high-performance 1024 x 1024 staring Focal Plane Arrays (FPAs) as well as Ballistic Missile Defense Organization's (BMDO's) advances in affordable eyesafe lasers. Addresses PEO-TAD and DRPM-AEGIS needs for ship and Theater Ballistic Missile (TBM) defense.
  - (U) Hardware and software integration of real time multi-dimensional COTS signal processor with the ship two-color IRST, and transition to PEO-TAD for at sea operational evaluation in FY-98 and FY-99.
  - (U) Develop 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 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) Develop IR signal processing algorithms to recognize and exploit man-made target signatures relative to natural backgrounds and countermeasures in support of tactical reconnaissance and strike warfare needs identified by Commander In Chief Pacific Fleet (CINCPACFLT) and N091.
  - (U) Develop Hyper Spectral Infrared sensor with greater than one hundred sub-bands in both the mid wave (3-5 microns) and long wave (8-12 microns) spectral bands for Naval airborne reconnaissance, surveillance, and targeting missions. Joint with USAF and Defense Airborne Reconnaissance Office (DARO).
  - (U) Develop modeling and simulations to enable fusion of multiple wavelength EO passive and active sensor attributes. Incorporate worldwide threat, scene/terrain and environmental databases. Conduct analysis and simulation of sensor and operating characteristics in environments representative of worldwide conditions.

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Budget Item Justification  
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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

Products of this development will be utilized to optimize sensor designs and architectures without incurring the cost of hardware and field tests.

- (U) (\$2,865) MULTI-SENSOR TECHNOLOGY
  - (U) Develop, within the physical constraints of an F/A-18 aircraft SUU-63A wing station pylon, the 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.
  - (U) Develop/integrate encoded modulation waveforms into existing aircraft (F/A-18, AV-8B) targeting laser for laser interrogation of an IFF system. Implementing the corresponding decoding logic into existing laser warning receivers to cue standard IFF response on own aircraft. Addresses Fleet and CNO-N66 needs for positive Combat ID.
  - (U) Develop data fusion/resource management processing to facilitate autonomous multi-sensor operation. Integrate COTS sensors (Radar, ESM, EO) into a multi-sensor test bed to enable 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) (\$1,833) COMMUNICATIONS NETWORKS:
  - (U) Design and test prototype software for the high performance transport protocol and QOS enhancements to the Internet Protocol (IP). Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Acquire ATM machines from France for performance testing. Install in the ATM networking testbed. Prepare test plans and procedures in coordination with French experts. Coordinated via IST Panel of the Defense S&T Reliance.
  - (U) Develop Domain Name Server for heterogeneous mobile networks. Coordinate with the DARPA Warfighters Internet program. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Analyze the QOS Channel Allocation Protocol for throughput, delay and robustness.
- (U) (\$10,014) RADIO COMMUNICATIONS:
  - (U) Continue development of key communications technologies for air, ship and submarines.

R-1 Line Item 8

Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) Conduct full-configuration at-sea testing of the compact low-profile buoyant cable submarine antenna. Determine the best deployment configuration of the most promising submarine SHF phased array antenna on the submarine platform. Prepare the on-hull extremely low frequency (ELF) submarine antenna for transition to engineering development.
  - (U) Develop the design software for the structurally-embedded, reconfigurable aircraft antenna array panel on a curved surface, and compare with computed predictions. Coordinated via the IST Panel of the Defense S&T Reliance.
  - (U) Develop an improved modem for UHF line-of-sight communications employing bandwidth efficient modulations and adaptive equalization of the fading and multi-path maritime channel. Incorporate 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) Adapt commercial code division multiple access (CDMA) wireless technologies to naval applications. Employ power management and control algorithms for improved network design. Coordinated via the Information Systems and Technology (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), develop framework for reception of Global Broadcast Service (GBS) on naval ships and aircraft.
- (U) (\$5,711) COMMAND SUPPORT:
    - (U) Complete prototype and demonstrate a 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.
    - (U) Demonstrate in a 6th Fleet FBX exercise a prototype of a secure flexible infrastructure resistant to traffic analysis (Anonymous Routing) over the internet.
    - (U) Demonstrate a beta prototype Wireless Identification System for computer access for test and evaluation of improved computer security.
    - (U) Initiate 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.
    - (U) Develop anti-data spoofing mechanisms for use in defensive information warfare that reduces vulnerability to intrusion by hackers.
    - (U) Transition GroupWare technology capable of integrating work-process-support mechanisms (i.e. planning, day-to-day ops, etc.) across the Battlegroup to SPAWAR's prototype Combat Operations Virtual Environment (COVE).

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Budget Item Justification  
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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) (\$1,627) NAVIGATION:

- (U) Continue development of key navigation technologies for air, ship and submarines.
- (U) Perform concept demonstration of the candidate signal structure for reduced Global Positioning System (GPS) vulnerability, and initiate transition.
- (U) Analyze and test the quantum-well mirror ring laser gyro technology and compare with conventionally designed ring laser gyros, transition technology to ring laser gyro manufacturers.
- (U) Complete laboratory evaluation of high performance fiber-optic gyro (FOG) for submarine applications and transition to the Navy Special Projects Office (SP-24).
- (U) Develop and test the high power fiber-optic light source for high performance FOGs.
- (U) Identify techniques for data compression and bulk processing applicable to fast processing of (GPS).

3. (U) FY 1999 PLAN:

- (\$21,750) RADAR TECHNOLOGY:

- (U) 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.
- (U) Install Multifunction shipboard radar sensor at Wallops Island for performance and operational utility assessments against representative targets in varying environmental and sea state conditions. Assessments jointly conducted with PEO-TAD and DRPM - AEGIS.
  - (U) Continue development of adaptive waveforms for multifunction shipboard radar to maximize detection and track performance in complex target and multi-path conditions and to minimize system dynamic range converter requirements. Addresses PEO-TAD 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 conduct 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. Incorporate High Power source developed jointly with the Electronics program under PE 0602234N.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (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.
  - (U) Transition compact UHF digital receiver to PMA-231 for integration into the Mountaintop experimental radar facility.
  - (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 multi-mode radar system into test aircraft for performance evaluation. 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.
- (\$12,465) EO/IR TECHNOLOGY:
    - (U) 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 ship and 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.
    - (U) Continue development of advanced IRST sensor and signal processing technology to further increase detection and track capabilities. Efforts include development of modular system architecture approaches to enable rapid insertion of emerging DARPA developed infrared focal plane arrays and signal processors.
    - (U) Integrate dual band airborne IRST sensor into a fleet configured E-2C aircraft for performance evaluation. Optical aperture to enable insertion of BMDO funded laser sensor when sufficiently mature is included.
    - (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.

R-1 Line Item 8

Budget Item Justification  
(Exhibit R-2, page 12 of 18)

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (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) (\$2,940) MULTI-SENSOR TECHNOLOGY:

- (U) Transition targeting avionics sensor to PMA 242 to provide precision targeting capabilities for U.S Navy and High Speed Anti-Radiation Missile (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 processor into COTS multi-sensor test bed and conduct ground system characterization and effectiveness assessments of the integrated system prior to flight test.

- (U) (\$1,959) COMMUNICATIONS NETWORKS:

- (U) Test and analyze the prototype software for the high performance transport protocol and the QOS enhancements to the (IP). Present the results to the IETF for incorporation 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. 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. Coordinated via the IST Panel of the Defense S&T Reliance.

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

- (U) Test the design of the QOS Channel Allocation Protocol as part of ATM battlegroup architecture.

- (U) (\$10,315) RADIO COMMUNICATIONS:

- (U) Continue development of key communications technologies for air, ship and submarines.

- (U) Transition the low-profile buoyant cable antenna enhancement to Space and Naval Warfare Systems

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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PROGRAM ELEMENT: 0602232N

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

Command PMW-173 for submarine applications. Finalize design of the on-hull ELF antenna and prepare transition to PMW-173.

- (U) Demonstrate the structurally-embedded, reconfigurable aircraft antenna array reconfiguration using optically activated switches in a doubly-curved panel. 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. Coordinated via the IST Panel of the Defense S&T Reliance.
- (U) Conduct laboratory and field tests 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) (\$5,955) COMMAND SUPPORT:

- (U) Continue development of C2 technologies for distributed real-time, secure information systems.
- (U) Continue development of software agents for intelligent data exploitation and retrieval in information systems.
- (U) Continue development of information warfare techniques and integrate into prototype hardware.
- (U) Initiate development of a collaborative integrated laboratory testbed to test and evaluate decision support projects (crises action planning, plan monitor and repair, and distributed situation awareness, etc.) for experimental use within a distributed Joint Service DARPA/DISA environment
- (U) Continue development of a real time decision support prototype system.

- (U) (\$4,969) NAVIGATION:

- (U) Continue development of navigation technologies for air, ship and submarines.
- (U) Demonstrate compression and frequency tracking algorithms employing simulated Global Positioning System (GPS) signals.
- (U) Employ micro-machining techniques to develop accelerometers for higher accuracy inertial applications.
- (U) Integrate advanced electronics into strategic submarine navigation systems to reduce dependence on diminishing source of supply for older componentry.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

- (U) (\$5,780) SPACE/STRATEGIC SYSTEMS TECHNOLOGY:
  - (U) Initiate new program to develop a design code to minimize the expertise required to design ballistic missiles.
  - (U) Initiate a new program to develop an underwater missile launch computer simulation model.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$54,651	\$65,566	\$71,426
(U) Appropriated Value		\$56,566	
(U) Adjustments from 1998 PRESBUDG:	-684	-10,752	-6,393
(U) FY 1999 President's Budget Request:	\$53,967	\$54,814	\$65,033

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect Small Business Innovation Research Transfer (-1,946), Revised Economic Assumptions (-73), Actual Execution Update (+1,335). FY 1998 adjustments reflect Congressional Undistributed Reductions (-1,627), Economic Assumptions (-125), Fiscal Constraint Reduction (-9,000). FY 1999 adjustment reflects fully funded Project M (-178), S&T Reductions (-5,100), Navy Working Capital Fund (NWCF) adjustments (-170), Inflation Adjustment (-1,167), Military & Civilian Pay Rates (+189), and Commercial Purchase Inflation Adjustment (+33).

(U) Schedule: Not applicable.

(U) Technical: FY 1998 Fiscal constraint reduction delays initiation of development of strategic systems technology for strategic submarine navigation system componentry and for development of new design codes for ballistic missiles. These developments will be initiated in FY 1999 per Program Decision Memorandum (PDM) I.

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Budget Item Justification  
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PROGRAM ELEMENT: 0602232N

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

## C. (U) OTHER PROGRAM FUNDING SUMMARY:

(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 0601153N (Defense Research Science)
- (U) PE 0601102F (Defense Research Science)
- (U) PE 0602101F (Geophysics)
- (U) PE 0602102F (Materials)
- (U) PE 0602702F (Command, Control and Communications)
- (U) PE 0603428F (Space Subsystems Technology)
- (U) PE 0603789F (C<sup>3</sup>I Technology Development)
- (U) PE 0601101F (In-House Laboratory Independent Research)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602712E (Materials and Electronics Technology)
- (U) PE 0602782A (Command, Control and Communications (C<sup>3</sup>) Technology)
- (U) PE 0603109F (Integrated Aircraft Avionics)
- (U) PE 0603203F (Advanced Avionics for Aerospace Vehicles)
- (U) PE 0602234N (Materials, Electronics and Computer Technology)
- (U) PE 0603217N (Air Systems and Weapons Advanced Technology)
- (U) PE 0603253F (Advanced Avionics Integration)
- (U) PE 0605502F (Small Business Innovation Research)
- (U) PE 0602204F (Aerospace Avionics)
- (U) PE 0602709A (Night Vision Technology)
- (U) PE 0603203F (Advanced Avionics for Aerospace Vehicles)
- (U) PE 0603253F (Advanced Avionics Integration)
- (U) PE 0603270F (Electronic Combat Technology)
- (U) PE 0603710A (Night Vision Advanced Technology)
- (U) PE 0602782A (Command, Control and Communications Technology)
- (U) PE 0603792N (Advanced Technology Transition)
- (U) PE 0603794N (C<sup>3</sup> Advanced Technology)

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PROGRAM ELEMENT: 0602232N

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

(U) Advanced Technology Transition is in accordance with the on-going Defense Technology Area planning process and contains no unwarranted duplication of effort among the Military Departments.

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N

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

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Readiness, Training and Environmental Quality Technologies									
	49,837	38,079	29,722	30,915	32,110	32,727	33,410	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.

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Budget Item Justification  
(Exhibit R-2, page 1)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

(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) Logistics technologies (transferred to PE 0602121N beginning in FY98) 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 off-shore facilities. Technology development in these areas responds to a variety of requirements, including: providing the logistic support needed to support amphibious landing; providing the diagnostic technologies that will enable the implementation of a condition-based vs. time-based maintenance philosophy; and providing a long distance logistics supply chain with short reaction time.

(U) Environmental quality technologies (transferred to PE 0602121N beginning in FY98) enable sustained Navy operations, world wide, in compliance with all national and international laws, regulations and agreements. Technology development in this area is in direct support of Chief of Naval Operations's prioritized Navy user and Science and Technology requirements and will lead to systems and processes that will provide the Fleet with the capabilities for environmentally compliant forward presence both ashore and afloat. Specific requirements that support this area include: minimizing the curtailment of military operations due to ship, shore and aircraft compliance requirements, utilization of advanced biosensors to maintain appropriate environmental quality and provide early warning against chemical and biological warfare agents; and providing the capability to sustain Naval forces anywhere in a timely and environmentally compliant manner.

(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.

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(Exhibit R-2, page 2)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

(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:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$24,323) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UPS - IN-FLIGHT PHYSIOLOGICAL MONITORING OF TACTICAL AIRCREW AND TOTAL VEHICLE MANAGEMENT SYSTEM):
  - Initiated:
    - (U) development of an integrated decision support and onboard training system to enhance command tactical decision making during shipboard air defense operations.
    - (U) In-Flight Physiological Monitoring of Tactical Aircrew - Development of real-time monitoring and feedback capability to restore and improve aircrew response to such stressors as maneuvering

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- acceleration, high altitude, fatigue and information overload. Transition to Advanced Technology Crew Station program (PE 0603216N) in FY 1999.
- (U) Total Vehicle Management System - Integration of the life system with the information system of an aviation crew station, with an emphasis on enhancing vehicle controllability during weapon delivery at high combat workload. Transition to Advanced Technology Crew Station program (PE 0603216N) in FY 1999.
  - Continued:
    - (U) evaluation of adverse side effects (e.g., motion sickness and postural instability) associated with the use of head mounted visual displays.
    - (U) development of interfaces for a decision-centered Combat Operations Center, to provide Marine Corps commanders flexible access to information that is tailored for specific situations, and which can support both analytical and intuitive decision making.
  - Completed:
    - (U) evaluations in operational environments of experimental tools to assist decision-makers in rapid situation assessment under conditions of high uncertainty.
    - (U) development and evaluation of visual-spatial tests to improve the validity of selection and assignment batteries by using computer-based, dynamic tests in addition to traditional verbal, multiple choice tests.
    - (U) development and demonstration of dynamic ocean display graphics optimized for instruction in Distributed Interactive Simulations involving dissimilar training devices and shallow water scenarios.
  - (U) (\$14,054) MEDICAL TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UP - BIOLOGICAL PROTECTION FOR CASUALTY REDUCTION):
    - Initiated:
      - (U) programs to deliver underseas medicine products that enhance the safety of Navy divers and submariners, and extend the diving operational envelope by permitting faster decompression and/or longer bottom times.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) develop underseas medicine programs that lead to preventive and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios.
  - (U) mission performance enhancement studies by investigating cognitive, affective, and performance impacts related to sleep disturbances of operational significance in mission performance. Validate the maintenance of an alertness test as a measure of stimulant effects during sleep deprivation.
  - (U) sustained operations/human performance enhancement studies to evaluate and determine underlying mechanisms necessary to prevent performance decrements during sustained operations in extreme environments.
  - (U) research to address the impact of chronic exposure to induced body currents from radio frequency radiation and develop techniques to ameliorate adverse human health effects.
  - (U) research to identify biomarkers of cardiac sensitization associated with exposure to refrigerants and fire suppression materials and to develop preventive measures. Initiate research to understand the biomechanisms involved with exposure to select neurotoxicants used in Navy operational environments.
  - (U) Biological Protection for Casualty Reduction - Develop a diagnostic tool for use in forward medical facilities needed to establish a treatment regime. Monitor systems that could be used to sample and verify that BW agents had been used in violation of international agreements. Develop countermeasures, both protective and therapeutic, to protect the war fighter and medical personnel. Identify materials and systems to remove contamination and restore operational capabilities.
- Continued:
- (U) research and development into supportive based resuscitation fluids that are able to stabilize combat casualties and permit delay of definitive treatment.
  - (U) research and development into preventive and therapeutic regimens/modalities that prevent, protect, and reduce ischemic and reperfusion injuries subsequent to combat trauma and hemorrhage.
  - (U) development of antibody-based enzymes for removing Rh determinants from red cells and more efficient recombinant enzymes for removing A antigen from red cells to produce universal donor transfusion blood units.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) evaluation of immunoregulatory monoclonal antibodies as adjuvants in inflammatory diseases related to combat injury complications.
- (U) research with oxygen-carrying blood substitutes formulated to provide oxygen delivery to tissues and organs, and to prevent reperfusion injuries in hemorrhagic animal models in order to develop regimens for treating ischemia and providing protected reperfusion.
- (U) (\$9,873) LOGISTICS AND ENVIRONMENTAL QUALITY TECHNOLOGY:
  - Initiated:
    - (U) development of supercritical fluid extraction technology for advanced shipboard bilgewater treatment.
    - (U) electrochemical technology development for pretreatment of shipboard liquid wastes.
    - (U) development of enhanced methodology for copper speciation and fate in site-specific marine waste/sediment systems.
    - (U) development of dry dock paint application control, overspray reduction and collection technologies for automated ship painting.
    - (U) development of decontamination surface cleaning technology for PCBs and other toxic/hazardous substances.
    - (U) development of environmentally benign substitute lubricant for aircraft carrier steam catapult systems.
    - (U) development of a fiber optic strain technology-based nondestructive evaluation (NDE) method to evaluate the condition of synthetic fiber ropes.
    - (U) development of concurrent engineering techniques and requirements for testability of Hull Machinery and Electrical equipment.
  - Continued:
    - (U) bench scale testing and developing design parameters required for Industrial Waste Treatment Plant to meet future Navy requirements.
    - (U) development of fuel additive technology for NOx reduction in gas turbine and diesel engines.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) development of new sensors and sensing techniques for condition based maintenance.
- (U) investigation of the use of neural networks for analyzing and predicting component loads and detecting faults in helicopter rotor systems.
- Completed:
  - (U) model testing of pier fendering system to enable accurate prediction of forces exerted upon piers during berthing operations.
  - (U) feasibility study and design criteria for advanced modular lighterage system in discharging cargo during amphibious operations.
- (U) (\$1,587) NSAP:
  - (U) continued 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 Persian Gulf Infonet World Wide Web based allied state information server for Persian Gulf Area of Responsibility, supported Tactical Evaluation of Viasat Advanced Data Controller for low Biological Warfare, ship-shore satcomms to support amphibious ops.
  - (U) provided 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 Humm Vee box frame corrosion, developed surface ship long life motor/bushing seals, developed Condition Based Maintenance technology for H-3 helos, and evaluated fiber optic lighting in hazardous spaces on Carrier Vessel and to reduce bulb replacement.
  - (U) addressed Fleet/Force operational readiness issues amenable to demonstration and application of Commercial Off the Shelf (COTS) technology solutions - provided thesis studies to address technology based readiness issues, completed installation of AUTOEYE/CAPS on Commander Task Force 67 asset, developed COTS Global Positioning System depth collector for surface ships, provided technology for improved night periscope capabilities, completed "live fire" evaluation of Ship Deployable Surface

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PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

Target & 2nd-Phase development of this system, concluded surface radar enhancements for Non-Cooperative Target Recognition project, provided submarine tactical information management system for littoral operations, supported COMNAVAIRPAC initiative for next generation strike warfare assessment of technology, and investigated sports medicine protocols for reduced USMC OCS attrition.

2. (U) FY 1998 PLAN:

- (U) (\$19,225) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Initiate:
    - (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.
  - Complete:
    - (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 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.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) development of advanced headphone displays for three-dimensional presentation of sonar information to improve target localization.
- (U) (\$10,027) MEDICAL TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UP - \$2,523 SMART AIRCREW INTEGRATED LIFE SUPPORT SYSTEM):
  - Initiate:
    - (U) develop system for biofeedback control of aircrew physiologic state and integrate with Vehicle Management System. Transition to Advanced Technology Crew Station program (PE 0603216N) in FY 1999.
  - Continue:
    - (U) research and development into supportive based resuscitation fluids that stabilize combat casualties and delay definitive treatment; transition optimal formulation to advanced development initiatives.
    - (U) research and development in therapeutic regimens/modalities that reduce ischemic and reperfusion injuries subsequent to combat trauma and hemorrhage and transition defined regimen into advanced development and large animal testing models.
    - (U) development of recombinant enzymes for removing A antigen from red cells to produce universal donor transfusion blood units and transition enhanced enzymes to advanced development for universal donor red cells.
    - (U) evaluation of immunoregulatory monoclonal antibodies as adjuvants in inflammatory diseases related to combat injury complications.
    - (U) research with oxygen-carrying blood substitutes formulated to prevent reperfusion injuries in hemorrhagic animal models and transition oxygen carrying substitutes with protected reperfusion modifications to advanced development for large animal testing.
    - (U) programs that extend the diving operational envelope by permitting faster decompression and/or longer bottom times.
    - (U) underseas medicine programs that lead to preventive and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) mission performance enhancement studies for cognitive, affective, and performance impacts of operational significance; validate the maintenance of an alertness test as a measure of stimulant effects during sleep deprivation.
- (U) sustained operations/human performance enhancement studies to evaluate and determine underlying mechanisms necessary to prevent performance decrements during sustained operation in extreme environments.
- (U) research to address impact of exposures to induced body currents from RF 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.
- (U) (\$1,064) 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) (\$7,763) SEA-STATE 3 LIGHTERAGE - CONGRESSIONAL PLUS-UP:
  - (U) establish a critical sealift support link by developing 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.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

## 3. (U) FY 1999 PLAN:

- (U) (\$20,508) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Continue:
    - (U) development and evaluation of unconventional visual, auditory and haptic cueing techniques to enhance learning of complex perceptual-motor skills.
  - 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) 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.
- (U) (\$8,025) MEDICAL TECHNOLOGY:
  - Continue:
    - (U) research and development into supportive based therapies that permit delayed resuscitation and stabilization of casualties through techniques involving hypothermia, hibernation and suspended animation.
    - (U) development of therapeutic regimens/modalities that prevent reperfusion injuries subsequent to combat trauma and hemorrhage using polynitroxylated macromolecules.

R-1 Line Item 9

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) evaluation of immunoregulatory monoclonal antibodies as adjuvants in inflammatory diseases and transition studies to large animal models.
- (U) research with blood substitutes formulated to provide oxygen delivery, prevent reperfusion injuries and enhance recovery from delayed resuscitation techniques in hemorrhagic animal models; transition polynitroxlyated macromolecule therapies to advanced development for large animal testing.
- (U) research to extend the diving operational envelope by permitting faster decompression and/or longer bottom times through novel biochemical based decompression.
- (U) underseas medicine programs that lead to preventive and treatment methods for oxygen toxicity and enhanced protocols for improving submarine rescue scenarios that incorporate biochemical decompression.
- (U) mission performance enhancement studies by investigating cognitive, affective, and performance biomedical interventions of operational significance; validate impact of interventions.
- (U) mechanisms research to prevent performance decrements during sustained operations in extreme environments implementing biomedical and pharmacologic interventions.
- (U) research in chronic exposure to induced body currents from RF 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.
- (U) (\$1,189) 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

-- (U) address Fleet/Force operational readiness issues amenable by demonstration and application of COTs technology solutions.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	47,494	31,762	33,120
(U) Appropriated Value:	-	39,362	-
(U) Adjustments from FY 1998 PRESBUDG:	+2,343	+6,317	-3,398
(U) FY 1999 President's Budget Submit:	49,837	38,079	29,722

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 increase consists of the SBIR assessment (-568), Revised Economic Assumptions (-52) and actual execution (+2,963). The FY 1998 increase consists of the Congressional Undistributed Reductions (-4,196), Economic Assumptions (-87) and Congressional Plus-Ups for Smart Aircrew Integrated Life Spt Sys (+2,600) and Sea-State 3 Lighterage (+8,000). The FY 1999 decrease results from S&T Adjustments (-2,799), Navy Working Capital Fund (-172), Commercial Purchases Inflation Adjustment (-525), NWCFC Surcharge correction (+28) and Military & Civilian Pay Rates (+70).

(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 Laboratory Independent Research)

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Budget Item Justification  
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DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N

PROGRAM ELEMENT TITLE: Human Systems Technology

- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602232N (Communications, Command and Control, Intelligence, Surveillance & Reconnaissance (C3ISR))
- (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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Materials, Electronics, and Computer Technology	85,881	70,174	77,617	81,026	84,159	86,449	88,822	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, 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, for example:

- (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, complex systems engineering, and high performance computing.
- (U) Joint Surveillance: real-time targeting, connectivity, counter-jamming and deception, infrared sensors, broadband control components, fiber optics technology, high performance computing, and artificial intelligence.
- (U) Space and Electronics Warfare/Intelligence (SEW/I): lightweight and radiation-hard satellite materials, radio frequency (RF) solid state devices, high performance computing, complex systems reengineering, software engineering environments, human computer interaction, security and assured computing approaches and tools, and expert system technology.
- (U) Strategic Deterrence: advanced ballistic missile launcher materials, RF solid-state devices for secure communications, engineering of complex systems, and high performance computing.
- (U) Forward Presence issues: high temperature pavements for advanced aircraft, RF solid state devices for secure communications, high power transmitters for precision strike, high performance computing, and decision aids.

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Strategic Mobility: development of advanced distributed manufacturing capabilities and advanced long-life materials for repair of aircraft at sea.

(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.

(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:

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Budget Item Justification  
(Exhibit R-2, Page 2)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

## 1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$2,970) SHORE FACILITIES MATERIALS. (includes Congressional plus-up for Engineered Lumber) 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) Continued development of engineered lumber composed of wood products, polymers, carbon fibers and adhesives for long life, environmentally benign, and low cost shore applications such as fender pilings.
  - (U) Demonstrated criteria for the cathodic protection of Navy pier substructures in the marine splash zone using embedded anodes and metallized zinc systems for 50-75% longer pier life and lower maintenance cost and including ship protection from pier cathodic systems to avoid costly ship hull damage.
  
- (U) (\$9,752) AIRBORNE MATERIALS. (includes Congressional plus-up for Aircraft Skin Materials) 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) Continued development and exploration of the plasma quench process to produce low cost titanium powder for aircraft components.
  - (U) Continued development of improved affordable composite materials for use in naval aircraft primary and secondary structures.
  - (U) Demonstrated technology for bronze bonding single crystal superalloy lugs to a polycrystalline nickel disk for producing a high T3 turbine disk.
  - (U) New superalloys with order of magnitude improvements in fatigue crack growth resistance demonstrated.
  - (U) Demonstrated material and fabrication concepts for a switchable (electrically conductive to non-conductive) missile radome to shield internal antennas from RF energy.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Transitioned conductive polymer composite technology into F414 engine front frame for subsequent production qualification of the engine front frame eliminating the need for additional coatings and coating weight.
- (U) Demonstrated 1500° Fahrenheit (F) nickel superalloy disk and orthorhombic titanium materials capable of functioning with the higher cooling air temperatures of the Phase II Integrated High Performance Turbine Engine Technology demonstration engines.
- (U) Demonstrated encapsulated, room-temperature storable adhesive for shipboard repair of aircraft, including higher temperature, bismaleimide composites to provide the Navy Fleet with an alternative to the short lived, costly, and logistically burdensome adhesives that require continuous cold storage.
- (U) (\$12,157) SEABORNE MATERIALS. (includes Congressional plus-up for Advanced Intelligent Materials processing center) 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) Explored the use of intelligent processing methods for advanced complex materials to reduce cost.
  - (U) Continued development of hydrogen control methods in welding materials and processes to eliminate hydrogen cracking in ship/submarine welded structures for more affordable hulls and processes.
  - (U) Demonstrated through field testing of biofouling and other fouling resistant gray-water filter membranes for ship application.
  - (U) Explored modeling and simulation techniques to predict material deformation and fracture behavior, for the design of ship and submarine hull materials with greater survivability, and weapons of enhanced lethality, in an effort to eliminate the expense and environmental impact of explosive testing "at sea".
  - (U) Demonstrated centrifugal casting/in-situ cladding with particulate reinforcement for order-of-magnitude improvement in wear resistance for shipboard machinery application.
- (U) (\$3,355) 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.

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Demonstrated processing methods for the incorporation of high thermal conductivity carbon fibers in metal thermal planes for a 50% increase in heat removal from electronic modules accompanied by a 30% decrease in thermal plane weight.
- (U) Determined mechanical, thermal, ablation, and moisture (aging) characteristics of replacement heat shield materials.
- (U) Demonstrated cost reduction of 60% of carbon preforms.
- (U) Demonstrated new compositions of hafnium carbide, which exhibit significantly, lower oxidation rate.
- (U) (\$5,237) 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) Demonstrated engine durability for stabilized zirconia thermal barrier coatings in marine turbine engines with at least 50% greater resistance to vanadate attack from lower grade oils than current zirconia coatings.
  - (U) Demonstrated the capability to remotely address embedded sensors in conductive carbon-fiber composites using RF energy.
  - (U) Continued development of non-linear laser protective materials based on phthalocyanine and focus advanced efforts on materials development for both eye and sensor protection from agile (tunable) lasers.
  - (U) Established material processes for new high strain sensor actuators.
- (U) (\$9,198) RF SOLID STATE DEVICE 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, 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, bandwidth, and size. Most of the work previously reported under Integrated Electronics has been integrated into this thrust to better reflect application of the Integrated Electronics technology to RF applications.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Demonstrated 18-40 GigaHertz (GHz) microwave Monolithic Integrated Circuit (MMIC) driver for MMW Power Module for use in decoys and extending the frequency range of the SLQ-32.
- (U) Continued development of InP/InGaAs heterojunction bipolar transistors for application to pulsed Ka-band phased arrays for dual mode, Electronic Countermeasure (ECM) resistant hyper-velocity strike weapon conformal aperture.
- (U) Continued development of a 100 kW (peak) W-band duplexer for Navy's 94 GHz radar program for ballistic missile defense and space object identification.
- (U) Demonstrated and manufactured planar Metal Oxide Semiconductor (MOS) Controlled Thyristers (MCTs) that operate at 1400 volts, 300A/cm<sup>2</sup> and 100 kiloHertz (kHz) switching speed for incorporation into Power Electronic Building Blocks (PEBBs).
- (U) Continued development of the technology for sub 500nm - 250nm p-channel silicon germanium (SiGe) devices with T-gate structures in 50nm thick thin-film silicon-on-sapphire for RF analog front-end receiver (10-20 GHz), and high performance Analog to Digital (A/D) converters for wireless communications, smart sensors/weapons, space/missile/airborne electronics, Advanced Stand off Weapons (ASW), and Electronic Warfare (EW) applications.
- (U) Demonstrated full functionality of all component functions for a 4-bit, 10 GSPS A/D converter for application to wideband channelized receivers for ELINT and narrowband digital receiver for radar and EW.
- (U) (\$14,564) 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 as a result of the power and size requirements.
  - (U) Demonstrated extension of the Microwave Power Module (MPM) concept to higher frequency by development of MMW (18-40 GHz, 50-W) power modules for EW applications.
  - (U) Continued development of selected elements of an advanced Microwave & Millimeter Wave Advanced Computational Environment (MMACE) design tool set for implementation in consort with the 2 and 3-dimensional Research & Engineering Framework (REF).
  - (U) Evaluated high power density MW window technology using man-made diamond. This technology is central to needed performance improvements in several Navy systems.
  - (U) Continued development of a high-power W-band gyro-klystron for Naval Research Laboratory W-band radar.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) (\$5,323) ELECTRO-OPTICS (E/O) TECHNOLOGY provides for the development of infrared 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 Infrared (IR) transmitting fibers for EW applications. The technology being developed is not available through COTS as a result of the military-unique applications.
  - (U) Demonstrated 128x128 adaptive Infrared Focal Plane Array (IRFPA) with on-chip non-uniformity correction for high dynamic range.
  - (U) Continued development of a 256 x 256 adaptive IRFPA with high dynamic range on-focal-plane electronics to implement non-uniformity correction.
  - (U) Demonstrated fiber optic beamformer for phased array radar with emphasis on a two-dimensional (4x4) array and rapidly tunable sources.
  - (U) Continued development of mid-IR fibers to reduce impurity loss <0.1 dB/m and total loss <0.5 dB/m with emphasis on longer fibers (50m) and IR fibers that transmit in the 8-12um region for Infrared Countermeasures (IRCM) applications.
  - (U) Demonstrated single color GaInSb/InAs superlattice detectors as an alternative to HgCdTe-based detectors for higher temperature operation at longer wavelengths.
  - (U) Continued development of a 128 x 128 color discriminating IRFPA for detection of missiles against ground clutter.
  - (U) Continued development of a 256x256 dual band IRFPA for detection of targets in clutter.
- (U) (\$411) INTEGRATED ELECTRONICS TECHNOLOGY supports activities to extend the capabilities of silicon-based materials significantly past that obtainable through COTS to realize compact signal processing elements.
  - (U) Demonstrated collocated interference cancellation circuitry for VHF communications systems applications.
- (U) (\$987) ELECTRONIC AND E/O MATERIALS supports activities to enhance the material properties of devices used in the thrusts of RF Solid State Devices and Control Components, Vacuum Electronics, Electro-Optics, and Integrated Electronics. This thrust extends the materials properties beyond that available through COTS.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Demonstrated growth techniques for modulation doping of InAs single quantum wells for FET applications.
- (U) Demonstrated nanometer-scale direct proximal probe patterning for fine-line (<0.05um) processing of metals to achieve a new class of metal-oxide transistor.
  
- (U) (\$8,000) 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 two apertures. 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 sharing of different RF functions and therefore offer 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, photonic, and microelectronic 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), SC-21, CVX, Program Executive Office (PEO) Theater Air Defense (TAD), PEO Surface Combatant Aegis Program (SC/AP) Common Support Aircraft (CSA) and Assistant Secretary of the Navy (ASN) Research, Development Acquisition (RDA). Specific efforts within this thrust include:
  - (U) Demonstrated a MW frequency, Continuous Wave (CW), high linearity GEISHA amplifier.
  - (U) Continued development of an UHF high power circulator for application to Multi-Functional Electromagnetic Radiating System (MERS) Advanced Technology Demonstration (ATD).
  - (U) Expanded high power SiC transistor structure development to combine high linearity wide bandwidth and high efficiency for fleet surveillance and protection applications.
  - (U) Continued development of a high dynamic range wide band Low Noise Amplifier (LNA) with very high second and third order intermodulation intercepts and explored potential use of LNAs in Joint Advanced Strike Technology (JAST) demonstration aircraft.
  - (U) Demonstrated 16 bit, 20 MHz low temperature superconducting Analog-to-Digital (A/D) converter.
  - (U) Demonstrated a RF beamforming network capable of RF frequency independent beam steering over  $\pm 60$  degrees from boresight using photonic technology to control RF transmission of an antenna array. Identified the necessary photonic components: integrated lasers and modulators, tunable lasers, dispersive fibers and tunable spectral filters.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Demonstrated the feasibility of using optical switches to activate nested wideband spiral antennas and thereby demonstrate RF beam steering. The initial optical switch is based on a photovoltaic field effect transistor (FET) structure activated by an optical fiber. Maintained a Voltage Standing Wave Ration (VSWR) of less than 2.2 over an operating bandwidth that will be no less than 4 octaves of bandwidth.
- (U) (\$2,689) HIGH PERFORMANCE COMPUTING (HPC) supports technologies for Navy systems with a primary focus on: merger of data with operator interaction modes for visualization of the battlespace for both real-time and collaborative planning scenarios; and exploration and evaluation of robust, real-time imaging systems in conjunction with balance communication links and sufficient imagery robustness for performing Navy mission.
  - (U) Prototyped and demonstrated a three dimensional (3D) virtual reality workbench for battlefield situation assessment via the Marine Corps Hunter Warrior exercise and the Advanced Concept Technology Demonstration (ACTD) "Extending the Littoral Battlespace (ELB).
  - (U) Demonstrated new wavelet coding algorithms with packet parity protection that is compatible with any packet switching network including Navy Link 16 messages.
  - (U) Developed a lossless image compression algorithm, which is both regionally, and multi-resolutionally decodable.
  - (U) Developed a statistical modeling for wavelet decomposition of natural images with empirically observed properties of wavelet coefficients to support digital watermarking, cryptographically secure communication, and texture based discrimination.
- (U) (\$2,815) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION. This area supports heuristic solutions to Navy problems with a focus on rapid, effective situation cognition/response via alternative information presentation styles and modes (e.g. auto feedback, speech, and gesture control) within Navy scenarios, e.g. unmanned vehicle and man-machine synergy.
  - (U) Distributed an advanced Case Based Reasoning Shell useful for building decision aids and demonstrated in domains such as weather forecasting and situation assessment and planning.

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Developed anonymous routing (Onion Routing), a working prototype of a flexible infrastructure resistant to traffic analysis. Developed a wireless identification system that allows only authorized users to unlock a computer and screen.
- (U) (\$4,423) ENGINEERING OF COMPLEX SYSTEMS. This area is concerned with streamlining and performance predictability of complex, time critical, reliable and safe computer/software-based systems which must be cost effectively designed and implemented; are very complex; are time-critical systems; are reliable and concerned with safety of personnel.
  - (U) Applied and validated a prototype "requirement specification capture tool" (from English-text) and applied design analysis to the development of a sub-system of the LPD-17, SC21 and AAUV systems. Early experiments proved effectiveness of this integrated automated software tool to support development of large complex computer-based systems.
  - (U) Designed an interoperable software environment under joint United States/France Technical Research and Development Project (TRDP) on Software Tools. Advanced affordable reusable component methodology using CORBA, Java, and other industry standards. Implemented early prototype allowing remote operation of tools via Web technology to prove concept. Tested a starter set of commercial/government components to get best functional capability for Command and Control (C2) and combat system development.
  - (U) Released a prototype of MIST, a tool for the aggregation of key component and system level metrics. Extended the SMERFS tool to include hardware and software reliability models. Completed development of an instrumentation-based single processor performance model for predicting resource requirements.
  - (U) Began development of readable notations for specifying the required timing and accuracy behavior of systems, and the development of efficient techniques for analyzing the specified timing and accuracy requirements of errors.
- (U) (\$4,000) ADVANCED DISTRIBUTED MANUFACTURING DEMONSTRATION
  - (U) Extended the Virtual Company model to include modules for Prototype Development and for Full Production Manufacturing for Navy applications. Enhanced the recently implemented Quality Assurance/Quality Control (QA/QC) modules. Continued development of a Best Practices and Capabilities module. Applied the Virtual

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

Company model to Navy requirements in the areas of software development and software reuse. The Machine Shop Company implementation of the model is being made available to private companies in order to expand industrial base capability to meet Navy needs.

## 2. (U) FY 1998 PLAN:

- (U) (\$948) SHORE FACILITIES MATERIALS.
  - (U) Demonstrate the benefits of corrosion resistant dual phase ferritic materials and flame-sprayed catalyzed titanium cathodic protection concepts for extension of service life of waterfront structures.
  - (U) Accelerate the application of advanced materials such as composites and low-cost wood products into naval fenders and other rubbing energy absorption systems to extend life and reduce the need for chemically treated wood.
- (U) (\$9,612) AIRBORNE MATERIALS includes Congressional plus-ups for plasma quench processes for Titanium powder and resin transfer molding of aircraft composites.
  - (U) Demonstrate single crystal/powder metal insertable bladed disk system materials for 1200° F compressors and 1450° F turbines.
  - (U) Demonstrate process for very low volatile organic (200 gram/liter) waterborne self-priming topcoats for aircraft.
  - (U) Demonstrate the benefits of cyanate ester adhesives for rapid curing aircraft repairs.
  - (U) Design distributed sensor systems for condition-based maintenance monitoring of aircraft corrosion and health of corrosion preventive coatings.
  - (U) Demonstrate casting technology for large gamma-titanium structures.
- (U) (\$12,655) SEABORNE MATERIALS includes Congressional plus-ups for a composite storage capsule and advanced intelligent materials processing center.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Demonstrate pilot scale development of part-on-call spray forming of non-axisymmetric parts, including titanium based components and investigate self-canning of powder components via selective laser sintering of the surface.
- (U) Demonstrate replacement candidate materials for seawater valves and nondestructive testing techniques to evaluate the health of such valves under service seawater conditions.
- (U) Continue development of a haze gray ship coating system with controlled spectral properties to meet the IR goals of MIL-E-24365a at much lower cost than competitive systems containing metal solids.
- (U) Develop the best spray-formed materials for shipboard incinerator applications.
- (U) Develop new weld filler metal design including hydrogen management techniques, to eliminate costly preheat and postheat as well as hydrogen cracking, for more affordable and reliable ship and submarine construction with advanced high strength steels.
- (U) Explore strength, fracture, and weldability characteristics of non-magnetic alloys for ship hull structures with reduced signature.
- (U) Determine fire resistance and ballistic resistance of both glass and graphite reinforced polyurethane as candidate lightweight, non-magnetic materials for construction of ships with reduced signature.
- (U) Explore advanced composites for submarine storage capsule applications.
  
- (U) (\$1,941) MISSILE/SPACE MATERIALS
  - (U) Demonstrate heat shield material with performance equivalent to state-of-the-art rayon-base materials using blends of low cost carbon and quartz fibers.
  - (U) Develop low-cost fabrication processes for ceramic composites based on hafnium and/or tantalum components.
  - (U) Demonstrate the benefits of heat shield replacement materials that emphasizes lower cost fabrication techniques.
  - (U) Develop ceramic materials for nozzle applications with emphasis on lower cost fabrication and tailored coatings for specific applications fuel conditions.
  
- (U) (\$5,433) MULTI-MISSION MATERIALS includes Congressional plus-ups for photomagnetic materials.

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Budget Item Justification  
(Exhibit R-2, Page 12)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Determine the vulnerabilities to lasers of the new uncooled IR detector arrays and establish plans for laser hardening approaches and materials to protect them.
- (U) Transition tubule-based materials for controlled release-coating applications.
- (U) Demonstrate high temperature composites based on fluorinated and non-fluorinated phthalonitrile polymers for high temperature application to multiple platforms.
- (U) Evaluate metal-plated microtubules for electro-active coatings in antenna systems and electronic displays. Such materials are expected to be more cost effective than competing etched or vapor deposited systems.
- (U) Develop nanometer wear-resistant coatings for valve stems, labyrinth seals, and rotating parts.
- (U) Explore photomagnetic phenomena for undersea communication devices.
  
- (U) (\$5,676) RF SOLID STATE DEVICES AND CONTROL COMPONENTS
  - (U) Develop 100 kW W-band duplexer for Navy's 94 GHz radar program.
  - (U) Develop highly compact, high Q, tunable filters and oscillators for transmit/receive (T/R) module applications.
  - (U) Develop InP/InGaAs heterojunction bipolar transistors for application to pulsed Ka-band phased arrays for dual mode, ECM resistant hyper-velocity strike weapon conformal aperture.
  - (U) Investigate the high power behavior of High Temperature Superconducting (HTS) MW devices and identify those material parameters that limit performance.
  - (U) Demonstrate the device technology for low power, low voltage sub 500nm - 250nm Complementary Metal Oxide Silicon (CMOS)/silicon germanium (SiGe) with T-gate structures in 50nm thick Thin Film Silicon-on-Sapphire (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) Develop 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) Demonstrate 4-bit, 10 GSPS A/D based on 100nm minimum feature size CMOS TFSOS for EW and radar applications.

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Budget Item Justification  
(Exhibit R-2, Page 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Develop analog very large-scale integrated (VLSI) continuous wavelet transform circuit for RF emitter identification.
- (U) (\$11,000) VACUUM ELECTRONICS
  - (U) Demonstrate MMW Power Module for Army SMART-T communication system.
  - (U) Demonstrate elements of an advanced MMACE design tool set for an electron gun/collector and helix Traveling Wave Tubes (TWTs) implementation in a 2D/3D REF.
  - (U) Demonstrate a high-power, moderate bandwidth gyro-klystron for the Navy's 94-GHz radar program.
  - (U) Develop a high-duty, wideband gyro-twystron to meet the requirements of MMW radar applications.
  - (U) Develop a reduced noise coupled cavity TWT for a ship-based illuminator.
- (U) (\$2,841) E/O TECHNOLOGY
  - (U) 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 8-12um region with loss less than 2 dB/m.
  - (U) Demonstrate 256 x 256 dual band IRFPA.
  - (U) Demonstrate a 256 x 256 adaptive IRFPA with high dynamic range on-chip electronics to implement on-chip nonuniformity correction.
  - (U) Develop a 128 x 128 color discriminating IRFPA.
  - (U) Develop broadband, amplified photoreceiver for 6-20 GHz links for ECM and Electronic Support Measures (ESM) applications.
- (U) (\$417) INTEGRATED ELECTRONICS TECHNOLOGY
  - (U) Develop a multi-chip module that incorporates analog adaptive weight learning circuits for co-site interference canceller for UHF communication frequencies.
- (U) (\$997) ELECTRONIC AND E/O MATERIALS

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Develop p-type doping of GaN grown by Organo-Metallic Vapor Phase Epitaxy (OMVPE). This task will enable device programs that rely on the use of p-n junctions.
- (U) Optimize the interface structure in RTD's grown in 6.1A materials in order to improve the peak-to-valley ratios and decrease current densities.
- (U) (\$9,500) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY
  - (U) Demonstrate an UHF circulator and provide to MERS ATD.
  - (U) Demonstrate highly linear broadband power amplification from GHz to 5 GHz with GEISHA.
  - (U) Develop Twystrode/klystrode-compatible field emitter arrays to reduce size of MPM for radar and EW applications.
  - (U) Demonstrate multifunctional operation of fiber optic beamformer with one and two-dimensional array.
  - (U) Demonstrate 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) Demonstrate the feasibility of a superconducting A/D converter operating with 20 bits of dynamic range for use in next generation wide area surveillance systems.
  - (U) Demonstrate an RF transmit and receive beamforming network capable of RF frequency independent beam steering over  $\pm 60$  degrees from boresight using photonic technology to control an antenna array. Characterize the performance of photonic technology components optimized for various beamforming architectures.
  - (U) Design 100 GHz logic-derived microwave synthesizer with integral beam former.
  - (U) Design low parasitic heterojunction bipolar microwave power transistor with 100 GHz Fmax and 50-200 volt breakdown voltage.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) (\$2,155) HIGH PERFORMANCE COMPUTING (HPC)
  - (U) Perform evaluation of Virtual Reality (VR) workbench with emphasis on operator interaction. Develop version of new VR architecture for Immersive Room and VR Responsive Workbench. Develop levels-of-details for representing terrain and objects on the Workbench Initiate software library and other aids to facilitate transition to Workbench applications.
  - (U) Explore utility and sensitivity of algorithms against images with high clutter in the missile testbed and begin to address image feature indexing robustness and sensitivity using wavelet and multichannel approaches.
  - (U) Develop new wavelet algorithms to focus on providing indexing keys for features in images to allow rapid retrieval; take feedback from the missile testbed and refine any problems discovered through the testing under varying conditions of both this application and for data compression/transmission in general. Develop robust feature compatible image transmission algorithms for tactical data links.
- (U) (\$2,599) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION (AI/HCI)
  - (U) Demonstrate software support of validation and verification methodologies and tools integrated with tools for building case-based decision aids.
  - (U) Develop Java COTS Case-Based Reasoning tool with Graphical User Interface, automated indexing of components, tree-indexing software, and interactive case authoring support.
  - (U) Large scale experiment and demonstration of the Onion Routing technology and wireless identification system. Begin studies leading to the development of tools for creating and analyzing multilevel C2 workflows in an architecture based on COTS components.
- (U) (\$4,400) ENGINEERING OF COMPLEX SYSTEMS (ECS)
  - (U) Finalize approach to incorporate human performance models in ECS tools for total system design and evaluation providing a basis for automated tools for human systems integration in the design of complex systems. Embed monitors in systems to identify changing human performance and roles over time to flag opportunities for manpower reduction. Develop multi-criteria optimization strategies for life-cycle cost

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Budget Item Justification  
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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

engineering of large, complex systems providing an automated means for measuring performance, reliability, safety, security, producibility, and cost tradeoffs.

- (U) Develop and deliver a system evaluation and assessment repository consisting of a system metrics knowledge base and non-invasive and minimally invasive measurement techniques for measuring effectiveness requirements. Develop an instrumentation-based multiple processor performance model for predicting resource requirements.
- (U) Complete initial prototype of US-France wide-area development environment named PCIS2. Develop plans for a collaborative demonstration with France using a unified distributed object architecture and repository; coordinate with Defense Information System Agency (DISA), Defense Information Infrastructure (DII) and DARPA co-laboratory efforts. Stress effective use of COTS components and standards in PCIS2.
- (U) Develop notation for expressing general timing behavior in real-time systems. Integrate decision procedures into the "STSR" toolset, which supports requirements analysis.

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(Exhibit R-2, Page 17)

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

## 3. (U) FY 1999 PLAN:

- (U) (\$1,002) SHORE FACILITIES MATERIALS
  - (U) Determine the durability of composite materials through characterization and parametric studies for waterfront upgrades of reinforced concrete structures.
  - (U) Determine controlling factors for the use and development of composite materials for fenders, camels, piles, and other applications.
- (U) (\$8,958) AIRBORNE MATERIALS
  - (U) Demonstrate the benefits of beryllium-aluminum alloys for aircraft applications.
  - (U) Identify novel elastomeric fuel cell materials for longer operational life in higher temperature application appropriate to advanced fighter aircraft.
  - (U) Demonstrate erosion resistance of diamond infrared domes.
- (U) (\$10,250) SEABORNE MATERIALS
  - (U) Demonstrate improved affordable incinerator materials for hot corrosion applications.
  - (U) Conduct field tests of nondestructive, field-portable coatings evaluation system that determines the health of ship paint systems.
  - (U) Evaluate and develop improved of polyaniline-based anticorrosive coatings for shipboard applications.
  - (U) Demonstrate new welding consumable which incorporate hydrogen management techniques, for more affordable and reliable welding of high strength steels in ship and submarine construction, with the elimination of preheat and postheat as well as hydrogen cracking.
  - (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) Establish the mechanical behavior of fiber reinforced polyurethane composites and their associated joints under high loading rates.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) (\$1,420) MISSILE/SPACE MATERIALS
  - (U) Demonstrate materials for affordable and reliable reentry vehicle heatshield applications.
  - (U) Demonstrate the benefits of ceramic materials for protection of propulsion components and other high temperature impingement applications.
  
- (U) (\$7,206) MULTI-MISSION MATERIALS
  - (U) Demonstrate a low cost laser protective cell that can be incorporated in optical systems for the Marine Corps.
  - (U) Demonstrate a system and controlling software for a reliable ultrasonic tomography that alleviates the problem of refraction.
  - (U) Demonstrate controlled release material systems for Naval anti-fouling and anti-fungal/mildew applications.
  
- (U) (\$9,608) RF SOLID STATE DEVICE AND CONTROL COMPONENTS
  - (U) Develop wideband receiver components in support of the Joint Strike Fighter.
  - (U) Demonstrate 100 kW W-band duplexer for Navy's 94 GHz radar program.
  - (U) Develop highly compact, high Q, tunable filters and oscillators for T/R module applications.
  - (U) Demonstrate GaP/GaAs heterojunction bipolar transistors for application in pulsed Ka-band phased arrays for dual mode, ECM resistant hyper-velocity strike weapon conformal aperture.
  - (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 very low power (<0.4 mw) high-resolution (16 - 18 bit) 2 - 5 kilosamples/sec A/D converter for sonar, shallow water ASW applications.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (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) (\$10,000) VACUUM ELECTRONICS
  - (U) Develop a high-power, moderate bandwidth gyro-twystron 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 MPM-for EW applications.
  - (U) Develop a high-duty, wideband gyro-twystron to support radar and EW applications at millimeter-wavelengths.
- (U) (\$5,741) E/O TECHNOLOGY
  - (U) Evaluate a 256 x 256 adaptive IRFPA
  - (U) Demonstrate a 128 x 128 color discriminating IRFPA.
  - (U) Develop optical microwave link with 50 mw output using <2.0V Vu external lithium niobate modulators at 20 GHz.
  - (U) Develop 3 band IRFPA to enhance performance against countermeasures and stealthy targets.
- (U) (\$420) INTEGRATED ELECTRONICS TECHNOLOGY
  - (U) Develop adaptive weight learning circuits for co-site canceller for >1 GHz frequencies needed to cancel L-band communication interferers.
- (U) (\$996) ELECTRONIC AND E/O MATERIALS
  - (U) Evaluate InAs/InGaSb growth techniques and transfer the techniques to industry and device technology programs.
  - (U) Continue development of 6.1A materials for high frequency applications.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) (\$11,750) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY
  - (U) Demonstrate 40 watt CW ultra broadband (1 - 5 GHz), ultra linear (cross modulation products 28 dbm below fundamental signal) compact amplifiers suitable for use in next generation wide area surveillance systems.
  - (U) Demonstrate 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) Demonstrate the generation of simultaneously multiple frequency independent RF beams capable of beamsteering over  $\pm 60$  degrees from boresight on transmit and receive with control structure that preserves a 500 MHz instantaneous RF bandwidth for each beam.
  - (U) Fabricate 100 GHz logic-derived microwave synthesizer and design integral phase and frequency modulator for synthesizer
  - (U) Fabricate from wide bandgap semiconductors and begin testing of low parasitic bipolar microwave power amplifier.
  
- (U) (\$2,258) HPC
  - (U) Continue evaluation of VR 3D Workbench and extend to Immersive Room. Develop speech, acoustic, and/or haptic interfaces for the Workbench. Develop information overlay methods. Develop overlay methods for representing physical phenomena such as weather. Apply workbench to Urban Warrior exercise and other emerging opportunities.
  - (U) Demonstrate a framework to allow end to end determination of the effect of lossy compression on the generation and performance of targeting systems as compared to lossless compression.
  - (U) Demonstrate novel techniques for characterization of subsets of images such that these keys can serve as rapid retrieval of similar images.
  
- (U) (\$3,021) AI/HCI
  - (U) Integrate case-based reasoning with alternative problem-solving strategies for advanced toolsets. Extend Java COTS Case-Based Reasoning tool with belief net modeling tools.

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

- (U) Continue to develop architecture for secure communication using COTS (Onion Routing). Develop architecture for Multiple Level Security (MLS) workflow management.

- (U) (\$4,987) ECS

- (U) Demonstrate an integrated System Engineering Environment including requirement and design capture repository, design structuring and optimization, and system assessment. This capability will provide the ability to evolve, assess, and track the complete system design and trade-offs subsequently across all phases of complex system development, production, and life-cycle support. Develop and demonstrate an initial capability of a human-centered system design processes and methods that specify and capture the essential roles and cognition requirements of human operators and decision-makers and subsequently enables automation to produce a balanced system design and subsequent track/monitor of the desired emergent behavior towards meeting Navy mission requirements.
- (U) Demonstrate unified distributed reusable Web-based object software development architecture and repository on a combat system application (US/French collaboration).
- (U) Complete a version of KBESD, a tool for evaluation of complex system design using the Analytic Hierarchy Process (AHP), a methodology for measuring and evaluating key system performance attributes.
- (U) Demonstrate formal methods approach to Navy safety-critical operation that takes system requirements and automatically generates in-depth analysis and simulation to guarantee completeness and safety properties.

Validate the tools and methods through test of specifications from previously implemented systems to determine if any new problems are detected to compare to errors actually found after implementation of the benchmark and discover any new faults previously undetected.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$84,724	\$76,653	\$87,445
(U) Appropriated Value		75,503	
(U) Adjustments from 1998 PRESBUDG:	1,157	-6,479	-9,828

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY

(U) FY 1999 President's Budget Submission \$85,881 \$70,174 \$77,617

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect a Small Business Innovation Research (SBIR) transfer (-193), Revised Economic Assumptions (-103), Actual Execution Updates (+1,453). The 1998 adjustments reflect the following Congressional additions: Resin Transfer Molding/Carbon Fibers (+2,000), Composite Storage Capsule (+2,000), Photomagnetic Research (+350), Plasma Quench Technology (+2,000), and Advanced Material Intelligent Processing Center (+2,500), Reduction to Vacuum Electronics (-3,000); Congressional Undistributed Reductions (-2,162), Economic Assumption (-167), and Fiscal Constraint Reduction (-10,000). The FY 1999 adjustments reflect Navy Working Capital Fund (NWCFF) adjustment (-566), Science and Technology adjustments (-10,015), Military and Civilian Pay Rates (+428), Commercial Purchases Inflation Adjustment (-1,375), and realign the affordability program to match changing warfare and mission priorities (+1,700).

(U) Schedule: N/A

(U) Technical: N/A

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)

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PROGRAM ELEMENT: 0602234N

PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS, AND COMPUTER 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 Navy's 6.1, 6.2, and 6.3 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.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Electronic Warfare Technology	18,274	21,164	23,849	25,460	25,983	26,552	27,191	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 Command and Control Warfare (C2W). This program develops technologies which support the effective utilization of naval force capabilities in the conduct of the Navy's Joint Mission Areas (JMAs) 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 (CONUS) and deployed forces". The program is planned jointly in accordance with Defense S&T Reliance agreements which 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 which 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 (ATD) 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 (SSD). 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

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PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

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, the programs described in the Accomplishments and Plans section are representative selections of the work included in this program element.

(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:

1. (U) FY 1997 ACCOMPLISHMENTS: Work continued on shipboard sensor and weapons response involved in operations in littoral regions. Programs focusing on combat identification, precision strike and information dominance will continue and development of micro/Unmanned Aerial Vehicle (UAV) designs for small radar cross section (RCS) platforms was initiated.

- (U) (\$3,330) THREAT WARNING - The objective developed 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-Optic /Infrared (EO/IR) technologies to provide early warning of hostile action, either surveillance or attack, to U.S. military platforms and to assist in identifying the threat and counter it.
  - (U) Demonstrated development of advanced processing technologies (including deinterleaver improvements, pulse repetition interval (PRI) fingerprinter, and decibel (dB) analysis). These technologies will be available for use in advanced receiver systems.
  - (U) An Application Specific Integrated Circuit (ASIC) was fabricated and will be tested and modified, providing a factor reduction in the size of the extraction and processing hardware for use in a miniature Specific Emitter Identification (SEI) system for tactical aircraft, UAVs, and portable systems making it attractive for application in weapons systems such as High Speed Anti-Radiation Missile (HARM).
  - (U) Developed preliminary double delta direction finding algorithm and demonstrated it along with dual channel signal acquisition hardware to provide a passive high precision direction finder comparable to multi-channel phase interferometers for air and surface platforms.

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Budget Item Justification  
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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (U) Characterized feature vector effectiveness and demonstrated part of the development of a 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 first phase of a compact, lightweight sensor system to detect and mark in space the location of small arms fire which will permit return fire in real time at ranges greater than the lethal range of the enemy weapon and can be carried and operated by a single individual.
- (U) (\$8,281) 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 IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
  - (U) Analyzed susceptibility of foreign and surrogate threats to develop and characterize jamming techniques, in the laboratory and at militarily significant ranges, to assess overall countermeasure (CM) system performance for the integrated onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
  - (U) Conducted Optokinetic Nystagmus experiments on man-in-the-loop IR imaging seekers, assessed capabilities of new foreign imagers, and assessed infrared counter measure (IRCM) techniques against imaging seekers, to enhance capability of the Advanced Integrated Electronic System (AIEWS) system against advanced IR guided anti-ship threats.
  - (U) Redesigned Multi-Cloud decoy hardware to create a more ship-like height and double the walk-off distance to enhance ship self-defense against IR guided anti-ship threats.
  - (U) Fabricated and tested 20 redesigned Kinematic Special Material Decoys (KSMD) units to assure they will properly eject under various wind conditions and then, fabricated 10 units for deployment and radiometric testing to evaluate special material IR payloads for tactical aircraft self-protection against those threats that employ motion as well as spectral discriminants.
  - (U) Improved antenna isolation model to represent antennas mounted on curved surfaces for any decoy platform and investigated interference cancellation techniques to achieve higher decoy effective radiated power (ERP) through improved antenna isolation.
  - (U) Integrated advanced technologies developed for the Mini-URANUS system (a modular, fully coherent jammer capable of jamming multiple simultaneous threats) into a ALQ-167 pod, for standoff and self-protection of aircraft, helicopters, and potentially UAVs, as part of the next generation C2W Electronic Attack function.

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PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (U) Fabricated and lab tested the Small Ship Jammer electronic attack (EA) subsystems developed for physically small surface patrol crafts that have no active onboard EA self-protection capability (e.g., special forces PC-1 and MK V SOC) and participated in fleet littoral warfare operations.
- (U) Updated imaging missile model algorithms and performed susceptibility measurements on selected foreign and domestic Focal Plane Arrays (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) (\$6,663) 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 (C2) 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, evaluate current method (ECM) and other mission-support aircraft to improve situation awareness, to provide dependable combat identification (ID) and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.
  - (U) Developed detailed design for 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) Analyzed and documented results of laboratory tests conducted with an upgraded EA-6B Universal Exciter, and planned and executed follow-on tri-service field tests for the development of countermeasures against modern cellular radio communication systems.
  - (U) Extended the real-time software bridge to interoperate with test-and-evaluation and real-world Command, Control, Communications, Computers and Intelligence (C4I) systems as part of a visually rich Command and Control Warfare (C2W) Simulator capable of synthesizing realistic operations found in modern combat missions for assessing Naval operational situations, planning future operations, and evaluating system effectiveness.
  - (U) Developed the sub-models for heat transfer, sea clutter, and surface reflectance as part of an IR ship target and scene model for the Cruise Missile EW simulation to address the shortcomings of previous IR ship predictive codes.
  - (U) Identified necessary modifications to the Little Monopulse Information Signal Processing Element (LMISPE) system and developed a tri-service plan to develop a system capable of fingerprinting modern cellular radio communication systems from airborne platforms.

2. (U) FY 1998 PLAN: FY 1998 funding reflects an enhanced program to address stand-off jamming (SOJ) technology for next generation support jamming. 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.

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PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (U) (\$3,990) 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 United States (U.S.) military platforms and to assist in identifying the threat and counter it.
  - (U) Coordinate development and packaging of a 12-bit analog to digital converter (ADC) to provide a 24 dB increase in dynamic range for the extraction and processing hardware for use in a miniature SEI system for tactical aircraft, UAVs, and portable systems and making it attractive for application in weapons systems such as HARM.
  - (U) Field test 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) Improve deinterleaver algorithms and design 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) Develop 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) Develop of an improved signal processing capability for detecting frequency modulated, continuous wave (FMCW) signal with a Signal to Noise ratio (S/N) of 0 dB 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) (\$9,566) 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 EO/IR 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) Evaluate robustness of jamming techniques and smart jam codes and timelines for causing optical breaklock for the integrated onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
  - (U) Test waveforms to determine timeline effectiveness of directional IRCM against Anti Ship Cruise Missile (ASCM) threats and use optical augmentation (OA) and Moving Target Indicator (MTI) 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) Add and test 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.

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PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (U) Radiometrically test of KSMD units and fabricate additional units for captive seeker testing to evaluate special material IR payloads for tactical aircraft self-protection against those threats that employ motion as well as spectral discriminants.
- (U) Improve antenna isolation model to represent antennas mounted on flat surfaces coated with Radar Absorbing Material (RAM) for any decoy platform and implement interference cancellation techniques to achieve higher decoy effective radiated power (ERP) through improved antenna isolation.
- (U) Demonstrate final integration and flight test the 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 C2W Electronic Attack function.
- (U) Integrate EA subsystems with electronic support (ES) subsystem and perform lab test of the Small Ship Jammer developed for physically small surface patrol crafts that have no active onboard EA self-protection capability (e.g., special forces PC-1 and MK V SOC) and are currently involved in fleet littoral warfare operations.
- (U) Perform susceptibility analysis and develop final cooperative IRCM techniques to 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) (\$7,608) 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 C2 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) Select design configuration, and build and test 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) Evaluate tri-service field tests of countermeasures against modern cellular radio communication systems and transition countermeasure techniques into the EA-6B jamming system.
  - (U) Integrate the use of the real-time software bridge in next generation, dynamic information fusion systems as part of a visually rich C2W Simulator capable of synthesizing realistic operations found in modern combat missions for assessing Naval operational situations, planning future operations, and evaluating system effectiveness.

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PROGRAM ELEMENT: 0602270N

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- (U) Conduct validation of heat transfer, sea clutter, and surface reflectance sub-models and incorporate into the IR ship target and scene model for the Cruise Missile EW simulation to address the shortcomings of previous IR ship predictive codes.
- (U) Implement modifications to the LMISPE system and test against surrogate cellular communication test sets to develop a system capable of fingerprinting modern cellular radio communication systems from airborne platforms.

3. (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/UAV designs for small RCS platforms and the IRCM development and SOJ work continue to be of importance.

- (U) (\$4,092) 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 the threat and counter it.
  - (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 S/N of 0 dB 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) (\$11,272) 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.

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PROGRAM ELEMENT TITLE: Electronic Warfare Technology

- (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) Evaluate captive seeker testing of thrusting KSMD using special material IR payloads for tactical aircraft self-protection against those threats that employ motion as well as spectral discriminants and transition to Electronic Warfare Advanced Technology (EWAT) or a Product Improvement Program (PIP) for air IR decoys.
- (U) Improve antenna isolation model to represent antennas mounted on random access memory (RAM) coated curved surfaces for any decoy platform and finalize isolation improvement techniques and document analysis methods to achieve higher decoy effective radiated power (ERP) 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., special forces PC-1 and MK V SOC) and are currently involved in fleet littoral warfare operations.
- (U) (\$8,485) 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 C2 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 C2W 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 Cruise Missile 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.

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PROGRAM ELEMENT: 0602270N

PROGRAM ELEMENT TITLE: Electronic Warfare Technology

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	21,535	22,810	24,707
(U) Appropriated Value:		21,810	
(U) Adjustments from FY 1998 PRESBUDG:	-3,261	-1,646	-858
(U) FY 1999 President's Budget Request	18,274	21,164	23,849

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 adjustment reflects Small Business Innovation Research transfer (-73), Revised Economic Assumptions (-26), and update actual execution (-3,162). The FY 1998 adjustments reflect general reductions (-598), Economic Assumptions (-48), and FY98 Fiscal constraint reduction(-1,000). The FY 1999 adjustments reflect Navy Working Capital Fund (NWCF) adjustment (-539), Commercial Purchases Inflation adjustment (-427), and Military and Civilian Pay Rate (+108).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(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)

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(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 (Surface/Aerospace Surveillance, & 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.

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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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Mine Countermeasures, Mining and Special Warfare Technology	40,958	41,451	45,928	45,264	51,164	52,145	53,241	CONT.	CONT.

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 will be 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.

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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 S&T program includes projects that focus on or have attributes that enhances 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 1997 ACCOMPLISHMENTS:

- (U) (\$19,011) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Completed sea testing of the Side-Looking Sonar (SLS). Demonstrated coordinated signal processing of both the Synthetic Aperture Sonar (SAS) and electro-optic imaging sensor integrated into a small

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PROGRAM ELEMENT: 0602315N

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

underwater towed vehicle. Based on analysis of at-sea tests, optimize the low frequency and high frequency SAS design for improved performance in shallow water.

- (U) Electro-Optic Sensors: Optimized electro-optic sensors based on analysis of at-sea performance. Conducted sea tests of next generation spectral imaging systems for power-efficient mine detection and identification.
  - (U) Electro-Magnetic Sensors: Conducted dock-side operability testing in small diameter underwater vehicle of superconducting gradiometer.
  - (U) Image Processing and Classification Algorithms: Conducted sea tests with integrated magnetic, SAS, and electro-optic sensors on an underwater platform in VSW to assess effectiveness of multi-sensor data fusion techniques. Demonstrated capability to use multi-source data fusion algorithms to identify locations of obstacles and mines. Demonstrated the performance of the artificial neural network target classifier for incorporation into acoustic response monitor which collects a mammal's mine detecting characteristic activities and correlates them with the location of a minefield.
- (U) (\$11,010) MINE/OBSTACLE NEUTRALIZATION (INCLUDES CONGRESSIONAL PLUS-UP RAPID AIRBORNE MINE CLEARANCE SYSTEM RAMICS):
    - (U) SW Mine Neutralization: Conducted laboratory experiments to evaluate potential effectiveness of new mine destruction concept using focused underwater shock waves. Completed individual hydroballistics testing of supercavitating projectiles. Completed test and evaluation of reactive materials for integration into RAMICS projectile. Completed LIDAR targeting measurements and initiated targeting algorithm development and an end-to-end simulation of RAMICS projectile, targeting and firecontrol and platform.
    - (U) SZ Mine Neutralization: Validated multi-phase coupled code model for simulation of explosive shock propagation through wet sand and used results to update SZ mine neutralization analytical model. Updated database of mine neutralization criteria (pressure, impulse, energy) for threat mines through testing and analysis. Completed full-scale testing of Thunder Road for deploying distributed explosive arrays. Initiated concept assessment of precision clearance and large bomb proposals.
    - (U) Obstacle Breaching: Developed model of damage sustained by finite concrete obstacles when hit or penetrated by high velocity penetrating ordnance. Initiated testing to validate predicted performance enhancement of simultaneous and sequential detonation of bombs for obstacle clearance. Performed initial concept investigations of proposed technologies for enabling instride obstacle breaching.
  - (U) (\$2,750) SEA MINING:
    - (U) Intelligent Mine Network: Evaluated concepts for integrating mobile sea mines into fields of autonomous sensor nodes communicating via covert acoustic modems.
    - (U) Sea Mine Sensors: Completed analyses of data and published final report from the first phase of Littoral Sea Mine (LSM) technology feasibility demonstration. Completed measurement of target advanced gradient signatures, completed theory and performance model development. Initiated work on sensors and signal processing for the Deployable Autonomous Distributed Systems (DADS) weapons concept.

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PROGRAM ELEMENT: 0602315N

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

- (U) Minefield Command and Control: Assessed at sea reliable communications concepts between a ship and mine, providing Identify Friend or Foe (IFF) and Remote Control capabilities. Assessed applicability of communication between mine nodes to achieve enhanced minefield effectiveness and flexibility in the form of Command/Control, sensors fusion, and minefield adaptability.
- (U) (\$8,187) SPECIAL WARFARE/EOD:
  - (U) Mission Mobility Technology: Completed and transitioned high speed boat shock mitigation system and Prototype and transition CO2 membrane scrubber technology. Developed drive mechanism and propeller for low signature diver propulsion vehicle.
  - (U) Mission Support Technology: Demonstrated prototype ultraviolet imaging system for mine identification. Evaluated ensemble containing phase change materials for passive diver thermal protection. Completed initial design and characterized optical parametric amplification laser for multispectral imaging.
  - (U) Clearance of UXO: Conducted development of 2 kilowatt laser diode stack for the neutralization of surface unexploded ordnance. Initiated development of 10,000 element high frequency acoustic imaging array to provide centimeter resolution images in turbid water environment at a 20 frame per second rate. Completed experiments with time domain electro-magnetic induction and SQUID gradiometer techniques for detecting and classifying buried UXO. Applied model based neural network processing to the buried UXO sensor data to reduce false alarms and increase detection rate.
  - (U) Response to WMD Incidents: Demonstrated a high velocity linear shaped charge for the disablement of the explosive firing train of a WMD.

2. (U) FY 1998 PLAN:

- (U) (\$23,157) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Integrate Toroidal Volume Search Sonar (TVSS) and SAS sensor modules into remote underwater sensor platform for Joint Countermine ACTD demonstration of sea mine detection, classification, and identification. Conduct at-sea testing of TVSS and SAS integrated sensor modules and demonstrate during the JCM ACTD. Continue development of advanced SAS and SLS beamforming techniques focusing on phase compensation for motion and environmentally induced errors.
  - (U) Electro-Optic Sensors: Complete sensor performance prediction model for optical mine identification system that includes the spectral characteristics of mine-like targets. Integrate Laser Line Scan (LLS) mine identification sensor into Remote underwater platform for demonstration during the Joint Countermine ACTD. Continue development of fluorescence imaging for mine identification focusing on the characterization of target/background spectral content.
  - (U) Electro-Magnetic Sensors: Complete development of thin film, single channel Low Temperature Critical(Tc) superconducting gradiometer test article to investigate motion-induced noise and radio frequency immunity.

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

Further 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: Develop 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. Integrate real-time processing algorithms on embedded processor and demonstrate as part of the Joint Countermine ACTD, real-time mine detection, classification , and identification.
- (U) (\$6,958) MINE/OBSTACLE NEUTRALIZATION:
  - (U) SW Mine Neutralization: Transition development and testing of anti-mine projectile for the RAMICS concept to an Advanced Technology Transition Project.
  - (U) SZ Mine Neutralization: Establish 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. Continue expanding database of mine neutralization criteria (pressure, impulse, energy) for threat mines through testing and analysis.
  - (U) Obstacle Breaching: Develop 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. Improve obstacle clearance models by incorporating results of simultaneous and sequential detonation testing. Develop technologies required for precise standoff bomb delivery for mine and obstacle clearance.
- (U) (\$2,860) SEA MINING:
  - (U) Intelligent Mine Network: Develop DADS mobile shallow water mine (DADS-weapon) concept. Develop covert deployment concept based upon Submarine Launched Mobile Mine. Develop concepts for "restart " of deployed mobile mine for target attack, communications with DADS during target attack mode, and terminal guidance.
  - (U) Sea Mine Sensors: Develop guidance sensors and signal processing for DADS mobile shallow water mines.
  - (U) MineField Command and Control: Develop concept for command and control of DADS weapons. Assess incorporating prior year developments of IFF and RECO into DADS. Develop concept for intra-field guidance of DADS weapon after launch using node and weapon sensors.
- (U) (\$8,476) SPECIAL WARFARE/EOD:
  - (U) Mission Mobility Technology: Complete development of components of low signature diver propulsion system; integrate, test and evaluate prototype. Transition of technology for incorporating micro Phase Change Materials into dive suits for passive, thermal protection. Develop NSW life support equipment technologies. Options for life support equipment technologies include passive in-water chemical detectors, advanced CO2 scrubbing technology, diver internal monitoring/biofeedback, field oxygen supply technologies.

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

- (U) Mission Support Technology: Fabricate, evaluate and demonstrate prototype of passive multispectral optical parametric amplification laser imager. Conduct field tests of sensors for use in a diver-portable multi-sensor buried minehunter; develop algorithms to process and display signals. Transition clandestine ultrashort range gate laser technology for underwater obstacle localization/identification.
- (U) Clearance of UXO: Demonstrate a capability to determine the status of electronic safe and armed fuzes from a standoff distance due to unintentional or stimulated emissions from the firing train components. Demonstrate 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.

3. (U) FY 1999 PLAN:

- (U) (\$24,551) 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 Joint Countermine 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) (\$9,548) 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.

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PROGRAM ELEMENT: 0602315N

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

- (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) Shallow Water Bottom Mines: Assess application of sensors and command and control concepts developed in prior years to SW bottom mines.
  
- (U) (\$8,854) 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 fuzes. 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.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1997	FY 1998	FY 1999
(U) FY 1998 President's Budget:	44,574	42,737	44,575
(U) Appropriated Value:	-	42,737	-
(U) Adjustments from FY 1998 PRESBUDG:	-3,616	-1,286	+1,353
(U) FY 1999 President's Budget Submit:	40,958	41,451	45,928

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PROGRAM ELEMENT: 0602315N

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

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 reduction consists of Navy Working Capital Fund Surcharge Correction (-752), Revised Economic Assumptions (-55) and actual execution (-2,809). The FY 1998 reduction consists of Congressional undistributed reductions (-1,191) and Economic Assumptions (-95). The FY 1999 increase is due to S&T Adjustments (+2,000), Commercial Purchases Inflation Adjustment (-809), Military & Civilian Pay Rates (+107), NWCF Surcharge Correction (+43), Navy Working Capital Fund (+12).

(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 0604654N (Joint Service EOD Development)

(U) PE 1160401BB (Special Operation Technology Development)

(U) PE 1160402BB (Special Operation Advanced Technology Development)

(U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)

(U) This program adheres to Tri-Service Reliance Agreements on EOD with coordination provided by the Joint Directors of Laboratories.

D. (U) SCHEDULE PROFILE: Not applicable.

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PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

(U) COST (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
N/A Oceanographic and Atmospheric Technology									
	70,661	71,491	56,722	59,974	51,819	52,630	53,783	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) natural-environment needs of regional warfare, (3) providing the on-scene commander the capability to exploit the environment to tactical advantage, and (4) 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.

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(U) These efforts support the Joint Warfare Strategy "Forward...From the Sea." This program fully supports the Director of Defense Research and Engineering's S&T Strategy and is coordinated with other DoD Components through the Defense S&T 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, and Space & Upper Atmosphere.

(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 1997 ACCOMPLISHMENTS:

- (U) (\$16,640) NATURAL-ENVIRONMENT ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS (INCLUDES CONGRESSIONAL PLUS-UP OCEAN CLIMATE RESEARCH):
  - (U) Transitioned a bottom-scattering strength algorithm, good down to low grazing angles, that will enable bottom scattering to be accurately incorporated in Navy models that support undersea surveillance systems.
  - (U) Developed and validated an environment-based method for clutter control in shallow water to advance the capabilities of underwater active acoustic detection techniques.
  - (U) Evaluated deterministic acoustic predictions of the influence of ocean fronts and horizontal refraction on slopes to determine the significance of such features for underwater surveillance systems.
  - (U) Conducted a field test of predictions based on stochastic propagation formalisms to determine whether the stochastic approach can adequately represent acoustic conditions in harsh shallow water environments.
  - (U) Performed an assessment of the impact of noise on full-spectrum processors (frequencies up to 5 kHz), which offer a means of exploiting nontraditional signals emitted by submarines.
  - (U) Demonstrated in a littoral environment narrowband and broadband internode processing for a multi-node surveillance array that accounts for differential target Doppler; this capability will allow greater node separation and a lower cost for a given area coverage.
  - (U) Derived semi-empirical relationships linking acoustic variability with ocean variability.

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PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) Extended the shallow water scattering function model used in torpedo Guidance & Control to muddy bottoms; updated the time, frequency and spatial coherence models using trial data.
- (U) Utilized underwater acoustic techniques to initiate effort to determine the ocean "climate" in a large ocean basin.
- (U) (\$23,457) NATURAL-ENVIRONMENT INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY (INCLUDES CONGRESSIONAL PLUS-UP SENSING SYSTEMS AND UNMANNED UNDERWATER VEHICLES (UUVs)):
  - (U) Began development of a semi-empirical formulation to predict lateral variability of high-frequency acoustic scattering in coastal areas and prepared to conduct further towed-body measurements to assess the spatial variability of high-frequency acoustic properties relevant to MCM operations in coastal areas.
  - (U) Developed geoacoustic models and bottom characterizations for littoral regions of Fleet/Naval Oceanographic Office interest and developed a database format for sediment properties/sediment type to predict mine burial and support high frequency acoustics.
  - (U) Used remote-sensing techniques to extend optical characterizations for MCM systems to high interest areas outside the continental US; evaluated surface effects on optical MCM system performance.
  - (U) Conducted experiment to demonstrate the natural-environment enhanced performance of magnetic MCM systems.
  - (U) Made an identification of the fluid flow parameters critical to the surf/swash zone mine/sediment interaction and developed an initial empirical model for the interaction.
  - (U) Completed the preliminary development of a three-phase constitutive model for sands to advance the natural-environment data base on which explosive techniques of mine clearance will depend.
  - (U) Analyzed data from the previous measurements to determine the influence of bubbles on acoustical and optical MCM systems.
  - (U) Transitioned tactical decision support functions to produce worldwide surf statistics, real-time surf data and amphibious vehicle operability data.
  - (U) Provided an upgraded coherence model to the MCM development community for insertion into the synthetic aperture sonar system performance prediction model.
  - (U) Continued use of simulations to determine sensitivities to the natural environment of systems and sensors that support mine warfare and amphibious warfare.
  - (U) Implemented moored, low-cost mini-Acoustic Doppler Current Profiler technology to enable an affordable means of monitoring current structures in littoral regions.
  - (U) Completed development of the Portable Hyperspectral Imaging Low-Light Spectrometer sensor and initiated characterization of the sensor capabilities in the coastal ocean.
  - (U) Completed a littoral warfare natural-environment simulation capability including high-resolution circulation, wave, tidal and acoustic models in the tactical oceanographic simulation laboratory and supported coastal simulations for joint undersea warfare.

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PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) Continued development of sensor technologies for the natural environment that contribute to measurements from remote semi-autonomous and autonomous ocean vehicles ; developed plans for further mapping of ocean structure.
- (U) (\$12,931) OCEAN AND ATMOSPHERIC PREDICTION: (INCLUDES CONGRESSIONAL PLUS-UP POAM)
  - (U) Delivered ocean forecast models for the South China Sea and the Sea of Okhotsk, both areas of special operational interest, for operational testing and evaluation.
  - (U) Demonstrated a coastal tide prediction model capable of assimilating water level data and ocean current measurements; tide prediction is an essential natural-environment capability for successful littoral operations.
  - (U) Demonstrated the "nesting" of high-resolution coastal ocean models into regional ocean models; nesting of ocean prediction models is the central paradigm being followed in the creation of an ocean prediction scheme that will provide the necessary coverage and detail for military operations.
  - (U) Continued development of completely coupled air-ocean modeling schemes; such schemes are needed to account for the effect of the atmosphere on ocean characteristics and of ocean conditions on the atmosphere, particularly in coastal regions where complex interactions are possible.
  - (U) Demonstrated new ensemble forecasting methods for atmospheric prediction as a means of yielding not only a forecast but a likely range of possibilities.
  - (U) Provided standards for incorporation of atmospheric parameters in Navy simulators.
  - (U) Developed synthetic atmospheric environments for use in Navy training, systems testing, and tactical simulations.
  - (U) Continued effort aimed at utilization of operational tactical radar systems for real-time, localized weather description and as providing input to on-scene mesoscale prediction models.
  - (U) Continued efforts aimed at integration of the POAM sensor for launch aboard a French satellite.
- (U) (\$4,858) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS (INCLUDES CONGRESSIONAL EARMARK PM-10):
  - (U) Extended the Navy aerosol model into the ocean surface layer (bottom 10m), which plays a critical role in the detection of sea-skimming missiles; continued further development of aerosol distribution capabilities including efforts aimed at particulate matter less than 10 microns in diameter (PM-10).
  - (U) Developed a model of cloud edge effects to reduce false alarm rates in infra-red detection systems.
  - (U) Delivered an airborne hybrid radio propagation model to improve EM propagation prediction for airborne platforms.
  - (U) Continued the Electric Optical Propagation and Aerosol Characterization Experiment (EOPACE) experiment at an east coast location, included an aerosol data system.
- (U) (\$12,775) NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM (NOPP) (CONGRESSIONAL PLUS-UP):

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PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) Established a NOPP to promote the goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean.
- (U) Solicited proposals through a Broad Area Announcement for partnership programs involving federal agencies, academia, industry, and other members of the oceanographic scientific community.
- (U) Established efforts in "virtual" ocean data and remote sensing centers/facilities that will 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) Established a National Littoral "Laboratory" to augment or leverage existing field efforts and programs, keying on analysis and modeling, but emphasizing model development together with data synthesis and assimilation.
- (U) Established broad-based partnership efforts in areas such as: mechanisms of cross-shelf transport; transport, fate, and effects of arctic ocean and coastal atmospheric contaminants.

## 2. (U) FY 1998 PLAN:

- (U) (\$10,897) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS (INCLUDES CONGRESSIONAL EARMARK \$1,941 - ARCTIC OCEAN CLIMATE OBSERVATIONS):
  - (U) Continue 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) Conduct 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) Develop techniques for acoustic/nonacoustic fusion performance prediction for nonstationary noise fields in shallow water as a means of improving undersea surveillance detection capabilities.
  - (U) Extend full-spectrum noise models to high frequencies (>15 kHz) and assess impact of full-spectrum noise on the performance of existing broadband detection/classification algorithms using both measured and modeled noise clutter statistics; develop new algorithms that exploit the full-spectrum noise characteristics to reduce the false-alarm/classification-error probabilities.
  - (U) Initiate the development and demonstration of natural-environment enhanced, volumetric, acoustic surveillance arrays for locating and tracking quiet threats in shallow water environments.
  - (U) Initiate the development of geo-acoustical inversion algorithms to improve the performance of natural-environment enhanced signal processing algorithms for undersea surveillance.

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PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) Participate in international program to conduct high-frequency acoustic measurements in shallow water off Australia; the aim is to characterize effects of the natural environment on detection, classification and localization of small, quiet submarines.
- (U) Continue the Arctic Ocean Climate Observations program aimed at utilizing underwater acoustics to determine and monitor ocean "climate" in a large ocean basin.
- (U) (\$30,101) NATURAL-ENVIRONMENT INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY (INCLUDES CONGRESSIONAL PLUS-UP \$9,703 - AUTONOMOUS UNDERWATER VEHICLE AND SONAR DEVELOPMENT, PLUS-UP \$2,660 - 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 level of capability achieved.
  - (U) Develop the utility of the Naval Surface Warfare Center 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, design and conduct 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 develop performance estimates of optical MCM systems in a foreign coastal area. Validate these using in-situ measurements.
  - (U) Initiate work on algorithms for hyperspectral remote sensing data by which detailed resolution can be achieved of littoral ocean characteristics important for naval warfare.
  - (U) Conduct field experiment to test data extraction algorithms (bathymetry, sediment type, bottom backscatter, sound velocity and volume reverberation) from mine-hunting sonars.
  - (U) Continue development of techniques for fusing multiple data types to achieve gains in MCM.
  - (U) Test performance of the toroidal volume sonar system (TVSS) and the side-looking sonar (SLS) using real time natural-environment data for performance prediction.
  - (U) Begin task of describing distribution as well as bulk percent gas in marine sediments for shock wave method of neutralizing mines.
  - (U) Complete micro-scale modeling of fluid-gas flow in marine sediments in support of improved shock wave models.
  - (U) Initiate tests of predictive quality of geoacoustic database algorithms for "type" geologic regions.
  - (U) Develop 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.

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PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) Continue assessments of techniques for optical characterization of natural environments to serve MCM, especially in terms of the variety of natural environments.
  - (U) Analyze data and report results of FY 97 experiment on shallow water, high-frequency acoustics bubble effects, especially as they impact MCM systems.
  - (U) Apply interim bubble/acoustics models to FY 97 shallow water data and help define a FY 99 experiment.
  - (U) Incorporate spatial/temporal coherence results from the Mediterranean site into the Synthetic Aperture Sonar (SAS) performance prediction model and make predictions/hypotheses for an additional very-shallow water site; conduct a major acoustic clutter experiment in a high-clutter environment.
  - (U) Develop composite mission/tactics analysis model which uses physics-based predictions with realistic descriptions of the natural environment.
  - (U) Make investment strategy suggestions relating to accuracies and space/time resolutions required for ocean descriptions based on known Korean and Persian Gulf natural environments.
  - (U) Develop fully-coupled nonlinear wave/tide model with data assimilation and incorporate into system performance models.
- (U) (\$9,553) OCEAN AND ATMOSPHERIC PREDICTION:
    - (U) Adapt the recent, conservative form of semi-Lagrangian schemes to an ocean model.
    - (U) Test 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) Deliver a fourth-order advective sigma-coordinate model.
    - (U) Deliver a fourth-order advective layer model with topography.
    - (U) Advance shipboard ocean forecast capability through inclusion of relocatable ocean circulation component and nesting with shore-based boundary conditions, transition to 6.4.
    - (U) Complete Sea of Japan/Yellow Sea SW Assimilation/Forecast System (SWAFS) development. Begin 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) Conduct critical evaluation of new predictive schemes with the aim of determining their effectiveness against current schemes.
    - (U) Explore 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) Transition a variational assimilation capability for incorporating satellite radiance observations directly into the operational atmospheric prediction system.
    - (U) Demonstrate and transition a shipboard tactical scale atmospheric prediction capability, incorporating local observations and interfaces to tactical decision aids.

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Budget Item Justification  
(Exhibit R-2, page 7 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (U) (\$4,269) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS (INCLUDES CONGRESSIONAL PLUS-UP \$728 - PM-10):
  - (U) Based on EOPACE data, develop 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) Develop improved periscope detection assessment capability with an EM propagation model incorporating an improved surface clutter model.
  - (U) Continue 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) (\$16,671) NOPP (INCLUDES CONGRESSIOANL PLUS-UP \$11,644 - NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM):
  - (U) Continue 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 efforts aimed at a National Littoral "Laboratory" with the long-term aim of "portable" coastal ocean/atmosphere forecasting capabilities.
  - (U) Use 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.
  - (U) Initiate 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 is to develop cutting edge 4-D nowcast and forecast systems for the open and coastal ocean to address civil and military requirements.
  - (U) Continue partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences and education focusing upon ocean observing technologies.
  
- 3. (U) FY 1999 PLAN:
  - (U) (\$10,621) NATURAL-ENVIRONMENT ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:
    - (U) Demonstrate techniques form adapting to the natural environment for in-situ, 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (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) (\$20,322) NATURAL-ENVIRONMENT INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY:
  - (U) Continue efforts in hyperspectral remote sensing technology to build a capability for detailed resolution of littoral ocean characteristics.
  - (U) Provide an initial spatial variability model (low-grazing angle bottom reverberation backscattering, bottom penetration/sediment scattering) and data bases to Naval Surface Weapons Center, Coastal Systems Station (NSWC-CSS) for MCM system development.
  - (U) Process Sea-Viewing-Wide-Field-of-View Sensor (SeaWiFS) 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (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) (\$11,672) 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 very high resolution (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) (\$4,107) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS:
  - (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.

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Budget Item Justification  
(Exhibit R-2, page 10 of 13)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (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 NAVSEA and SPAWAR a small 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) 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.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	73,407	48,211	58,037
(U) Appropriated Value:	-	73,711	-
(U) Adjustments from FY 1998 PRESUDG:	-2,746	+23,280	-1,315
(U) FY 1999 President's Budget Submit:	70,661	71,491	56,722

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 decrease results from the SBIR assessment (-1,052), revised economic assumption (-90) and actual execution (-1,604). The FY 1998 increase results from the congressional undistributed reductions (-2,057), economic assumptions (-163) and Congressional Plus-Ups: Autonomous Underwater Vehicle Sensor (+10,000), Ocean Partnership (+12,000), NSWC South Florida Test Facility (+2,750) and PM-10 (+750). The FY 1999 decrease results from the Navy Working Capital Fund Surcharge correction (+128), Navy Working Capital Fund (-836), S&T Adjustment (+252), Commercial Purchases Inflation Adjustment (-1,008), and Military & Civilian Pay Rates (+149).

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

(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 0602314N (Undersea Warfare Surveillance Technology)

(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)

(U) PE 0602633N (Undersea Warfare Weapons Technology)

(U) PE 0602784A (Military Engineering Technology)

(U) PE 0603207N (Air/Ocean Tactical Applications)

(U) PE 0603785N (Combat Systems Oceanographic Performance Assessment)

(U) PE 0604218N (TESS ENG)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602435N

PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N

PROGRAM ELEMENT TITLE: Dual Use Applications Program

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Dual Use Applications Program	0*	0*	20,000	18,700	18,600	18,700	18,800	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 has been transferred from DARPA and allocated equally among the three Services.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of the Dual Use Applications Program (DUAP) 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, Dual Use Science & Technology (S&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 1997 ACCOMPLISHMENTS: Not applicable.
2. (U) FY 1998 PLAN: Not applicable.

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Budget Item Justification  
(Exhibit R-2, page 1 of 4)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N

PROGRAM ELEMENT TITLE: Dual Use Applications Program

3. (U) FY 1999 PLAN:

- (U) (\$20,000) ONR will issue a call to Navy activities for topics to be included in a single 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 25% of the total proposed effort with industry providing at least 50%.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	0	0	0
(U) Appropriated Value:	-	0	-
(U) Adjustments from FY 1998 PRESBUDG:	0	0	+20,000
(U) FY 1999 President's Budget Request:	0	0	20,000

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N

PROGRAM ELEMENT TITLE: Dual Use Applications Program

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1999 adjustment is due to transfer by DOD to Navy for program execution (+20,000).

(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.

R-1 Line Item 16

Budget Item Justification  
(Exhibit R-2, page 3 of 4)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602805N

PROGRAM ELEMENT TITLE: Dual Use Applications Program

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Budget Item Justification  
(Exhibit R-2, page 4 of 4)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0446 Advanced Avionics Subsystems (formerly Maritime Avionics & Subsystems Technology (MAST))	7,461	6,793	3,442	3,499	3,564	3,622	3,685	CONT.	CONT.
R0447 Weapons Advanced Technology	17,992	19,369	24,364	21,611	23,726	24,769	25,371	CONT.	CONT.
R2264 Air Systems Affordability	3,072	3,510	5,758	5,607	5,650	5,710	5,781	CONT.	CONT.
R2327 Integrated High Payoff Rocket Propulsion Technology (IHPRPT)	933	971	0	0	0	0	0	0	1,904
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	7,412	3,919	7,579	7,317	7,274	8,002	7,467	CONT.	CONT.
R2455 Vectoring ESTOL Control Tailless Operation Research (VECTOR)	0	0	7,000	2,000	500	0	0	0	9,500
TOTAL	36,870	34,562	48,143	40,034	40,714	42,103	42,304	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.

(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

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

Surveillance and Reconnaissance technology issues relevant to this PE include platform mission endurance and survivability. Five 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 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, 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. In FY98 the Extending the Littoral Battlefield (ELB) ACTD was added to this project.

(U) Integrated High Payoff Rocket Propulsion Technology (IHRPT): This project supports the achievement of the IHRPT program time-phased goals by conducting integrated component demonstrations of rocket propulsion technology developed under PE 0602111N.

(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: A FY 1997 new start, 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.

(U) VECTOR Program: A FY 1999 new start, international flight demonstration effort utilizing the X-31 aircraft to demonstrate the feasibility of tailless fighter designs to perform carrier and amphibious ship/land-based strike fighter

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Budget Item Justification  
(Exhibit R-2, page 2 of 38)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Advanced Technology

missions. In addition, the effort will seek to flight demonstrate the concept of Extremely Short Takeoff and Landing (ESTOL) to facilitate early takeoff rotation and high angle-of-attack (AoA) approaches to landing.

(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 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0446    Advanced Avionics Subsystems (AAS) (formerly Maritime Avionics Subsystems & Technology (MAST))	7,461	6,793	3,442	3,499	3,564	3,622	3,685		

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project has been supported by Congress since FY 1995 and will become a core effort in the Navy budget beginning in FY 1999. This project is the only Navy core avionics technology effort to demonstrate commercial-off-the-shelf (COTS) and non-destructive inspection (NDI) technology that will facilitate the introduction of new functionality (e.g., 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. This 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 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 COTS and NDI technologies, protocol-independent high-speed/high-bandwidth databases, and ability to introduce new functionality for effective joint warfighting.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROJECT NUMBER: R0446

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS: (\$8015 total FY 96 & FY 97 funding released in FY 97)

(U) Accomplishments funded with \$4,015 FY 96 dollars:

- (U) (\$1,480) Advanced Graphics and Data Fusion.

(U) Initiated:

- (U) Analysis and development methods for linking PowerScene (commercially-based 3-D visualization and data fusion) and the Tactical Aviation Mission Planning System (TAMPS) to provide two-way communications. Integration of PowerScene with TAMPS will provide the operational aircrew with the capability to rehearse missions and verify mission routing prior to actually flying the mission in the aircraft. Based on rehearsal, the aircrew may also change or update TAMPS routing prior to downloading mission data to cartridge for use in the aircraft.

(U) Continued:

- (U) Development of data compression and automatic 3-D feature extraction algorithms and techniques. Data compression techniques can be used to feed real time video from Unmanned Air Vehicle (UAV) or other offboard sensors into the aircraft for near real time fusion with other sensor and graphic database information, thus providing improved aircrew situational awareness. 3-D feature extraction uses relative motion of sensor or stereoscopic imagery to create 3-D perspective views of man-made objects such as buildings or other objects not included within onboard databases (e.g., National Imagery and Mapping Agency (NIMA) Level Z data does not include 3-D information about buildings).
- (U) JSF Program using developmental MAST software for requirements analysis in ground-based virtual environment for mission preview and cockpit simulation.
- (U) Evaluation of MAST graphics software in McDonnell-Douglas Aerospace F/A-18 future cockpit simulator, connected to the F/A-18 avionics laboratory.

(U) Completed:

- (U) Modification to the PowerScene architecture to permit the following improved/additional capability: direct use of source data, improved image quality and exploitation of parallel processing. These

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DATE: February 1998

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PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and  
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PROJECT NUMBER: R0446  
PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

accomplishments facilitate the migration from workstation prototype hardware to an embedded hardware prototype for real-time aircraft applications.

- (U) Working jointly with the U. S. Air Force (USAF), MAST enabled the USAF mission planning system to incorporate 3-D graphics software for advanced 3-D mission preview capability.

- (U) (\$1,700) Scalable Open Architecture.

(U) Initiated:

- (U) Initiated the process of including the off-board data gateway functions into the system architecture. This capability will allow onboard processing and data distribution between components of a scalable open architecture mission processor.

(U) Continued:

- (U) Expansion and refinement of the open systems architecture initiated in FY96.

- (U) Development of performance measurements and measures of effectiveness for real time embedded processors, using commercially-based technologies and approaches.

(U) Completed:

- (U) Integration of graphics, displays and signal processing algorithms and software objects written in legacy and higher order languages with commercial-off-the-shelf (COTS) processors using technology based on commercial industry standard Object Request Broker (ORB) technology. ORB technology reduces the software dependence upon computer (processor) hardware and provides a reduced risk migration path for new and advanced commercial processors as they become available. Leveraging COTS processor technology in this way provides an affordable means of taking advantage of the latest technology and provides the operational customer with maximum capability.

- (U) (\$535) Advanced Interconnect Technology.

(U) Completed:

- (U) Optical Backplane Interconnect System (OBIS) technology demonstration as part of JSF avionics demonstration effort. For the demo, the core processor electrical backplane was replaced with a backplane using optical techniques. The optical backplane demonstrated improved performance with a development and production cost at approximately 1/10 of that for the electrical backplane.

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PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

- (U) Environmental evaluation of OBIS technology to determine the effects of heat, vibration and structural loading on optical components.

- (U) (\$150) Advanced Packaging and Cooling Technology

(U) Completed:

- (U) Development and demonstration of technology required for 600 input/output connectors between a card and an electrical backplane, or to connect a cable to a box. This technology represents a 50% increase in throughput capacity over current 400 pin connector technologies used on aircraft such as F-22 and provides connectivity for high density electrical components

- (U) (\$150) Low Cost Antennas and Connectivity

(U) Completed:

- (U) Analysis of wide bandwidth multifunction aperture and low cost Transmitting/Receiving (T/R) module.  
- (U) Transition of Airborne Shared Aperture Project technology to the JSF Multifunction Integrated Radio Frequency (RF) System (MIRFS) demonstration.

(U) Accomplishments funded with \$4,000 FY 97 dollars:

- (U) (\$1,500) Advanced Graphics and Data Fusion

(U) Initiate:

- (U) Porting of 3D PowerScene visualization software onto Scalable Open Architecture avionics hardware. PowerScene Graphical User Interface (GUI) development to facilitate 3D scene editing, annotation, and model building.

- (U) Virtual prototype and design for a multithread processing engine for high speed 3-D visualization graphics and emulation of existing military processors.

(U) Continue:

- (U) Integration of PowerScene with TAMPS based upon FY97 analysis. This hard link will be necessary to enable real-time mission replanning in an aircraft system. The results will also have immediate use in providing TAMPS users a mission preview/rehearsal capability.

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Subsystems (AAS)

- (U) Development of geo-registered video-mosaicing techniques required to fuse data from various sensors and data sources into a seamless and coherent 3-D perspective display.
- (U) Development of data compression technology required to transport information from offboard sensors for fusion into 3-D perspective display.
- (U) Demonstration of combined 2-D/3-D PowerScene functionality, operating in near real time on SOAP processing environment.

(U) Complete:

- (U) Finalization of open graphics architecture concepts using commercially-based software and hardware for implementation into a tactical mission processor on legacy aircraft such as AV-8B, F/A-18 and JSF. This includes ensuring compliance of both 2-D and 3-D versions of PowerScene software with Posix and OpenGL standards.
- (U) Modeling to accurately render Infrared (IR) imagery and of environmental effects.

- (U) (\$1,460) Scalable Open Architecture

(U) Initiated:

- (U) Joint MAST and Dual-Use S&T behavior verification, virtual prototype and emulator chip for reuse/renewal of legacy software. Chip to utilize novel advanced architecture. Capable of emulating AN/AYK-14, MIL-STD-1750, and other legacy processors found in naval aircraft and other DoD weapon systems.
- (U) High performance COTS based graphics in SOAP hardware.

(U) Continued:

- (U) Demonstration and benchmarking of Object Oriented Architecture using commercial hardware and software components. Uses actual F/A-18 OFP11c or newer for operational analysis.
- (U) Real-Time COTS Operating System and Object Request Broker infrastructure.
- (U) Embedded visualization node in the SOAP architecture for 2-D then 3-D visualization.

(U) Completed:

- (U) Demonstration of multiple COTS processors from multiple vendors running in SOAP architecture using Optical Fiber Channel network.
- (U) Demonstration of eight objects interconnected in SOAP architecture running with F/A-18 OFP being one subject, open graphics another, Vx works another, etc. This is initial step in direction of using object oriented software in a real-time deterministic system like the F/A-18 or other tactical aircraft.

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PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

- (U) (\$760) Advanced Interconnect Technology  
(U) Continued:
    - (U) Development of key components for High Speed Optical Backplane.(U) Completed:
    - (U) Demonstration of COTS based scalable multiprocessor system with optical backplane interconnect.
  - (U) (\$180) Low Cost Sensors and Connectivity  
(U) Continued:
    - (U) Efforts in IR model applications and analysis of microwave/millimeter-wave circuits to advanced low cost sensors as well as connectivity between sensors and shooters.
  - (U) (\$100) Advanced Packaging  
(U) Completed:
    - (U) Fabrication of female side of 600 I/O gold dot high density connector.
2. (U) FY 1998 PLAN: (\$7,300 includes \$3,461 FY 97 funding released in FY 98)
- (U) (\$2,120) Visualization and Data Fusion Software  
(U) Continue:
    - (U) Mosaicing of off-board and on-board information into geospecific 3-D imagery.
    - (U) Refining image generation software for portability to multiple COTS graphics engines.(U) Complete:
    - (U) PowerScene Integration with TAMPS for integrated mission planning and rehearsal capability and application at Fallon.
    - (U) F/A-18 integrated 2-D cockpit demonstration at Boeing's Advanced Avionics Center in St. Louis, MO.
    - (U) Initial demonstration of ability to bring off-board imagery from a commercial source into military cockpit.
  - (U) (\$3,930) Scalable Open Architecture

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Weapons Advanced Technology

PROJECT NUMBER: R0446  
PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

(U) Initiate:

- (U) Integration of signal processing node and high speed multiprocessor node into the SOAP architecture based on COTS technology.

(U) Continue:

- (U) Evaluation of multiprocessor and dynamic reconfiguration in a COTS environment.
- (U) Benchmarking performance of object code in reconfigurable COTS architecture.
- (U) Performance analysis and development of common object request broker architecture in a real-time deterministic system.
- (U) Demonstration of integrated data base management of on/off-board information for 3-D visualization.
- (U) Definition of network requirements and capabilities for an information intensive unified system.

(U) Complete:

- (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) (\$870) Advanced Avionics Interconnect Technology

(U) Initiate:

- (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.

(U) Continue:

- (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) (\$270) Low Cost Sensors and Connectivity

(U) Continue:

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PROGRAM ELEMENT: 0603217N

PROJECT NUMBER: R0446

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

- (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) Continue:
  - (U) Evaluation of COTS packaging technology in naval avionics applications.

3. (U) FY 1999 PLAN: (\$6,396 includes \$2,954 FY 98 funding released in FY 99)

- (U) (\$1,800) Advanced Graphics and Data Fusion  
(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) 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) (\$3,200) Scalable Open Architecture  
(U) Continue:
  - (U) Integration with operational flight program, including weapons control and off-board data communications into optimized architecture for full system performance evaluation.
  - (U) Real-time common object request broker architecture evaluation using actual OFP along with new functionality software written in higher order language.

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Weapons Advanced Technology

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Subsystems (AAS)

(U) Complete:

- (U) Renewal of legacy software systems processor emulator prototype chip which is capable of emulating the AN/AYK-14 mission computer processor.

- (U) (\$870) Advanced Interconnect Technology

(U) Continue:

- (U) Evaluation of optical interconnect components for ships and aircraft under joint NAVSEA/NAVAIR Dual-Use S&T project agreement.  
- (U) Integration of key components for High Speed Optical Networks.

- (U) (\$526) Low Cost Sensors and Connectivity

(U) Continue:

- (U) Millimeter-wave antenna concept analysis.

## B. (U) PROGRAM CHANGE SUMMARY

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	3,672	0	0
(U) Appropriated Value:	-	7,000	-

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BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603217N      PROJECT NUMBER: R0446  
PROGRAM ELEMENT TITLE: Air Systems and      PROJECT TITLE: Advanced Avionics  
Weapons Advanced Technology      Subsystems (AAS)

(U) Adjustments from FY 1998 PRESBUDG:	+3,789	+6,793	+3,442
(U) FY 1999 President's Budget Request:	7,461	6,793	3,442

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect reductions for Small Business Innovation Research (SBIR) reduction (-\$202); actual execution update (+\$4,000); and Revised Economic Assumptions (-\$9). FY 1998 adjustments reflect Congressional Undistributed reductions (-\$207); and Congressional Add MAST (+\$7,000). FY 1999 adjustments reflect S&T realignment to fund MAST (+3,500); Commercial Purchases Inflation Adjustment (-\$61); and S&T adjustments (+\$3).

(U) Schedule: Not applicable

(U) Technical: Not applicable.

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)

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PROJECT TITLE: Advanced Avionics  
Subsystems (AAS)

- (U) PE 0603238N (Precision Strike and Air Defense Technology)
- (U) PE 0603792F (Advanced Technology Demonstrations)
- (U) PE 0603800N & 0603800F (Joint Advanced Strike Technology Program)
- (U) PE 0603253F (Advanced Avionics Integration)

D. (U) SCHEDULE PROFILE: Not applicable.

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PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0447 Weapons Advanced Technology	17,992	19,369	24,364	21,611	23,726	24,769	25,371	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project will reduce technical risk and demonstrate guidance and control, ordnance, air breathing propulsion and airframe sub-system/component concepts emerging from Navy and Industry Applied Research 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. 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).

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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 1997 ACCOMPLISHMENTS:

- (U) (\$1,641) Advanced Anti-Radiation Missile (ARM) Guidance Demonstration (AAGD):  
(U) Initiated:
  - (U) Analysis of integrated Radio Frequency (RF) receiver and conformal antenna bench and anechoic chamber test data.(U) Continued:
  - (U) Integration of Anti-Radiation Homing (ARH) and terminal sensor.(U) Completed:
  - (U) ARH Software Code Generation and Fabrication.
  - (U) Bench and Anechoic Chamber Testing of Integrated RF Receiver and Conformal Antenna.
  - (U) Integration of digital signal processor with ARH receiver.
  - (U) Delivery of terminal sensor (Imaging Infrared (IR)).
  
- (U) (\$3,664) Cruise Missile Real Time Retargeting Demonstration:  
(U) Initiated:
  - (U) Design of common aperture for a dual mode laser detection and ranging/imaging IR seeker.
  - (U) Design and fabrication of a flight test hardware pod.
  - (U) Design and fabrication of the flight test hardware pod interface with the F/A-18 test aircraft to be used during flight test.
  - (U) Design and fabrication of a higher power, Build 2 LADAR seeker. Seeker is designed for use on Tomahawk, Standoff Land Attack Missile (SLAM), Pre-planned product improvement (P3I), Joint Stand Off Weapon (JSOW), and Joint Air to Surface Standoff Missile (JASSM).(U) Continued:
  - (U) Development of the data base of laser detection and ranging images.
  - (U) Development of Mission Planning procedures and software for strike planning, targeting and neural network training.

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PROJECT TITLE: Weapons Advanced Technology

- (U) Fabrication of Build 1 Laser Detecting and Ranging Seeker (LADAR).
- (U) Extending current solid state laser detection and ranging sensor capabilities by providing variable resolution for increased frame rates, direct control of field of view and increased device power.
- (U) Completed:
  - (U) Upgrade of Low Cost Anti-Armor Submunition (LOCASS) seeker with integrated Global Positioning System (GPS)/Inertial Measurement Unit (IMU) and resolvers to quantify image motion error and take sequential frames of target aim points.
  - (U) Complete flight test, data collection, and analysis with LOCASS seeker.
- (U) (\$1,992) 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) Initiated:
    - (U) Design, development, and fabrication of RF submodules
    - (U) Design, development, and fabrication of modem submodules
    - (U) Design, development, and fabrication of network control processor submodules
    - (U) Design, development, and fabrication of central processor submodules
    - (U) Design of electrical and mechanical terminal interfaces
  - (U) Continued:
    - (U) Refinement of system level performance requirements
    - (U) Performance prediction analysis of weapon control data link system
  - (U) Complete:
    - (U) Definition of mechanical and electrical interface requirements
    - (U) Definition of RF waveform
    - (U) Technology/design tradeoff studies of antennas, communication channels, RF architecture, RF modulation techniques, error control coding techniques, communication network techniques, video compression techniques.
    - (U) Assessment of video compression algorithms
- (U) (\$4,639) Concentric Canister Launcher (CCL):

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PROJECT TITLE: Weapons Advanced Technology

(U) This task demonstrates a universal munitions launcher for Tomahawk, Standard Missile (SM-2) Block IV, and Evolved Sea Sparrow Missile (ESSM). The technologies involve missile fly out from a full scale launcher tube; validation, verification, computational design tools; and demonstrate a distributed launch control system capable of simultaneous and coordinated launch of multiple missile types. This program addresses reduced Life Cycle Costs through reducing manning, automated construction, and by utilizing a modular design.

(U) Initiated:

- (U) Restrained firing and fly out tests from CCLs on stands.
- (U) Shock and vibration tests of loaded canisters.
- (U) Manufacture full length Integral Ship Weapon Module (ISWM).
- (U) ISWM deck plate test.
- (U) 3-D Computational Fluid Dynamics (CFD) internal ballistics simulation for Navy Tactical Missile System (NTACMS).
- (U) Design and build full scale steel NTACMS launcher.

(U) Completed:

- (U) Building all full scale steel launchers.
- (U) Fly out tests from CCLs on stands.
- (U) Shock collar design and demonstration.
- (U) Two missile types electro/optical interfaces with launcher and demonstrate same.
- (U) ISWM deck plate test.

- (U) (\$2,862) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:  
(U) This advanced seeker effort has the potential of significantly reducing the cost of future strike weapon seekers without impacting their required performance capabilities. Specifically, this cost savings is achieved by reducing the number and complexity of mechanical parts, emphasizing software and electronics, maximizing the use of body-fixed components, and simplifying integration issues.  
(U) Initiated:
  - (U) System integration.
  - (U) Test platform integration.
  - (U) Subsystem lab and environmental testing.

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PROJECT TITLE: Weapons Advanced Technology

(U) Continued:

- (U) Subsystem laboratory testing.
- (U) Ball-Joint gimbal prototype fabrication.
- (U) Large field of view (FOV) sensor prototype fabrication.

(U) Completed:

- (U) Ball-Joint design analysis.
- (U) Large FOV sensor design analysis.
- (U) Mechanical/electrical hardware design.

• (U) (\$1,722) Shared Aperture:

(U) This task demonstrates a shared RF aperture with the ability to simultaneously act as a common/shared antenna for multiple RF systems (such as: radar, communication, Electronic Support Measures (ESM), or Electronic Counter-counter Measures) for use on Navy platforms.

(U) Initiated:

(U) Establishment of system requirements and performance specifications.

- (U) Perform design studies for RF shared aperture array antennas.
- (U) Conduct simulations and time-line analyses of each aperture type to verify combined sensor performance.

• (U) (1,472) ELB:

(U) Initiated:

- (U) Fires and targeting planning and definition.
- (U) Near, mid and long term exercises and feasibility demonstration definition.
- (U) Generation of time critical target imagery and relay.
- (U) Naval Surface Fire Support Warfare Control System hardware integration with AFATDS.

2. (U) FY 1998 PLAN:

- (U) (\$3,662) Cruise Missile Real Time Retargeting Demonstration:  
(U) Initiate:

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PROJECT TITLE: Weapons Advanced Technology

- (U) Flight testing of Build 1 solid state LADAR on T-39 aircraft.
- (U) Establish ground testing capability for Build 1 solid state LADAR in North Range Towers.

(U) Continue:

- (U) Modifying 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) Development of Build 2 solid state LADAR components. Phase 3 will finalize the designs for the Tomahawk (Navy) and Small Smart Bomb (Air Force) tasks.
- (U) Development of mission planning procedures and software for strike planning, targeting, and neural network training.
- (U) Development of fixed target Autonomous Target Recognition Software.

(U) Complete:

- (U) Build 1 seeker.

- (U) (\$3,028) Surgical Strike Adaptive Weapon Control Video 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) Initiate:
    - (U) Design, integration, and lab testing of RF modules, modem modules, network control processor modules, and central processor modules.
  - (U) Continue:
    - (U) Refinement of system level performance requirements.
    - (U) Performance prediction analysis of weapon control data link system.
    - (U) Design, development, and fabrication of RF, modem, network control, processor, and central processor submodules.
    - (U) Platform integration approach/design.
    - (U) Definition of electrical and mechanical terminal interfaces.
  - (U) Complete:
    - (U) Antenna design.

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PROJECT TITLE: Weapons Advanced Technology

- (U) (\$1,200) CCL:  
(U) This task will demonstrate a universal munitions launcher for Tomahawk, SM-2 Block IV, and 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) Initiate:
    - (U) Design and fabrication of cannister interface electronics unit.
    - (U) Development of fiber optic LAN architecture.
  - (U) Continue:
    - (U) Demonstration of all up distributed control system.
    - (U) Hardware design for planned outyear SM2 Blk IV restrained firing tests.
- (U) (\$3,219) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:
  - (U) Initiate:
    - (U) CE seeker demonstration.
    - (U) Ground, rooftop, HITL. Fabrication and flight clearance tests.
  - (U) Continue:
    - (U) CE seeker integration and test.
  - (U) Complete:
    - (U) Mechanical/electrical hardware design.
    - (U) Integrated CE seeker development and environmental demonstration.
- (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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447  
PROJECT TITLE: Weapons Advanced Technology

(U) Initiate:

- (U) Construction of test prototype.

(U) Continue:

- (U) Final design for open architecture multifunction RF system capable of meeting Navy requirements for a set of radar, communications and Electronic Warfare (EW) functions,

(U) Complete:

- (U) System requirements and performance specification.

• (U) (\$6,898) ELB:

(U) Continue:

- (U) Fires and targeting definition for ELB ACTD system design.

- (U) Exercises and feasibility demonstration definition.

- (U) ACTD systems engineering, development and integration.

- (U) Design and initial outfitting of afloat testbed interface with Navy fires and targeting systems.

4. (U) FY 1999 PLAN:

• (U) (\$5,790) Cruise Missile Real Time Retargeting Demonstration:

(U) Initiate:

(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) Continue:

- (U) Flight testing of the Build 1 solid state LADAR on the T-39 aircraft.

- (U) Demonstration of 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) Fabrication of Build 2 sensor for delivery in FY 2000.

(U) Complete:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447  
PROJECT TITLE: Weapons Advanced Technology

- (U) 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) Build 2 of the solid state LADAR delivered.
- (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) Initiate:
    - (U) Flight test planning for FY 2000 system verification and testing.
    - (U) Integration of terminals into ground test platforms.
    - (U) Ground testing of multiple terminals.
    - (U) Integration of terminals into flight test platforms.
  - (U) Continue:
    - (U) Refinement of system level performance requirements.
    - (U) Performance prediction analysis of weapon control data link system.
    - (U) Laboratory integration testing of terminals.
  - (U) Complete:
    - (U) Design, development, and fabrication of RF, modem, network control, processor, and central processor submodules.
    - (U) Platform integration approach/design.
    - (U) Definition of electrical and mechanical terminal interfaces.
- (U) (\$5,270) CCL:
  - (U) Continue:
    - (U) Tomahawk CFD model validation.
    - (U) Hatch design and fabrication.
    - (U) Prototype launch system hardware fabrication.
    - (U) Design and fabrication of cannister interface electronics unit.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447  
PROJECT TITLE: Weapons Advanced Technology

- (U) Complete:
  - (U) Demonstration of all up distributed control system.
  - (U) Development of fiber optical LAN architecture.
  - (U) Conduct SM2 Blk IV restrained firing.
- (U) (\$3,530) CE Ball-Joint Gimbal for Joint Strike Weapon:
  - (U) Initiate:
    - (U) CE seeker flight tests and demonstration.
  - (U) Continue:
    - (U) CE seeker integration and test, ground, rooftop, HITL tests.
  - (U) Complete:
    - (U) Integrated CE gimbal hardware and flight test pod.
    - (U) Ground, rooftop, HITL, flight tests, and program documentation.
- (U) (\$3,620) 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) Initiate:
    - (U) Demonstration to evaluate resource manager and prototype performance relative to Navy requirements for radar, communications and EW systems.
  - (U) Continue:
    - (U) Construction of test prototype.
  - (U) Complete:
    - (U) Final design for open architecture multifunction RF system.
- (U) (\$1,000) Hypersonics:
  - (U) This task will support the development and testing of a hypersonic dual combustion ramjet concept for potential next generation Navy high speed strike missiles.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447  
PROJECT TITLE: Weapons Advanced Technology

(U) Initiate:

- (U) Initial design of dual combustion ramjet test vehicle.
- (U) Development of the test plan for free jet testing of the ramjet.
- (U) Preliminary design of the test stand.

- (U) (\$1,950) Air and Surface Weapons Technology (ASWT) Demonstrations:

(U) This task demonstrates the technologies to achieve the Phase I ASWT Phase I goals.

(U) Initiate:

- (U) Planning for the Air Superiority, Strike, Ship Based Defense, Naval Surface Fire Support, and Integrated High Payoff rocket Propulsion Technology (IHRPT) technology demonstrations.
- (U) Development of test program and plan for IHRPT technology demonstrations.
- (U) Initial design of tactical rocket test components.

## B. (U) PROGRAM CHANGE SUMMARY

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	21,841	23,838	24,154
(U) Appropriated Value:	-	20,038	-
(U) Adjustments from FY 1998 PRESBUDG:	-3,849	-4,469	+210
(U) FY 1999 President's Budget Request:	17,992	19,369	24,364

## (U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect Revised Economic Assumptions reduction (-\$22); and Actual Execution Updates (-\$3,827). FY 1998 changes reflect Congressional Undistributed reductions (-\$669), and Congressional fiscal constraint

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT NUMBER: R0447  
PROJECT TITLE: Weapons Advanced Technology

reduction (-\$3,800). FY 1999 adjustment reflect Navy Working Capital Fund (+\$590); Commercial Purchases Inflation adjustment (-\$429); and Military and Civilian Rates (\$49).

(U) Schedule: Not applicable

(U) Technical: AAGD effort terminated in FY98. CCL substantially reduced in FY98 due to funding constraints.

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.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ESTIMATE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2264 Air Systems Affordability	3,072	3,510	5,758	5,607	5,650	5,710	5,781	CONT.	CONT.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS: 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.

1. (U) FY 1997 PLAN:

- (U) (\$3,072) Precision Strike Navigator (PSN):
  - (U) This task is a transition/continuation of a project selected through the Advance Technology Demonstration (ATD) process, started in Program Element (PE) 0603792N in FY 1996, and transitioned to this PE for continued long term development and demonstration. This task will develop a highly accurate, compact, and low cost Inertial Measurement Unit (IMU), that will provide pinpoint guidance even if Global Positioning System is lost for new weapons systems such as Joint Stand-Off Weapon (JSOW)/Joint Direct Attack Munition (JDAM) and Tomahawk Block IV missiles.
  - (U) Initiated:
    - (U) Fabrication and testing of PSN IMU.
    - (U) Wafer fabrication.
    - (U) Software development and verification.
  - (U) Completed:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT NUMBER: R2264

PROJECT TITLE: Air Systems Affordability

- (U) IMU housing for testing purposes.
- (U) Risk reduction for hybrid wafer.

2. (U) FY 1998 PLAN:

- (U) (\$3,510) PSN:
  - (U) Continue:
    - (U) Fabrication and testing of PSN IMU
  - (U) Complete:
    - (U) Wafer fabrication.

3. (U) FY 1999 PLAN:

- (U) (\$5,758) PSN:
  - (U) Initiate:
    - (U) Test preparation and integration.
  - (U) Complete:
    - (U) Fabrication and testing of PSN IMU.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY1998</u>	<u>FY1999</u>
(U) FY 1998 President's Budget:	3,198	3,617	5,652
(U) Appropriated Value:	-	3,617	-
(U) Adjustments from FY 1998 PRESBUDG	-126	-107	+106
(U) FY 1999 President's Budget Request:	3,072	3,510	5,758

(U) CHANGE SUMMARY EXPLANATION:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT NUMBER: R2264

PROJECT TITLE: Air Systems Affordability

(U) Funding: FY 1997 adjustments reflect Revised Economic Assumptions (-\$4);and an Update to reflect actual execution (\$-122). FY 1998 adjustments reflect Congressional undistributed reductions (\$-99); and Economic Assumptions (\$-8). FY 1999 adjustments reflect Navy Working Capital Fund (NWCF) adjustments (+\$180); Commercial Purchases Inflation adjustments (-\$101); and Military and Civilian pay rates (+\$27).

(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 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	7,412	3,919	7,579	7,317	7,274	8,002	7,467	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project covers the Navy's share of the demonstrator engine efforts under IHPTET, 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), 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 (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 three phases with the ultimate goal of doubling propulsion capability by the year 2003. Additional goals are currently being developed to address future concepts beyond Phase III. Phase I has been completed and demonstrated for each of the three classes of demonstrators. 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)):

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PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT NUMBER: W2014  
PROJECT TITLE: Integrated High Performance  
Turbine Engine Technology (IHPTET)

(U) Phase I - 1993: +30% thrust/weight (Fn/Wt), +100 °F combustor inlet temperature (CIT), +300 °F turbine inlet temperature (TIT), -20% fuel burn.  
(U) Phase II - 1997: +60% Fn/Wt, +200 °F CIT, +600 °F TIT, -20% acquisition cost, -20% maintenance cost, -30% fuel burn.  
(U) 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)):  
(U) Phase I - 1993: +40% shaft horsepower/weight (SHP/Wt), -20% specific fuel consumption (SFC), +300 °F TIT.  
(U) Phase II - 1997: +80% SHP/Wt, -30% SFC, +600 °F TIT, -20% acquisition cost, -20% maintenance cost.  
(U) 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)):  
(U) Phase I - 1991: +35% thrust/airflow (Fn/Wa), -20% SFC, +1100 °F CIT, +500 °F TIT, -30% Cost.  
(U) 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) Each engine company attempts to utilize at least two engine builds or demonstrator tests within each Phase to demonstrate the performance goals. The JETEC 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 1997 ACCOMPLISHMENTS:

- (U)(\$7,412) Continued:
  - (U) Phase II JTDE: Design, fabrication and assembly of demonstrator engines.
  - (U) Phase II JTAGG: Design, component development, fabrication and initial demonstrator engine test. Demonstrated -22% SFC and +54% SHP/Wt and transient capability in the latest gas generator test.

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DATE: February 1998

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 (IHPTET)

- (U) Phase II JETEC: Fabrication and assembly of propfan engine core to demonstrate Phase III SFC goal. Fabrication and assembly of a metallic and non-metallic hot section turbojet engine to demonstrate Phase II Fn/Wa and cost goals.
- (U) Advanced concept studies for all three classes of demonstrators to determine potential post Phase III requirements and technologies that will generate significant benefits.

2. (U) FY 1998 PLAN:

- (U) (\$3,919) Continue:
  - (U) Phase II JTDE: Completion of fabrication and assembly and instrumentation of demonstrator engines.
  - (U) Phase II JTAGG: Design, component development and fabrication for demonstrator engine and initiate demonstrator engine testing to meet Phase II goals.
  - (U) Phase II JETEC: Supersonic Phase II demonstrator test of a non-metallic core turbojet meeting Fn/Wa and cost goals.

3. (U) FY 1999 PLAN:

- (U) (\$3,079) Initiate:
  - (U) Phase III JTDE: Source selection and contract award. Design of Phase III demonstrator engines.
  - (U) Phase III JTAGG: Source selection and contract award. Design of Phase III demonstrator engines.
  - (U) Phase III JETEC: Source selection and contract award. Design of Phase III demonstrator engines.
- (U) (\$4,500) Continue:
  - (U) Phase II JTDE: Demonstration of Phase II goals.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 (IHPTET)

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	7,079	7,638	7,735
(U) Appropriated Value:	-	4,038	-
(U) Adjustments from FY 1998 PRESBUDG	+333	-3,719	-156
(U) FY 1999 President's Budget Request:	7,412	3,919	7,579

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect Small Business Innovation Research reduction (-\$154); Revised Economic Assumptions (-\$9); and Update to reflect actual execution (+\$496). FY 1998 adjustments reflect Congressional Undistributed reductions (-\$110); Economic assumptions (-\$9); and Congressional Fiscal constraint reduction (-\$3,600). FY 1999 adjustments reflect S&T adjustments (-\$38); Navy Working Capital Fund adjustment (+\$10); Commercial Purchase Inflation adjustment (-\$134); and Military & Civilian Pay rates (+\$6).

(U) Schedule: Due to FY98 budget actions, the Phase III design and component development will be delayed until FY99, and may affect the demonstration of the Phase III goals on schedule, or will require the accommodation of greater levels of risk or the elimination of engine builds. In addition, FY98 Phase II JTAGG and JETEC efforts will continue at a reduced pace due to the FY98 funding reduction.

(U) Technical: Major technical problems associated with materials and hardware failures have largely been overcome. Funding availability is now driving schedules and the potential for technology transition to JSF, F-18E/F, and SH-60R.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 (IHPTET)

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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603217N  
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ESTIMATE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2455    Vectoring ESTOL Control Tailless Operation Research (VECTOR)	0	0	7,000	2,000	500	0	0	0	9,500

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Vectoring, ESTOL Control, Tailless, Operation Research (VECTOR) program will demonstrate reduced tail/reduced directional control and extremely short take-off and landing (ESTOL) utilizing the X-31 aircraft with fully integrated flight, engine and nozzle controls with the AVEN® axisymmetric engine nozzle and Advanced Air Data System (AADS) technologies. VECTOR is an international cooperative program with Germany and Sweden. VECTOR results will be applicable to tactical aircraft and unmanned aerial vehicles (UAVs). Manned US aircraft candidates for applicability are F/A-18 and Joint Strike Fighter (JSF). Foreign candidates include GRIPPEN (Sweden) and EFA (Germany). In addition, applicability to Foreign Military Sales (FMS) F/A-18 could be realized through F-400 series engine rework in foreign depots (e.g.: Integrated Product Team (IPT)).

1. (U) FY 1997 ACCOMPLISHMENTS: Not applicable.
2. (U) FY 1998 PLAN: Not applicable.
3. (U) FY 1999 PLAN:

- (U) (\$7,000) VECTOR

(U) 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 impinging paddles to produce thrust vectoring and was limited to medium and high altitude fighter maneuvering. Reduced tail/directional control and ESTOL were not addressed. VECTOR rejoins Germany as a partner, who brings vectored thrust, vectored thrust flight control, and Advanced Air Data System (flush port) expertise. It adds Sweden, who provides unique engine control, vectoring nozzle and flight control integration expertise. The program will provide quality metrics and operational concept formulation and validation of reduced tail/directional controls and ESTOL

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROJECT NUMBER: R2455

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT TITLE: Vectoring ESTOL Control  
Tailless Operation Research (VECTOR)

using axisymmetric nozzle thrust vectoring with a fully integrated flight, engine and nozzle control. Pay-offs for such technologies and concepts include a reduction in aircraft weight, observability, maintenance, complexity and development and acquisition cost. 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 catapult and arresting gear requirements), and increased safety of flight (due to significantly reduced out-of-control flight incidents).

(U) Initiate:

- (U) System 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. and the world.
- (U) Fabrication, testing, and integration of an axisymmetric exhaust vectoring nozzle.
- (U) Fabrication, installation, and integration of an Advanced Air Data System.

(U) Continue (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) Modifications to X-31 engine controls.

(U) Complete (work funded in previous years in PE 0603790N):

- (U) Design of an Advanced Air Data System (flush port).
- (U) Design of an axisymmetric exhaust vectoring nozzle and aircraft modification requirements.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY1998</u>	<u>FY1999</u>
(U) FY 1998 President's Budget:	0	0	0
(U) Appropriated Value:	-	0	-
(U) Adjustments from FY 1998 PRESBUDG	0	0	+7,000

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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) FY 1999 President's Budget Request: 0 0 7,000

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1999 adjustments reflect realignment of funds (+\$7,000).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E: This program adheres to Defense S&T Reliance Agreements for Air Platforms (Fixed Wing Vehicles).

- (U) PE 0601101F (Geophysics)
- (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 0603800N & 0603800F (Joint Advanced Strike Technology Program)

R-1 Line Item 17

Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603217N

PROJECT NUMBER: R2455

PROGRAM ELEMENT TITLE: Air Systems and  
Weapons Advanced Technology

PROJECT TITLE: Vectoring ESTOL Control  
Tailless Operation Research (VECTOR)

(U) PE 0603790N NATO Research and Development

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 17

Budget Item Justification  
(Exhibit R-2, page 38 of 38)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2145 Cruise Missile Defense	43,607	30,216	34,064	15,280	29,766	32,584	30,544	CONT.	CONT.
R2266 Mobile Offshore Basing	18,003	4,852	0	0	0	0	0	0	32,332
R0834 Naval Science Assistance Program (NSAP) note 1/ 15,534	67	4,462	4,715	4,842	4,959	5,092	CONT.	CONT.	
R2314 Fleet Advanced Demonstration	0	7,541	19,780	29,510	30,061	30,635	31,233	CONT.	CONT.
R2371 Littoral Airborne Sensor/Hyperspectral (LASH)	0	11,643	0	0	0	0	0	0	11,643
TOTAL	77,144	54,319	58,306	49,505	64,669	68,178	66,869	CONT.	CONT.

Note: 1/ Fiscal year 1997 funds were executed under Program Element (PE) 0205658N.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program focuses science and technology 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

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Budget Item Justification  
(Exhibit R-2, page 1 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Technology

Capabilities and the following Joint Mission Areas (JMAs): Strike, Littoral Warfare, Intelligence, Surveillance & Reconnaissance, Nuclear Deterrence and Sea and Air Superiority.

(U) Precision Strike integrates surveillance and targeting capabilities developed in the Global Surveillance area with high-speed processing and precision weapons for rapid response against high-value, short-dwell targets over extended ranges. The Navy Tactical Missile System provided a demonstration launch of a Navy variant of the Army Tactical Missile System from a ship in support of the Navy's Surface Fire Support mission.

(U) The Air Superiority and Defense area develops and demonstrates all-weather, day/night engagement capabilities against manned aircraft, cruise missiles (including supersonic sea-skimmers), helicopters and tactical ballistic missiles that will be employing stealth and countermeasures. The Airship Demonstration assesses the potential contribution that airships could make to the airborne component of the ship self defense/cooperative engagement capability, over-the-horizon targeting and surveillance, and other relevant mission areas. Supporting the Nuclear Deterrence and Sea and Air Superiority JMAs, the Mobile Offshore Base Project will demonstrate the feasibility of a forward positioned Strike Platform in geographical areas where surrounding non-aligned countries desire to maintain their sovereignty.

(U) Cruise Missile Defense (CMD): This is a continuation of a program initiated in FY 94. The Cruise Missile Defense Advanced Technology effort includes: 1) an Advanced Concept Technology Demonstration (ACTD), Phase I, which demonstrates that an AEGIS ship (or other surface based missile launch platform) using one or more surrogate airborne sensor partners can provide greatly expanded air defense capabilities leading to a robust capability against overland cruise missiles beyond surface based radar line-of-sight; 2) and a CMD Phase II that accelerates and aligns E-2C Airborne Early Warning (AEW) aircraft and Standard Missile (SM-2) programs toward a fielded CMD capability and balances performance, cost, schedule and risk across multiple technology programs; and initiates advanced missile technology efforts to develop and demonstrate engagement capabilities against next generation overland cruise missiles.

(U) Mobile Offshore Base (MOB): To develop a MOB concept to provide a means by which a long-term U.S. presence can be maintained. Technology issues associated with both semi-submersible and mono-hull modules connected into platforms between

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Budget Item Justification  
(Exhibit R-2, page 2 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Technology

1000 and 3000 meters in length will be explored. Technical challenges include mobility to get on station, as well as sea keeping and stability to support cargo transfer.

(U) The Naval Science Assistance Program (NSAP): This is a continuation of the project previously funded in PE 0205658N (Naval Science Assistance Program) through FY 1997. Provide on-the-spot technical assistance, insertion, and advice to Joint, Naval, and Marine Corps Commands by assigning and managing 32 Science and Technology (S&T) Advisors worldwide. Develop S&T issues and requirements documents to influence the longer term S&T programs. Develop a cadre of civilian scientists and engineers fluent in operational issues. Identify mature technologies which have the potential for improving readiness and warfighting capabilities and evaluate selected technologies, determined by the Commander in Chiefs (CINCs), in operational environments. Serve as the two way bridge between the operational and S&T communities. Beginning in FY 1998, this PE incorporated the Naval Technology Insertion Program (NTIP) (initiated in FY 1996 by Congressional plus-up) to provide for rapid insertion of mature technologies selected by Fleet CINCs into operational forces in small numbers, for test and evaluation in operational settings.

(U) Fleet Advanced Demonstration: This project demonstrates high-risk/high-payoff technologies that could significantly enhance 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. Fleet Advanced Demonstrations are selected for a match between technological potential and Naval requirements which are derived from operational issues of concern to the fleet, Joint Mission Area/Support Area assessments, and the S&T Roundtables. Each demonstration is designed to assess the extent to which the advanced technology is feasible, affordable and compatible with operational concepts and projected force structure.

(U) Littoral Airborne Sensor/Hyperspectral (LASH) is a modular airborne imaging sensor system with an integrated navigation and control system. Operating in visible and near infrared spectrums, LASH collects hyperspectral imagery using extensive spectral channels (colors) to exploit subtle color features inherent in different materials and substances. 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.

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Budget Item Justification  
(Exhibit R-2, page 3 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2145 Cruise Missile Defense	43,607	30,216	34,064	15,280	29,766	32,584	30,544	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Cruise Missile Defense (CMD) Advanced Technology effort includes: 1) an Advanced Concept Technology Demonstration (ACTD), Phase I, which demonstrated that an AEGIS ship (or other surface based missile launch platform) using one or more surrogate airborne sensor partners can provide greatly expanded air defense capabilities leading to a robust capability against overland cruise missiles beyond surface based radar line-of-sight; 2) and a CMD Phase II that accelerates and aligns E-2C Airborne Early Warning (AEW) aircraft and Standard Missile (SM-2) programs toward a fielded CMD capability and balances performance, cost, schedule and risk across multiple technology programs; and initiates advanced missile technology efforts to develop and demonstrate engagement capabilities against next generation overland cruise missiles.

(U) The Air Superiority and Defense area develops and demonstrates all-weather, day/night engagement capabilities against manned aircraft, cruise missiles (including supersonic sea-skimmers), helicopters and tactical ballistic missiles that will be employing stealth and countermeasures.

(U) The Extending the Littoral Battlespace (ELB) effort includes: An ACTD which will demonstrate and exploit emerging technologies (commercial and government) for use in theater-wide, real-time management of Extending the Littoral Battlespace. Confirm capabilities and potential applications for significant increase in effectiveness and commensurate reduction of vulnerabilities of expeditionary forces.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R2145

PROGRAM ELEMENT TITLE: Precision Strike and  
Air Defense Technology

PROJECT TITLE: Cruise Missile Defense

## (U) PROGRAM ACCOMPLISHMENTS AND PLANS

### 1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$43,607) CMD Phase II  
(U) Completed
  - (U) Makaha Radar Facility (MRF) 97 critical experiments/demonstration
- (U) Continued:
  - (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 seeker and fuze technology development and surveillance upgrades leading toward captive flight testing in FY 1999.

### 2. (U) FY 1998 PLAN:

- (U) (\$30,216) 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 seeker and fuze technology development and surveillance upgrades leading toward captive flight testing in FY 1999.

### 3. (U) FY 1999 PLAN:

- (U) (\$21,803) CMD Phase II  
(U) Initiate:
  - (U) MRF 99 critical experiments/demonstration.
  - (U) Conduct affordability focused development and demonstrations to reduce cost of technology transition to production; e.g., captive carry tests of form-factored guidance section to prove out hardware that is sized and packaged for use in production missiles.
- (U) Continue:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R2145

PROGRAM ELEMENT TITLE: Precision Strike and  
Air Defense Technology

PROJECT TITLE: Cruise Missile Defense

- (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 seeker and fuze technology development and surveillance upgrades leading toward captive flight testing in FY 1999.
- (U) Complete:
  - (U) MRF 99 critical experiments/demonstration.
- (U) (\$10,000) ELB
  - (U) Initiate:
    - (U) Command and Control (C2) demonstration hardware and software upgrades
  - (U) Continue:
    - (U) Strike weapon control integration (ring of fire)
    - (U) Common tactical picture
    - (U) Design integration and planning efforts for Demo I
    - (U) Situational/tactical data into common tactical picture
    - (U) Airspace Four Dimensional (4D) deconfliction
    - (U) Conduct Demo I
- (U) (\$2,261) HPM: Transfer of classified ATD.

## B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	44,235	31,439	14,703
(U) Appropriated Value:	-	31,439	-
(U) Adjustments from FY 1998 PRESBUDG:	-628	-1,223	+19,361
(U) FY 1999 President's Budget Request:	43,607	30,216	34,064

## (U) CHANGE SUMMARY EXPLANATION:

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Budget Item Justification  
(Exhibit R-2, Page 7 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R2145

PROGRAM ELEMENT TITLE: Precision Strike and  
Air Defense Technology

PROJECT TITLE: Cruise Missile Defense

(U) Funding: FY 1997 adjustments reflect Federally Funded Research & Development Center (FFRDC) reduction (-\$97); and Revised Economic Assumptions adjustment (-\$54); and Actual Execution updates (-\$477). FY 1998 adjustments reflect Congressional Undistributed reductions (-\$1,223). FY 1999 adjustments reflect Naval Working Capital Fund (NWCF) surcharge correction (+\$61); Science and Technology realignment (+\$15,800); Commercial Purchase Inflation adjustment (-\$600); realign the affordability program to match changing warfare and mission priorities (+4,100).

(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 0602111N (Air and Surface Launched Weapons Technology)
- (U) PE 0602121N (Ship, Submarine & Logistics Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronic and Computer Technology)
- (U) PE 0603006A (C3 Advanced Technology)
- (U) PE 0603009A (Tractor Hike)
- (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)
- (U) PE 0603726F (C3I Subsystem Integration)
- (U) PE 0603746N (Retract Maple)
- (U) PE 0603755N (Ship Self Defense)
- (U) PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
- (U) PE 0603794N (C3 Advanced Technology)
- (U) PE 0603609N (Conventional Munitions)
- (U) PE 0604366N (Standard Missile Improvements)
- (U) PE 0604770F (Joint Surveillance/Target Attack Radar Systems (JSTARS))
- (U) PE 0604866C (Patriot Risk Reduction Mitigation)

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Budget Item Justification  
(Exhibit R-2, Page 8 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R2145

PROGRAM ELEMENT TITLE: Precision Strike and  
Air Defense Technology

PROJECT TITLE: Cruise Missile Defense

- (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))

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
(Exhibit R-2, Page 9 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0834 Naval Science Assistance Program (NSAP)	15,534	67	4,462	4,715	4,842	4,959	5,092	CONT.	CONT.

Notes: 1/ Fiscal year 1997 reflects funding executed in Program Element (PE) 0205658N Project R0834 (Navy Science Assistance Program). FY 1997 includes a Congressional plus-up for Littoral Airborne Sensor/Hyperspectral (LASH) executed in PE 0205658N.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This is a continuation of the project previously funded in PE 0205658N (Naval Science Assistance Program) through FY97. The project provides on-the-spot Science and Technology (S&T) Advisors to Joint, Navy, and Marine Corps operational commands worldwide, solves real problems rapidly and inexpensively by insertion and evaluation of mature technologies in operational environments, and provides S&T issues and requirements documents 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 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.

FY 1998 reflects 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 FY97, NSAP will transition to a smaller corps of advisors while increasing emphasis on rapid, affordable solutions to real operational problems. This strategy has been developed with the concurrence of the Chief of Naval Operations and is being implemented cooperatively with the Navy Fleet Commanders and the Commandant of the Marine Corps.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603238N      PROJECT NUMBER: R0834  
PROGRAM ELEMENT TITLE: Precision Strike and      PROJECT TITLE: Naval Science Assistance Program  
Air Defense Technology

## (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

### 1. (U) FY 1997 ACCOMPLISHMENTS:

(U) NSAP (Executed in PE 0205658N/Project R0834 in FY 1997.)

- (U) (\$7,334) Supported full complement of 30 scientists and engineers serving as the S&T Advisors to 30 Joint, Navy, and Marine Corps commands, provided the primary interface between operating forces and the technical community. Determined readiness shortfalls amenable to technology solutions within the operational commands for first two quarters of the year. Managed NSAPOPS at Office of Naval Research (ONR), solving identified readiness problems with mature technologies. Provided coordination of operational insertion of these technologies and joint evaluations between the developers and operators. Developed and implemented strategy to reduce Advisor team to 14 during third quarter by close coordination with the Navy Fleet and Marine Corps Commanders. Improve process for developing Command Technology Issues (CTIs) to focus insertions of on-the-shelf and maturing technologies and provided requirements documentation to influence longer term development and acquisition programs. Managed technology insertions that solved deficiencies identified by CTIs.
- (U) (\$200) Produced documentation of overall effectiveness of the program, developed transition mechanisms for these products to advanced development and acquisition programs, and provided fleet customers and stakeholders with metrics to evaluate NSAP effectiveness. Used these metrics to continually improve the processes and quality of NSAP support to the operators and NSAP ability to leverage mature technology to solve CTIs.
- (U) (\$8,000) Littoral Airborne Sensor/Hyperspectral (LASH)(Congressional plus-up executed in PE 0205658N/Project R0834 in FY 1997.)  
Conducted systems integration and engineering of sensors and real-time processing components that together provided a littoral airborne sensor/hyperspectral Anti-Submarine Warfare (ASW) capability aboard Orion P3C aircraft. Planned operational tests and evaluations during FY97 in Pacific Fleet on well established and calibrated ranges. Provided overall management and transition direction through an Integrated Product Team (IPT) established with Commander in Chief U. S. Pacific Fleet (CINCPACFLT).

### 3. (U) FY 1998 PLAN:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603238N      PROJECT NUMBER: R0834  
PROGRAM ELEMENT TITLE: Precision Strike and      PROJECT TITLE: Naval Science Assistance Program  
Air Defense Technology

(U) NSAP (FURTHER FUNDING TO BE PROVIDED DURING EXECUTION)

(U) (\$67) 14 scientists and engineers serve as the S&T Advisors to 14 Joint, Navy, and Marine Corps commands, providing the primary interface between operating forces and the technical community. Determine readiness shortfalls amenable to technology solutions within the operational commands and provide liaison support to subordinate and component commands. Manage NSAP Headquarters Operations Center at ONR, identifying mature technologies to solve CTIs. Provide coordination of operational insertion of these technologies and joint evaluations between the developers and operators.

4. (U) FY 1999 PLAN:

- (U) (\$4,462) 14 scientists and engineers serve as S&T Advisors to 14 Joint, Navy, and Marine Corps commands, providing the primary interface between operating forces and the technical community. Determine readiness shortfalls, document them in CTIs, and find solutions from mature and on the shelf technologies where possible. Broker the remaining CTIs 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 FY96 and FY97 technology insertions now nearing completion of evaluation phases. Manage new technology insertion IPTs for products selected from the ONR Blue Book. Provide fleet customers and other stakeholders metrics for determining of effectiveness of NSAP products and improves processes and quality of products accordingly.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	12,533	4,110	4,657
(U) Appropriated Value:	-	110	-
(U) Adjustments from FY 1998 PRESBUDG:	+3,001	-4,043	-195
(U) FY 1999 President's Budget Request:	15,534	67	4,462

(U) CHANGE SUMMARY EXPLANATION: Funding: FY 1997 adjustments reflect Small Business Innovation Research (SBIR) transfer (-\$200); Actual Execution update (+\$3,216); and Revised Economic Assumptions adjustments (-\$15). FY 1998

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Budget Item Justification  
(Exhibit R-2, Page 12 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R0834

PROGRAM ELEMENT TITLE: Precision Strike and  
Air Defense Technology

PROJECT TITLE: Naval Science Assistance Program

Congressional Undistributed reductions (-\$43); and Fiscal Constraint Reduction (\$-4,000). FY 1999 adjustments reflect Navy Working Capital Fund (NWCF) reduction (\$-126); Commercial Purchase Inflation adjustment (\$-79); and Military and Civilian Pay Rates (\$+10).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E: Not applicable.

D. (U) SCHEDULE PROFILE: Not applicable.

R-1 Line Item 18

Budget Item Justification  
(Exhibit R-2, Page 13 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603238N      PROJECT NUMBER: R2314  
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense      PROJECT TITLE: Fleet Advanced  
Technology      Demonstration

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2314 Fleet Advanced Demonstration	0	7,541	19,780	29,510	30,061	30,635	31,233	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This new start project demonstrates high-payoff technologies that could significantly enhance 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. Fleet Advanced Demonstrations (FADs) are selected for a match between technological potential and Naval requirements which are derived from operational issues of concern to the fleet, Joint Mission Area/Support and Infrastructure Area assessments, and the Science and Technology (S&T) Roundtables. Each demonstration is designed to assess the extent to which the advanced technology is feasible, affordable and compatible with operational concepts and projected force structure.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS: Not applicable.

2. (U) FY 1998 PLAN:

- (U) (\$4,056) DIRECT ATTACK MUNITION AFFORDABLE SEEKER (DAMASK): Initiate FAD to demonstrate an image guided bomb concept which includes an image seeker that will provide autonomous three meter precision, through adverse weather, at standoff ranges, and at low cost.
  - (U) Develop imaging template and adapt pattern matching software.
- (U) (\$3,485) ADVANCED SURFACE SITUATIONAL AWARENESS: Initiate classified program.

4. (U) FY 1999 PLANS:

- (U) (\$6,314) DAMASK:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603238N      PROJECT NUMBER: R2314  
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense      PROJECT TITLE: Fleet Advanced  
Technology      Demonstration

- (U) Initiate:
  - (U) Fabricate and bench test seeker;
  - (U) Design and build signal processor;
  - (U) Continue:
    - (U) Demonstrate image template generation and matching technology.
- (U) (4,515) Advanced Surface Situational Awareness: Continue clasified program.
- (U) (\$8,951) Initiate FY 1999-start FADs.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	0	7,771	28,734
(U) Appropriated Value	-	7,771	-
(U) Adjustments from FY 1998 PRESBUDG:	0	-230	-8,954
(U) FY 1999 President's Budget Request:	0	7,541	19,780

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 adjustments reflect Congressional Undistributed reductions (-\$213), and Economic Assumptions (-\$17). FY 1999 adjustments reflect Navy Working Capital Fund (NWCF) increase (+\$92); Science and Technology realignment (-\$8,712); Commercial Inflation adjustment (-\$348); and Military/Civilian pay rates (+\$14).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N

PROJECT NUMBER: R2314

PROGRAM ELEMENT TITLE: Precision Strike and Air Defense  
Technology

PROJECT TITLE: Fleet Advanced  
Demonstration

- (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 & Computer Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602435N (Oceanographic & Atmospheric Technology)
- (U) PE 0602633N (Undersea Warfare Weapon Technology)

D. (U) Schedule Profile: Not applicable.

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Budget Item Justification  
(Exhibit R-2, Page 16 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
E2194 Electronic Warfare Advanced Technology	6,468	9,454	9,251	10,354	9,529	9,673	9,875	CONT.	CONT.
R2090 Functional Recognition & Response	7,604	7,181	7,918	8,555	8,763	8,958	9,179	CONT.	CONT.
TOTAL	14,072	16,635	17,169	18,909	18,292	18,631	19,054	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). Program Element (P.E.) 0603270N 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 which 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 which 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 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 Air (TACAIR), low observable aircraft, surface EW platforms, and Pre-planned Product Improvement programs to address the modern threat (including multi-spectral/multi-modal sensors and seekers). This is done 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(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 item 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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
E2194 Electronic Warfare Advanced Technology	6,468	9,454	9,251	10,354	9,529	9,673	9,875	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).

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$1,150) Developed passive missile identification and time-to-intercept techniques. Verify performance during Air-to-Air live fire testing.
- (U) (\$1,340) Evaluated passive missile identification and tailored-response effectiveness evaluation.
- (U) (\$1,816) Demonstrated advanced missile countermeasures techniques.
- (U) (\$1,307) Demonstrated feasibility of TACAIR directed energy countermeasures.
- (U) (\$855) Designed, fabricated and flight tested an integrated missile/laser warning sensor system.

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Budget Item Justification  
(Exhibit R-2, page 3 of 8)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N  
PROGRAM ELEMENT TITLE: Advanced Electronic  
Warfare Technology

PROJECT NUMBER: E2194  
PROJECT TITLE: Electronic Warfare  
Advance Technology

2. (U) FY 1998 PLAN:

- (U) (\$3,853) Develop and integrate laser directed energy countermeasures and two color/multispectral infrared (IR) missile warning system onto a Navy drone aircraft. Perform manned flight tests and validation of concept.
- (U) (\$1,904) Conduct flight tests and evaluations of the integrated EW avionics suite with tailored threat response and enhanced crew situational awareness.
- (U) (\$2,942) Develop countermeasures to imaging and dual-mode missile seekers.
- (U) (\$755) Perform concept demonstration of countermeasures to laser-guided weapons.

3. (U) FY 1999 PLAN:

- (U) (\$4,499) Conduct missile live-fire evaluations of the TACAIR directed infrared countermeasures (IRCM) system, with advanced multispectral infrared (IR) missile warning.
- (U) (\$3,770) Demonstrate countermeasures to advanced two-color and imaging seekers.
- (U) (\$982) Develop laser countermeasure capability for the Tactical Air Directed IRCM (DIRCM) system and perform evaluations.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$ 7,070	\$10,347	\$10,364
(U) Appropriated Value:		9,744	
(U) Adjustments from FY 1998 PRESUDG:	-602	-893	-1,113
(U) FY 1999 President's Budget Request	\$ 6,468	\$9,454	\$ 9,251

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflects a reduction for Small Business Innovative Research Transfer(-88), Revised Economic Assumptions (-9), and actual execution updates (-505). FY98 adjustments reflect Congressional Undistributed Reductions (-268) Economic Assumptions (-22), and FY98 Fiscal Constraint Reduction (-603). FY 1999 adjustments reflect Naval Working Capital Fund (NWCFF) adjustment (+36), Commercial Purchase Inflation Adjustment (-181), S&T adjustments (+32), and S&T adjustment to fund Vector (-1,000).

(U) Schedule: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N  
PROGRAM ELEMENT TITLE: Advanced Electronic  
Warfare Technology

PROJECT NUMBER: E2194  
PROJECT TITLE: Electronic Warfare  
Advance Technology

(U) Technical: Not applicable.

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.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2090 Functional Recognition & Response	7,604	7,181	7,918	8,555	8,763	8,958	9,179	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 1997 ACCOMPLISHMENTS:

- (U) (\$1,182) Demonstrated Functional ID system for generic hardware incorporated into existing receiver systems.
- (U) (\$719) Prepared flight test plans for using the optimized chaff (AN/ALE-39), Expert system and Advanced Airborne Expendable Decoy integrated suite against surrogate Microwave threats at Naval Air Warfare Center, China Lake.
- (U) (\$1,233) Tested coordinated onboard jamming and towed decoy using fiber optic link.
- (U) (\$1,027) Demonstrated Shipboard sensor fusion hardware based on artificial intelligence techniques for generic countermeasures.
- (U) (\$1,027) Verified fidelity and resolution of generic threat simulator ALQ-170 test bed for testing functional ID and Uninitiated Modulation On Pulse (UMOP).
- (U) (\$1,233) Integrated and tested two low probability of intercept seekers for identification and response technique effectiveness.
- (U) (\$1,183) Evaluated airborne and shipboard test hardware/software to establish effectiveness of newly developed UMOP and SEI concepts and hardware.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROJECT NUMBER: R2090

PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology

PROJECT TITLE: Functional Recognition/Response

2. (U) FY 1998 PLAN:

- (U) (\$1,841) Demonstrate optimal Functional ID system architecture.
- (U) (\$1,778) Demonstrate combined Functional ID and SEI systems.
- (U) (\$1,796) Flight test optimized chaff, expert system and integrated towed decoy.
- (U) (\$1,766) Develop Functional ID, SEI and generic countermeasures to support development of Advanced Integrated Electronic Warfare System (AIEWS).

3. (U) FY 1999 PLAN:

- (U) (\$2,479) Demonstrate and transition optimal Functional ID architecture into the Navy's Advanced Integrated Electronic Warfare System (AIEWS).
- (U) (\$2,537) Demonstrate and transition optimal Functional ID architecture into the Navy's EA-6B and follow-on aircraft.
- (U) (\$2,902) Demonstrate Functional ID, SEI and generic countermeasures to support development of AIEWS.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$ 7,399	\$ 7,797	\$ 8,374
(U) Appropriated Value		7,400	
(U) Adjustments from FY 1998 PRESBUDG:	205	-616	-456
(U) FY 1999 President's Budget Submission	\$ 7,604	\$ 7,181	\$ 7,918

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 adjustments reflect Revised Economic Assumptions (-9), and actual execution update (+214). The FY 1998 adjustments reflect Congressional Undistributed Reductions (-203) Economic Assumptions (-16) and FY 1998 Fiscal Constraint Reduction (-397). The FY 1999 adjustments reflect Navy Work Capital Fund (NWCF) adjustments (-344), Commercial Purchases Inflation adjustment (-142), and Military and Civilian Pay Rate adjustment (+30).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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Budget Item Justification  
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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603270N

PROJECT NUMBER: R2090

PROGRAM ELEMENT TITLE: Advanced Electronic  
Warfare Technology

PROJECT TITLE: Functional Recognition/  
Response

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.

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Budget Item Justification  
(Exhibit R-2, page 8 of 8) |

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# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	23,956	25,857	34,351	36,291	35,490	36,055	36,735	CONT.	CONT.
R2328 Project M	4,667	9,704	4,913	5,874	0	0	0	0	25,158
R2373 Composite Helicopter Hanger	0	9,703	0	0	0	0	0	0	9,703
S1848 Gas Turbine Engine Technology	2,441	2,997	0	0	0	0	0	0	103,357
<b>TOTAL</b>	<b>31,064</b>	<b>48,261</b>	<b>39,264</b>	<b>42,165</b>	<b>35,490</b>	<b>36,055</b>	<b>36,735</b>	<b>CONT.</b>	<b>CONT.</b>

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) There are three projects: Ship and Submarine HM&E Advanced Technology (R2224), Project M (R2328), and Gas Turbine Engine Technology (S1848). Products from this PE will improve the effectiveness and operational efficiency of all Navy ship and submarine platforms in all Joint Mission Areas. Affordability is addressed through large-scale demonstrations and validation of concepts that reduce costs associated with design, fabrication, outfitting, maintenance, and operation. All naval platforms inherently require mobility, efficiency, reliability, and availability as primary requirements for Naval Warfare. This program directly supports the Readiness and Support and Infrastructure Joint Mission Areas in the area of sustainability and supports Strike, Littoral Warfare, Joint Surveillance, Joint Surface Electronic Warfare, Strategic Deterrence, and Maritime Support for Land Forces, and Strategic Sealift relative to reduced signatures and increased survivability.

(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

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Budget Item Justification  
(Exhibit R-2, Page 1 of 12)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

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.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	23,956	25,857	34,351	36,291	35,490	36,055	36,735	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).

(U) AVR technology reduces submarine acoustic signature. This technology addresses general submarine signature issues and will be 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). 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.

(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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

(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 Propulsion Motor (QEPM) 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 1997 ACCOMPLISHMENTS:

- (U) (\$16,751) AVR:
  - (U) CONTINUED:
    - (U) Evaluation of at-sea test data.
  - (U) COMPLETED:
    - (U) TEMPALT installation of AVR system on SSB 688 class submarine.
    - (U) AVR system evaluation.
    - (U) At-sea acoustic trials of AVR system.
    - (U) Removal of AVR system components from test platform.
- (U) (\$4,917) ARM:
  - (U) TRANSITIONED:
    - (U) Sensor and extinguishing technology from PE 0602121N for development of intelligent HM&E ship damage control systems to minimize manning and increase operational reliability. (DCARM)

R-1 Line Item 20

Budget Item Justification  
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# UNCLASSIFIED



# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

(U) CONTINUED:

- (U) Development of automated ship damage control system to minimize manning and damage. (DCARM)

• (U)(\$2,049) AES:

(U) TRANSITION:

- (U) Technology from PE 0602121N to demonstrate form, fit, and function for shipboard system level applications of PEBB modules. (SSSA)

(U) CONTINUED:

- (U) Initial design of Electrically Reconfigurable Ship. (SSSA)

(U) COMPLETED:

- (U) Definition of key field and shipboard demonstrations for the Electrically Reconfigurable Ship to define requirements, reduce risk and enhance technology transition. (SSSA)

• (U)(\$239) SSHS

(U) TRANSITION:

- (U) Technology from PE 0602121N and PE 0603792N to integrate Frequency Selective Structure (FSS), detachable low signature joints, and a lightning protection system for the LPD-17 advanced mast. (ATS)
- (U) Concept from PE 0602121N for the Retrofit Bow Bulb for the DDG51 Class. (ISPS)
- (U) Ship system impact study of the Retrofit Bow Bulb for the DDG51 Class. (ISPS)

2. (U) FY 1998 PLAN:

• (U)(\$1,662) AVR:

(U) COMPLETE:

- (U) Evaluation of at-sea test data.
- (U) Final reports documenting AVR program and transition advanced technology to Naval Sea Systems Command (NAVSEA).

• (U)(\$7,256) ARM:

(U) CONTINUE:

- (U) Development of intelligent HM&E ship control systems to minimize manning and increase operational reliability. (DCARM)

(U) COMPLETE:

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 5 of 12)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

- (U) Fire and fluid control of damage detection requirements for automated ship damage control system. (DCARM)
- (U) Selection of automated reasoning and control topology for automated ship damage control system. (DCARM)
- (U) Demonstration to establish baseline for automated ship damage control system. (DCARM)
  
- (U)(\$10,473) AES:
  - (U) TRANSITION:
    - (U) Tools developed in the Submarine Technology Applied Research program to predict two-dimensional electric motor forces. (QEPM)
    - (U) Diesel fuel processing technology for fuel cells from PE 0602121N. (SSFC)
  - (U) CONTINUE:
    - (U) Construction of small-scale motor variants to evaluate measurement techniques and passive design parameters in quiet electric motors. (QEPM)
    - (U) Generate baseline force and acoustic measurements and predictions of small-scale electric motor variants. (QEPM)
    - (U) Develop motor controller models and active control concepts. (QEPM)
    - (U) Develop concepts for a 2500 kilowatt Ship Service Fuel Cell power systems. (SSFC).
    - (U) Electrically Reconfigurable Ship concept. (SSSA)
    - (U) Demonstration of key equipment capabilities for the Electrically Reconfigurable Ship. (SSSA)
  - (U) COMPLETE:
    - (U) Initial Ship Impact and Technology Assessment (SITA) Study. (QEPM)
  
- (U)(\$6,466) SSHS:
  - (U) TRANSITION:
    - (U) Transition technology from PE 0602121N for development of Machinery Support Systems (AMSS) for improved shock and acoustic performance. (AMSS)
  - (U) CONTINUE:
    - (U) Evaluation of the impact of flanking paths, flexible truss and shock strengthening concepts on acoustic performance of truss. (AMSS)
    - (U) In air shock testing of machinery truss system. (AMSS)
    - (U) Evaluation of coating optimization through simulation. (AMSS)
    - (U) Fabrication of advanced enclosed mast test article for the LPD-17. (ATS)

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 6 of 12)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

3. (U) FY 1999 PLAN:

- (U) (\$10,302) ARM:
  - (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 automated damage assessment and response processor for the automated ship damage control system. (DCARM)
    - (U) Validation of initial fire suppression and fluid control concept for automated ship damage control system. (DCARM)
- (U) (\$14,868) AES:
  - (U) CONTINUE:
    - (U) Fabrication of a 500KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)
    - (U) Demonstrate integral active control in quiet electric concept experiments. (QEPM)
    - (U) Propulsion system concept studies. (QEPM)
    - (U) Development of motor acoustic prediction capability. (QEPM)
    - (U) Development of critical component technology for intermediate-scale QEPM demonstration. (QEPM)
  - (U) COMPLETE:
    - (U) Demonstration of prototype self-synthesizing, dynamically reconfigurable 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 Reconfigurable Ship. (SSSA)
- (U) (\$9,181) SSHS:
  - (U) CONTINUE:

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 7 of 12)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

- (U) In-water quarter-scale demonstration of Machinery Support Structure system concept for shock performance. (AMSS)
- (U) Evaluate impact of flexible truss and shock strengthening concepts on acoustic performance of truss. (AMSS)
- (U) COMPLETE:
  - (U) Assessment of flanking path impact on system performance for evaluation at ISMS. (AMSS)
  - (U) In air shock testing of machinery truss sytem. (AMSS)
  - (U) Fabrication and demonstration of advanced mast test article for the LDP-17. (ATS)

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	24,597	36,648	42,995
(U) Appropriated Value:	-	34,737	-
(U) Adjustments from FY 1998 PRESBUD:	-641	-10,791	-8,644
(U) FY 1999 President's Budget Request:	23,956	25,857	34,351

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 decrease reflects Small Business Inovation Research (SBIR) transfer (-\$1,959) revised economic adjustments (-30) and actual execution updates (+1,348). FY 1998 adjustments reflect realignment for Project M (-5,000); Congressional Undistributed reductions (-732); economic assumptions (-59); and Fiscal Constraints Reduction (-5,000). FY 1999 reflects an adjustment made to realign the affordability program to match changing warfare and mission priorities (-5,600); Navy Working Capital Fund (NWCF) adjustments and minor adjustments (+51); realignment for Project M (-491); commercial purchases inflation adjustment (-642); S&T adjustment to fund Vector (-2,000); and Military and Civilian Pay Rates (+38).

- (U) Schedule: Not applicable.
- (U) Technical: Not applicable.

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 8 of 12)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine  
HM&E Advanced Technology

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 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

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 9 of 12)

# UNCLASSIFIED

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2328 Project M	4,667	9,704	4,913	5,874	0	0	0	0	25,158

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 1997 ACCOMPLISHMENTS (4,667)(Congressional Plus-up):
  - (U) Complete system design of the Project M demonstration system.
  - (U) Fabricate the large scale support structure to be used in the test program.
  - (U) Fabricate and validate prototypes of key system components.
2. (U) FY 1998 PLAN (9,704) (Congressional Plus-up (4,715)):
  - (U) Install large scale support structure and associated test fixture in plant.
  - (U) Develop electronics, sensors, magnets, and software for the demonstration system.
  - (U) Prepare test plans for all subsystem and system level tests, including the final in water demonstration.
  - (U) Conduct preliminary Ship Impact and Technology Assessment (SITA) studies for naval applications of Project M technology.
  - (U) Install components on the structure/test fixture and integrate the demonstration system.
  - (U) Conduct in-plant system testing of the demonstration system.
  - (U) Conduct in-air performance tests in plant.
3. (U) FY 1999 PLAN (4,913):
  - (U) Conduct structural acoustic characterization tests of the test vehicle (PIKE) at the Intermediate Scale Measurement System (ISMS).
  - (U) Install components on the structure/test fixture and integrate the demonstration system.

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Budget Item Justification  
(Exhibit R-2, Page 10 of 12)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2328

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Project M

- (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 NSWC Carderock and install in Pike Model.
- (U) Conduct in-air demonstration testing of Project M in Pike model at NSWC Carderock.
- (U) Ship Pike model and Project M demonstration system to NSWC bayview for in-water tests.

(U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	4,799	0	0
(U) Appropriated Value:	-	5,000	-
(U) Adjustments from FY 1998 PRESBUD:	-132	+9,704	+4,913
(U) FY 1999 President's Budget Request:	4,667	9,704	4,913

B. (U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustment reflects Small Business Innovation Research (SBIR) transfer (-\$127) and revised economic adjustments (-5). FY 1998 adjustments reflect transfers to fund Project M from submarine specific program elements (+\$5,000); Congressional plus-up to fund Project M (+5,000); economic assumptions (-22); and Congressional Undistributed reductions (-274); FY 1999 changes reflect transfers to fund Project M from submarine specific program elements (+5,000) and commercial purchases inflation adjustments (-87).

(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 0602121N (Ship, Submarine & Logistics Technology)

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2328

PROGRAM ELEMENT TITLE: Surface Ship & Submarine  
HM&E Advanced Technology

PROJECT TITLE: Project M

- (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

R-1 Line Item 20

Budget Item Justification  
(Exhibit R-2, Page 12 of 12)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 1998		
BUDGET ACTIVITY <b>3 - Advanced Development</b>				PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>					
COST (In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	57146	58780	41931	44476	46132	45441	46397	Continuing	Continuing
C2223 Marine Corps Advanced Technology	24144	22392	8520	10701	11947	15692	15791	Continuing	Continuing
C2297 Marine Corps Warfighting Laboratory (MCWL)	28002	26685	23584	23985	24418	28777	29637	Continuing	Continuing
C2362 Extended Littoral Battlespace (ELB), Advanced Concept Technology Demonstration (ACTD)	5000	9703	9827	9790	9767	972	969	Continuing	Continuing
Quantity of RDT&E Articles	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 Science and Technology Project Reliance agreements and the Joint Chiefs of Staff Joint Warfare Capabilities. 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) 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.

**(U) Justification for Budget Activity:** 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.

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>			
<b>BUDGET ACTIVITY</b> <b>3 - Advanced Development</b>				<b>PE NUMBER AND TITLE</b> <b>0603640M Marine Corps Advanced Technology Demonstrations</b>				<b>PROJECT</b> <b>C2223</b>		
<i>COST (In Thousands)</i>	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
C2223 Marine Corps Advanced Technology	24144	22392	8520	10701	11947	15692	15791	Continuing	Continuing	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	
<p><b>(U) <u>JUSTIFICATION FOR BUDGET ACTIVITY:</u></b> (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 of transition to an ongoing acquisition program.</p> <p><b>(U) PROGRAM ACCOMPLISHMENTS AND PLANS:</b></p> <p><b>(U) FY 1997 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• (U) \$ 8603 Maneuver Imperative: Completed initial concept development of the Reconnaissance, Surveillance and Targeting Vehicle (RST/V) program and prepared for transition to the Joint DARPA/USMC ATD. Began Future Light Combat Vehicle Technical Concept development. Completed development of the Joint Amphibious Mine Countermeasure System and transitioned to the Joint Countermine Advanced Concept Technology Demonstration (JCM ACTD). Completed an Early Operational Assessment of Coastal Battlefield Reconnaissance (COBRA) Mine Detection system and began hardware/software optimization. Transitioned basic COBRA technology to the JCM ACTD. \$500K set aside for closed accounts.</li> </ul>										
Project C2223			Page 21 - 2 of 21 - 17 Pages				Exhibit R-2			

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2223</b>
<ul style="list-style-type: none"> <li>• (U) \$ 5952 Firepower Imperative: Developed and demonstrated technologies to enhance Reconnaissance, Surveillance, and Target Acquisition. Transitioned Forward Observer/Forward Air Controller (FO/FAC) to Program Manager ground weapons. Demonstrated Close Air Support (CAS) bomb-on coordinate with the integration of FO/FAC with Automated Target Handoff System (ATHS2). Demonstrated FO/FAC to Advanced Field Artillery Data System (AFATDS) integration. Participated in joint efforts with the Army (Force XXI Land Warrior). Demonstrated reduced weight load bearing system for the individual Marine through the Army Force XXI Land Warrior contracts. Participated in the joint development of the Objective Individual Combat Weapon (OICW). Target Location Designation and Handoff System (TLDHS):  <ul style="list-style-type: none"> <li>(1) Completed Early Operational Assessment Test (OT-0) of the Forward Observer/Forward Air Controller Advanced Technology Demonstrator. The system successfully demonstrated “proof-of-concept” of enhanced target location and automatic hand-off of target data for close-air-support, field artillery and Naval surface fire support operational missions.</li> <li>(2) Demonstrated the FO/FAC system and its enhanced capabilities at the Hunter Warrior Advanced Warfighting Exercises.</li> <li>(3) Participated in Design Trade Study in cooperation with the Army’s Program Manager Night Vision/Reconnaissance, Surveillance and Target Acquisition to determine cost and performance drivers in the development of a lightweight laser target acquisition and designation system.</li> <li>(4) Completed laser designator market survey and technology assessment.</li> <li>(5) Developed draft TLDHS Performance Specification.</li> </ul>                     Shoulder-launched Multipurpose Assault Weapon (SMAW): Demonstrated advancements in the shoulder-launched weapon system technology that may extend SMAW’s service life and its operational utility by reducing its firing signature and increasing its warhead lethality. Air Defense Alerting Device (ADAD): Conducted developmental and limited tests to assess ADAD’s capability to meet USMC passive sensor requirements.                 </li> <li>• (U) \$ 3826 Command and Control Imperative: The Integrated Combat Operations Center (ICOC) played a key role in the Commandant’s Warfighting Laboratory Advanced Warfighting Experiment and was demonstrated in the Joint Warfighter Integrated Demonstration 97 (JWID-97). Reconnaissance, Surveillance, Target Acquisition, and Communications were demonstrated in commander display format that clearly improved the tactical picture and enabled intuitive decision making by the commander in a chaotic environment. Rapid, accurate dissemination of friendly and enemy essential elements of information was demonstrated. The potential for joint interoperability was demonstrated. Capability gaps were identified to support follow-on S&amp;T efforts. Downsized Master Station (DSMS) enhancements: Conducted DSMS enhanced capability demonstrations.</li> </ul>		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2223</b>
• (U) \$ 2000	Logistics Imperative: Developed and demonstrated technologies for Combat Service Support Operation Center (CSSOC) and mobile CSSOC automation in support of 1 <sup>st</sup> and 2 <sup>nd</sup> Force Service Support Groups (FSSGs). Supported Marine Corps joint service participation in the Logistics Anchor Desk (LAD) Program under the Joint Logistics Advanced Concept Technology Demonstration (JL-ACTD). Developed and demonstrated advanced radio label tags for total asset visibility applications. Developed and demonstrated a Marine Corps initial prototype builds of interoperable logistics planning and execution software segments applicable to the MAGTF C4I baseline, in cooperation with US Army PM CSSCS. Demonstrated advanced technologies for aerial re-supply in conjunction with Advanced Warfighting Experiment (AWE) Hunter Warrior. Developed system design concepts for an Amphibious Expeditionary Logistics Transporter (AELT). Initiated planning for technology development and demonstrations in support of Logistics Vehicle System Rebuild (LVSr).	
• (U) \$ 3763	Training and Education Imperative: Completed development of the Team Tactical Engagement Simulator (TTES) prototype and conducted DT and EOA; participated in US Army Warrior Network experiments. Completed development of the Range Instrumentation System (RIS) (subtask of Joint Modeling & Simulation) demonstration, conducted DT and EOA, and transitioned to the RIS program (PE 26313M project C2315). Completed the Forward Observer (FO) trainer demo and transitioned to the Closed Loop Artillery Simulator (CLAS) ATD.	
(U)Total \$ 24,144		
<b>(U) FY 1998 Planned Program:</b>		
• (U) \$ 7728	Maneuver Imperative: Continues to develop and demonstrate technologies and concepts to enhance the Ground Combat Element's (GCE) abilities to locate, close with, and destroy the enemy. The principle objectives are 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 are: technologies for future combat vehicles, incorporated hybrid electric propulsion suites, and Mine Countermeasures (MCM), which encompassed mobility, low observables and survivability, develops technologies to detect mines, minefields, and countermeasure mines rapidly, at safe standoff and fully integrate with the GCE. Efforts include: Begin the Joint DARPA/USMC RST/V 6.3 ATD. Design RST/V demonstration candidates, and downselect. Continue Future Light Combat Vehicle Technical Concept development. Continue COBRA hardware/software optimization; conduct OT and EOA; transition COBRA upgrades to JCM ACTD. Prepare for transition to COBRA DEMVAL/EMD (PE 26313M C2272 in FY 2000). Manufacture, test and evaluate a Common Automatic Recovery System (CARS).	
• (U) \$ 6436	Firepower Imperative: Continue to develop and demonstrate 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. Test and evaluate prototype OICW (Objective Individual Combat Weapons) Systems. Develop the capability to fire the Shoulder Launched Multipurpose Assault Weapon (SMAW) from an enclosed space.	

**UNCLASSIFIED**

<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2223</b>
• (U) \$	1131	Command and Control Imperative: Continue to develop and demonstrate technologies and concepts for the elements of the MAGTF, with a focus on the Command Element (CE). These demonstrations support the rapid, accurate capture, process and dissemination of friendly and enemy essential elements of information, improved situational knowledge through reconnaissance, surveillance, target acquisition, and streamlined communications.
• (U) \$	4495	Logistics Imperative: Continue system concept development and rapid prototype of technologies in support of CSSOC and mobile CSSOC field demonstrations with the 1 <sup>st</sup> and 2 <sup>nd</sup> FSSGs. Focus of CSSOC related efforts is on rapid prototype developments, demonstration, and transition documentation of a standardized Marine Corps Rapid Request Tracking System (RRTS) and Web-based Common Database Repository (COMDAR) to provide enhanced logistics management capability to the FMF. Continue prototype enhancement and cooperative international development and testing with Germany of the Mobilizer, an improved tactical Rough Terrain Container Handler (RTCH) concept demonstration prototype. The Mobilizer was a planned augmentation to the existing RTCH and provide a new capability for container movement from ship to shore destination using all current and future landing craft/lighterage concept. Continue Logistics Vehicle Systems Rebuild (LVSR) technology selection and development for demonstration. Technologies include: advanced onboard vehicle diagnostics, improved materials, and enhanced engineering design recommendations for in-service life optimization. Aerial resupply technologies will be selected for demonstration and transition to advanced development. The Advanced Amphibious Logistics/Combat Service Support (AAL/CSS) Advanced Technology Demonstration (ATD) program will continued\ to demonstrate and transition advanced technologies for all functional areas of operational and tactical logistics. (e.g., Supply, Engineering, Maintenance, Transportation, Health Services, and Services). Develop and fabricate a Meteorological Hydrogen Generator and demonstrate at Urban Warrior. Develop a 2-3 Kilowatt Fuel Cell, electro chemical compressors and reformat gas scrubbers.
•	2602	Training and Education Imperative: Develops and demonstrates technologies that enhanced the mental abilities of Marines to deal with battlefield uncertainty and chaos, to assimilate information rapidly to be decisive and completely to make the decisions good enough to win.
(U)Total \$	22,392	
<b>(U) FY 1999 Planned Program:</b>		
• (U) \$	3296	Maneuver Imperative: Continues to develop and demonstrate technologies that enhance operational mobility. Survivability of platforms and minimizing the footprint ashore of Marine units. Efforts include: Continue the Joint DARPA/USMC Reconnaissance, Surveillance and Targeting - Vehicle (RST/V) 6.3 ATD. Fabricate and test RST/V platform and begin integration of survivability and sensor systems. Continue Future Light Combat Vehicle Technical Concept development; fabricate and demonstrate selected technologies. Complete COBRA system integration and transition to DEMVAL/EMD (PE 26313M).
• (U) \$	1211	Firepower Imperative: Investigate technologies to increase accuracy, range, lethality, integration and timeliness of direct, indirect and close fires. Transition OICW to Engineering and Manufacturing Development (EMD).
• (U) \$	938	Command and Control Imperative: Continues to develop and demonstrate technologies to make decisions, communicate information, and expand knowledge in a high tempo, uncertain, and chaotic battlefield.

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>							
<b>BUDGET ACTIVITY</b> <b>3 - Advanced Development</b>	<b>PE NUMBER AND TITLE</b> <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	<b>PROJECT</b> <b>C2223</b>							
<ul style="list-style-type: none"> <li>• (U) \$ 1650 Logistics Imperative: Continue to develop and demonstrate technologies to enhance MAGTF capabilities in operational and tactical logistics (CSS) in the functional areas of: Supply, Engineering, Maintenance, Transportation and Services. Goal is to enable sea-based logistics, a tailored presence ashore and reducing consumables. Program focus includes: transition of CSSOC and mobile CSSOC system concepts; continuation of LVSR technology insertion efforts; final demonstration and transition of Mobilizer ITCH concept. New efforts are anticipated to include: technology demonstration of new concepts for expeditionary bulk liquids distribution systems; and demonstration of improved Material Handling Equipment (MHE) and packaging concepts in direct support of USMC modernization efforts and emerging maritime seabased logistics operational capability requirements.</li> <li>• (U) \$ 1425 Training and Education Imperative: Continues 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 Range Instrumentation System (MOUT RIS); conduct DT and EOA; transition technology to MOUT ACTD and Marine Corps Urban Warrior AWE.</li> </ul> <p>(U)Total \$ 8,520</p>									
<b>B. (U) <u>Project Change Summary</u></b>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>						
(U) Previous President's Budget	61127	34178	39617						
(U) Adjustments to Previous President's Budget	-36983	-11786	-31097						
(U) Current Budget Submit	24144	22392	8520						
(U) Change Summary Explanation:									
(U) Funding: FY 1997 reduction is a result of internally realigning \$33M to the Marine Corps Warfighting Lab (MCWL), Project C2297, and the Extended Littoral Battlespace (ELB), Project C2362. \$3M was reprogrammed for various execution adjustments, \$1.4M was transferred for SBIR and FFRDC funding and \$.1M for revised economic adjustments. The FY 1998 and FY 1999 adjustments reflect similarly realignment to MCWL and ELB funding from this project. FY 1998 adjustment also reflect funding for CARS (\$2.0M), 2KW Fuel Cell (\$3.0M), and SMAW (\$5.0M) and a 1.5% General Reduction, R&D General Reduction and economic assumptions. The FY 1999 adjustment also reflect a decrease for Commercial Purchases Inflation.									
(U) Schedule: Not applicable.									
(U) Technical: Reduced technical scope across all Warfighting Imperatives, i.e., unable to let various contracts pursuant to BAA solicitations.									
<b>C. (U) <u>Other Program Funding Summary</u></b> (APPN, BLI #, NOMEN)	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	To <u>Compl</u>	Total <u>Cost</u>
(U) Not applicable.									
Project C2223		Page 21 - 6 of 21 - 17 Pages					Exhibit R-2		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2223</b>
<p><b>(U) Related RDT&amp;E</b></p> <ul style="list-style-type: none"> <li>(U) PE 0602618A (Ballistics Technology)</li> <li>(U) PE 0603004A (Weapons and Munitions Advanced Technology)</li> <li>(U) PE 0603005A (Combat Vehicle and Automotive Advanced Technology)</li> <li>(U) PE 0603606A (Landmine Warfare and Barrier Advanced Technology)</li> <li>(U) PE 0603607A (Joint Service Small Arms Programs)</li> <li>(U) PE 0603619A (Landmine Warfare and Barrier Advanced Demonstrations)</li> <li>(U) PE 0603772A (Battlefield Force Integrations)</li> <li>(U) PE 0604207A (STINGRAY)</li> <li>(U) PE 0604710A (Night Vision Systems - Engineering Development)</li> <li>(U) PE 0604806A (Chemical/Biological Defense Equipment - Engineering Development)</li> <li>(U) PE 0604808A (Landmine Warfare and Barrier Engineering Development)</li> <li>(U) PE 0602301E (Computing Systems and Communications Technology)</li> <li>(U) PE 0602702E (Tactical Technology) Technology Demonstrations (ATDs)</li> <li>(U) PE 0603226E (Experimental Evaluation of Major Innovative Technologies)</li> <li>(U) PE 0206623M (Marine Corps Ground/Supporting Arms Systems)</li> <li>(U) PE 0602131M (Marine Corps Landing Force Technology)</li> <li>(U) PE 0603612M (Marine Corps Mine/Countermeasures Systems)</li> <li>(U) PE 0603635M (Marine Corps Ground Combat/Support System)</li> <li>(U) PE 0204163N (Fleet Communications)</li> <li>(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)</li> <li>(U) PE 0603555N (Undersea Superiority Technology Demonstrations)</li> <li>(U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)</li> <li>(U) PE 0603794N (Command, Control, Communications, Advanced Technology)</li> <li>(U) PE 0206313M (Marine Air Ground Task Force Command/Control/Communications/Computers &amp; Intelligence MAGTF C4I)</li> <li>(U) PE This program is in compliance with Tri-Service Reliance Agreements</li> </ul> <p><b>D. (U) <u>Schedule Profile:</u></b> Not applicable.</p>		
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>			
<b>BUDGET ACTIVITY</b> <b>3 - Advanced Development</b>				<b>PE NUMBER AND TITLE</b> <b>0603640M Marine Corps Advanced Technology Demonstrations</b>				<b>PROJECT</b> <b>C2297</b>		
<i>COST (In Thousands)</i>	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
C2297 Marine Corps Warfighting Laboratory (MCWL)	28002	26685	23584	23985	24418	28777	29637	Continuing	Continuing	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	
<p><b>A. (U) <u>Mission Description and Budget Item Justification:</u></b></p> <p>(U) The Marine Corps Warfighting Laboratory (MCWL) [formerly titled Commandant’s Warfighting Laboratory (CWL)] is the centerpiece for the operational enhancement of the Marine Corps for the next century. Using the Special Purpose Marine Air-Ground Task Force (Experimental) (SPMAGTF(X)) as its first “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 and guide the Marine Corps into the next century. 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.</p> <p>(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: fires; biological, chemical and non-lethal technologies; expeditionary logistics; and advanced training and education techniques.</p> <p>(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 one or two technology areas or concepts. 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. The supporting Extended Littoral Battlespace (ELB) [formerly titled Sea Dragon] Advanced Concept Technology Demonstration (ACTD) focuses on selected technologies in the AWEs and LOEs, and seeks to identify valuable “residuals” for the operating forces and recommends accelerated acquisition when appropriate/applicable.</p> <p>(U) Under the guidance of the Five Year Experimentation Plan (FYEP), MCWL’s current plans include three AWE “build-up” phases culminating in actual AWE execution:</p>										
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2297</b>
<p>1) Hunter Warrior: (March 1996 through April 1997) Experimented with advanced operational concepts and technologies on an extended and dispersed battlefield, in open and mountainous terrain at the mid-intensity operational level.</p> <p>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.</p> <p>3) Capable Warrior: (June 1999 through To Be Determined) 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.</p> <p><b>(U) FY 1997 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• (U) \$ 5500 MCWL Operations (Support): Continued searching for, locating, developing and evaluating advanced warfighting operational and organizational concepts and enabling technologies for LOEs and AWEs. Continued research planning; model and simulation development; preparation; execution; and analysis and assessment to extend exploration of critical components. Provided a personal computer based Video Teleconferencing (VTC) capability to link major Marine Corps headquarters which allowed coordination and information dissemination during experimentation. Provided multi-spectral ultra-lightweight camouflage screening and thermal infra-red sheeting for experimentation during the Hunter Warrior AWE. Continued investigations into "Clear Thinking", advanced technology pattern recognition and decision making. Executed the Hunter Warrior AWE.</li> <li>• (U) \$ 13262 Command, Control, Communications, Computers and Intelligence (C4I): Purchased and supported fundamental hardware and software which was used as the principle means of communications for the infantry and its attachments to communicate between each other and back to the Enhanced (Experimental) Combat Operations Center (ECOC) during the Hunter Warrior AWE. Initiated systems engineering, integration, and technical support for the ECOC and Combat Operation Center (Interim) (COC(I)). Continued development of a Visualization/Assessment/Training system (Virtual Reality Workbench), which projects a three dimensional (3D) image of the battlefield. Initiated Internet-Node-in-the-Sky (INITS) development, a communications system that can be carried by an unmanned aerial vehicle (UAV). Initiated Sounder development, a UAV capable of transporting the INITS. Continued Integrated Marine Multi-Agent Command and Control System (IMMACCS) Engine (formerly known as Force Engagement Analysis Tool, Version 4 (FEAT4)) effort, an initiative which seeks to use "automated experts" to process data and execute pre-programmed decisions. Continued IMMACCS two dimensional (2D) Viewer (formerly known as the Experimental Battlefield Awareness and Intelligence Toolkit (XBAIT)) effort, which uses rapid decision making in order to facilitate human understanding of operational plans.</li> </ul>		
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Development</b>	PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	PROJECT <b>C2297</b>
• (U) \$ 3277	Sensors and Drones: Initiated enhancements to the Expendable Drone (Exdrone) UAV to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Installed acoustic/magnetic sensors and pan-tilt-zoom cameras in/on UAVs to assist in identifying and tracking friendly and enemy forces. Initiated investigations into the Broad Area Unmanned Retail Re-supply Operation (BURRO) concept, a helicopter/UAV capable of carrying heavy loads. Initiated investigations into the Hummingbird, a suitcase-portable UAV which operates like a helicopter. Participated in a Sustainment LOE in which UAV delivery of supplies, alternative fuel sources and automated diagnostics were employed.	
• (U) \$ 2945	Fires and Targeting & Training and Education: Began development of an Unattended Mortar System (Dragon Fire, formerly known as the Box Mortar) experimental prototype, an unmanned indirect fire system that can be emplaced and controlled by ground units. Purchased equipment used by Marines in an experimental unit to test new techniques in Urban Warfare in an ongoing series of experiments. Developed simulation software, used in Hunter Warrior, which augmented many of the systems being demonstrated. Since there was no live firing of weapon systems during Hunter Warrior, the simulation played a key role in final data collection and analysis.	
• (U) \$ 1731	Mobility and Maneuver, Survivability, and Sustainment: Conducted a Survivability LOE that experimented with concepts and capabilities (robotics systems, sensors and advanced optics) designed to improve the survivability of Marine forces operating on a non-contiguous, extended naval battlefield with a focus on developing a concept to ensure our Marines can survive while operating on an increasingly lethal battlefield. Investigated Advanced Precision Air Delivery System (APADS), used to accurately and quickly deliver cargo on a selective basis. Developed an electronic measurement capability to monitor quantity and quality of fuel supplies shore. Developed a system that remotely monitors and assists in the repair of vehicles in the field. Developed a system used to monitor the location and quantity of logistics assets ashore. Conducted a Sustainment (Combat Service Support) LOE that experimented with enhanced command and concepts to include reachback distribution and total asset visibility. Purchased an enhanced mobility matting system and provided to a deploying Marine Expeditionary Force for fleet experimentation to investigate beach mobility of wheeled vehicles.	
• (U) \$ 1287	Chemical and Biological (Chem/Bio), Analysis, and Non-Lethals: Expanded Reachback Communications Systems (RCS) efforts to link chem/bio scientific and medical experts with the Chem/Bio Incident Response Force (CBIRF). Purchased, integrated with the Exdrone, and began testing air sampler-biosensor systems for the remote identification of biological warfare agents. Continued efforts to improve upon the automated data collection system designed and implemented during Hunter Warrior. Provided strategic and analytical support and assessment for long range Non-Lethal technology planning efforts.	
(U)Total \$ 28,002		
<b>(U) FY 1998 Planned Program:</b>		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Development</b>	<b>0603640M Marine Corps Advanced Technology Demonstrations</b>	<b>C2297</b>
<ul style="list-style-type: none"> <li>• (U) \$ 5401 MCWL Operations (Support): Expand search for, location, development and evaluation of 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. Investigate the impact of MCWL experimental results on manpower reductions. Provide for Marine Forces (Atlantic and Pacific) Battle Laboratories to conduct experimentation.</li> <li>• (U) \$ 10278 C4I: Purchase and support fundamental hardware and software which will be used as the principle means of communications for the infantry and its attachments to communicate between each other and back to the Enhanced (Experimental) Combat Operations Center (ECOC) during the Urban Warrior AWE. Continue systems engineering, integration, and technical support for the ECOC and COC(I). Complete Virtual Reality Workbench development. Continue INITS development. Continue IMMACCS Engine and IMMACCS 2d Viewer related development efforts. Continue investigations into "Clear Thinking" technology pattern recognition. Initiate integration of Air/Land/Sea mission planning and the Sea Dragon experimentation concept of coordinating all fires in real time. Develop and implement the Object-Oriented (OO) database required by the IMMACCS using National Imagery and Mapping Agency (NIMA) data as input. Develop and implement the required ability to allow updates of the OO database with inputs provided by "intelligent agents". Analyze configuration recommendations, based on modeling and simulation, for the Urban Warrior communication network.</li> <li>• (U) \$ 2895 Drones and Aviation: Continue enhancing the Exdrone UAV to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Expand investigations into the BURRO and Hummingbird UAV concepts. Provide mission planning and visualization capabilities, simulation of urban terrain and digital ground to air connectivity in support of urban aviation experimentation. Experiment 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.</li> <li>• (U) \$ 3260 Fires and Targeting &amp; Training and Education: Expand development of the Dragon Fire Mortar System experimental prototype. Continue development of a laser range finder which will provide ground forces with accurate target acquisition. Initiate investigations into a means of "tagging" targets so that they can be tracked and attacked later. Initiate the potential for ground units to illuminate targets for direct fire weapons engagement and expand investigations to include urban direct fire technologies. Provide and integrated software application (Advanced Close Air Support system (ACASS)) which automates Forward Air Controller (FAC) tasks in an urban environment and can be evaluated during MCWL's Urban Warrior experiments. Investigate available and emerging digital camera/video surveillance technologies. Conduct high visibility experiments using existing training rounds at the Military Operations in Urban Terrain (MOUT) training facility. Provide 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.</li> </ul>		
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DATE  
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BUDGET ACTIVITY  
**3 - Advanced Development**

PE NUMBER AND TITLE  
**0603640M Marine Corps Advanced Technology Demonstrations**

- (U) \$ 2055 Mobility and Maneuver, Survivability, and Sustainment: Search for and evaluate emerging commercially available technologies that could significantly improve urban mobility. Search for, evaluate, and perform seabasing analysis. Participate in an experiment to centralize personnel administration at the group, regiment, major subordinate command, and Marine Expeditionary Unit (MEU) Command Element (CE) level. Support experimentation with aerosolized foams for reinforcing structures as well as bridging and counter-mobility operations. Continue investigations into APADS capabilities. Experiment with electronic markers used in complex terrain to help small units maneuver quickly and safely. Provide the sea-based logistician with a multi-faceted logistics support package which includes alternative power sources, small urban movers, mobility/counter-mobility foams, cargo tagging/recording/tracking technologies, etc. and analyze efforts. Experiment with Carbine Rifle optics to improve the ability to engage with direct fires. Experiment with counter-sniper technologies focusing on increasing the survivability of Marines operating in the urban environment. Leverage ongoing work, in the Day/Night Small Unit Target Acquisition field, of several advanced technology programs and provide field user evaluation/feedback through experimentation. Integrate clothing and equipment that will enhance Marines' survivability in urban combat.
  - (U) \$ 2702 Chem/Bio, Analysis, and Non-Lethals: Continue RCS efforts to link chem/bio scientific and medical experts with the CBIRF. Explore capabilities to quickly and safely treat and evacuate casualties from the urban battlefield, with the smallest possible support load on the maneuver commander. Complete air sampler-biosensor systems testing for the remote identification of biological warfare agents. Provide an instrumentation capability that will support MCWL experimentation in the urban environment. Expand efforts to improve upon the automated data collection system designed and implemented during Hunter Warrior. Provide overall systems engineering and integration support for ongoing experimentation. Develop and demonstrate a liquid dispensing upgrade to the Powered Parafoil UAVs in support of non-lethal experimentation.
  - (U) \$ 94 SBIR: Portion of program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638(f)(1).
- (U)Total \$ 26,685

**(U) FY 1999 Planned Program:**

- (U) \$ 4115 MCWL Operations (Support): Continue searching for, locating, developing and evaluating advanced warfighting operational and organizational concepts and enabling technologies for LOEs and AWEs. 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.
- (U) \$ 12700 C4I: Continue systems engineering, integration, and technical support for the ECOG and COC(I). Continue Virtual Reality Workbench development. Continue INITS and Sounder development. Continue FEAT4 and XBAIT related development efforts. Continue investigations into "Clear Thinking" technology pattern recognition. Continue integration of Air/Land/Sea mission planning and the Sea Dragon experimentation concept of coordinating all fires in real time. Provide forward-deployed forces with the real-time access to RCS and CBIRF staffs, experts and the supporting establishment.

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
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<ul style="list-style-type: none"> <li>• (U) \$ 2560 Sensors and Drones: Continue enhancing the Exdrone UAV to perform battle damage assessment; data targeting; reconnaissance and surveillance; and accurate deployment of unattended sensors. Complete investigations into the BURRO concept. Continue Hummingbird UAV investigations. 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.</li> <li>• (U) \$ 1471 Fires and Targeting &amp; Training and Education: Continue development of a Box Mortar System experimental prototype. Continue development of a laser range finder which will provide ground forces with accurate target acquisition. Investigate existing and emerging training enhancements and simulation equipment and devices.</li> <li>• (U) \$ 1290 Mobility and Maneuver, Survivability, and Sustainment: Provide small units and individual Marines with an equipment kit that will enhance maneuver in the urban environment. Continue investigations into APADS capabilities. Continue experimentation with counter-sniper technologies. Continue integrating clothing and equipment that will enhance Marines' survivability in urban combat.</li> <li>• (U) \$ 1448 Information Warfare and Non-Lethals: Develop operational concepts for information warfare. 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.</li> </ul> <p>(U)Total \$ 23,584</p>		
<b>B. (U) <u>Project Change Summary</u></b>	<u>FY 1997</u>	<u>FY 1998</u>
(U) Previous President's Budget	0	0
(U) Adjustments to Previous President's Budget	28002	26685
(U) Current Budget Submit	28002	26685
<p>(U) Change Summary Explanation:</p> <p>(U) Funding: Funding for FY 1997 (\$28,002), FY 1998 (\$20,000), and FY 1999 (\$24,000) was previously contained under Project C2223, Marine Corps Advanced Technology in this Program Element. An FY 1998 Congressional enhancement of \$7,500 allowed for the expansion of existing tasks and pursuit of new efforts. General, economic, and commercial reductions decreased FY 1998 and FY 1999 efforts by \$815 and \$416 respectively. FY 1999 program/tasking adjustments were made based on Hunter Warrior AWE experimentation results and continued program analysis, re-direction, and revision.</p> <p>(U) Schedule: Not applicable.</p> <p>(U) Technical: Not applicable.</p>		
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>		
BUDGET ACTIVITY <b>3 - Advanced Development</b>				PE NUMBER AND TITLE <b>0603640M Marine Corps Advanced Technology Demonstrations</b>			PROJECT <b>C2297</b>		
<p>C. (U) <u>Other Program Funding Summary</u> (APPN, BLI #, NOMEN)</p> <p>(U) Not applicable</p> <p>(U) <b>Related RDT&amp;E:</b></p> <p>(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations), Project C2223, Advanced Technology Demonstrations</p> <p>(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations), Project C2362, Extended Littoral Battlespace, Advanced Concept Technology Demonstration</p> <p>D. (U) <u>Schedule Profile:</u> Not applicable.</p>	<p><u>FY 1997</u></p>	<p><u>FY 1998</u></p>	<p><u>FY 1999</u></p>	<p><u>FY 2000</u></p>	<p><u>FY 2001</u></p>	<p><u>FY 2002</u></p>	<p><u>FY 2003</u></p>	<p>To <u>Compl</u></p>	<p>Total <u>Cost</u></p>
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>			
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<i>COST (In Thousands)</i>	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
C2362 Extended Littoral Battlespace (ELB), Advanced Concept Technology Demonstration (ACTD)	5000	9703	9827	9790	9767	972	969	Continuing	Continuing	
Quantity of RDT&E Articles										
<p><b>A. (U) <u>Mission Description and Budget Item Justification:</u></b></p> <p>(U) Concept of operations for the Extended 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.</p> <p>The ELB ACTD was approved by DUSD(AT) on 16 January 1997.</p> <p><b>(U) FY 1997 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• (U) \$ 2979 Developed C4I Surveillance and Reconnaissance (C4ISR) system architecture and design in preparation for a major demonstration in FY 99.</li> <li>• (U) \$ 1451 Operational Capability Enhancements developed testbeds to conduct incremental demonstrations and testing in support of the ACTD while contributing to FMF modernization efforts and development of initial tactics, techniques and procedures to support concepts of employment.</li> <li>• (U) \$ 570 Conducted engineering, technical and operational assessments to define system demonstration scenarios.</li> </ul> <p>(U)Total \$ 5,000</p>										
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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>				
<b>BUDGET ACTIVITY</b> <b>3 - Advanced Development</b>	<b>PE NUMBER AND TITLE</b> <b>0603640M Marine Corps Advanced Technology Demonstrations</b>	<b>PROJECT</b> <b>C2362</b>				
<p><b>(U) FY 1998 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• (U) \$ 500 Continue development and completion of the 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.</li> <li>• (U) \$ 1669 Conduct enabling technologies efforts to 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.</li> <li>• (U) \$ 2000 Integrate feasibility demonstrations to provide an early operational assessment and to collect data relative to technologies/systems critical technical characteristics for purposes of defining technical risks and refinement of hardware/software design configurations.</li> <li>• (U) \$ 5203 Select and purchase of system and subsystem hardware, software, training, maintenance, spares, etc. for FY 1999 system demonstration.</li> <li>• (U) \$ 331 SBIR: Portion of program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638 (f)(1).</li> </ul> <p>(U)Total \$ 9,703</p> <p><b>(U) FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• (U) \$ 2900 Continue pre-demonstration activities to include system integration, test, software verification and validation, ship installation, and operator training.</li> <li>• (U) \$ 4000 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.</li> <li>• (U) \$ 2000 Demonstration/post demonstration assessment for evaluating the system concept and assessing its military utility.</li> <li>• (U) \$ 927 Continue training and logistics support to successfully demonstrate a C4ISR system-of-systems ACTD.</li> </ul> <p>(U)Total \$ 9,827</p> <p><b>B. (U) <u>Project Change Summary</u></b></p> <table style="width: 100%; border: none;"> <tr> <td></td> <td style="text-align: center;"><u>FY 1997</u></td> <td style="text-align: center;"><u>FY 1998</u></td> <td style="text-align: center;"><u>FY 1999</u></td> </tr> </table>				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>			
Project C2362	Page 21 - 16 of 21 - 17 Pages	Exhibit R-2				



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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>							DATE <b>February 1998</b>					
<b>BUDGET ACTIVITY</b> <b>3 - Advanced Development</b>				<b>PE NUMBER AND TITLE</b> <b>0603640M Marine Corps Advanced Technology Demonstrations</b>			<b>PROJECT</b> <b>C2362</b>					
<b>B. (U) <u>Project Change Summary</u></b>				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>						
(U) Previous President's Budget				0	0	0						
(U) Adjustments to Previous President's Budget				5,000	9,703	9,827						
(U) Current Budget Submit				5,000	9,703	9,827						
 (U) Change Summary Explanation:												
<p>(U) Funding: FY 1997 change reflect funds reprogrammed from Project C2223, Marine Corps Advanced Technology in this Program Element. FY 1998 and FY 1999 change due to Congressional adds and various economic adjustments such as SBIR, general reductions, and commercial purchases inflation adjustments.</p> <p>(U) Schedule: Not applicable.</p> <p>(U) Technical: Not applicable.</p>												
<b>C. (U) <u>Other Program Funding Summary</u></b>				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>To</u>	<u>Total</u>
<b>(APPN, BLI #, NOMEN)</b>												
(U) Not Applicable												
 <b>(U) <u>Related RDT&amp;E</u></b>												
(U) PE 0603640M (Marine Corps Advanced Technology Demonstrations), Project C2223, Advanced Technology Demonstrations												
(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)												
 <b>D. (U) <u>Schedule Profile:</u></b> Not applicable.												
Project C2362				Page 21 - 17 of 21 - 17 Pages				Exhibit R-2				

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0095 Fleet Health Technology	7,788	11,495	11,291	10,327	10,535	10,710	10,916	CONT.	CONT.
R0096 Fleet Health Standards	4,225	5,129	5,432	5,538	5,650	5,745	5,856	CONT.	CONT.
R2022 Bone Marrow Registry	18,770	0	0	0	0	0	0	CONT.	148,851
R2332 Mobile Medical Device	3,730	1,941	2,005	0	0	0	0	CONT.	7,676
R2333 Rural Health	3,263	2,911	0	0	0	0	0	CONT.	6,174
M2334 Bone Marrow	13,061	32,992	0	0	0	0	0	CONT.	46,053
R2335 Casualty Stabilization	2,422	0	0	0	0	0	0	CONT.	2,422
R2336 Freeze Dried Blood	2,334	1,456	0	0	0	0	0	CONT.	3,790
R2374 Biocide Materials	0	5,337	0	0	0	0	0	CONT.	5,337
R2375 Dental Research	0	1,941	0	0	0	0	0	CONT.	1,941
R2376 Natural Gas Cooling/Desiccant Demo	0	2,426	0	0	0	0	0	CONT.	2,426

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2377 National Biodynamics Lab	0	2,523	0	0	0	0	0	0	5,361
TOTAL	55,593	68,151	18,728	15,865	16,185	16,455	16,772	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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0095 Fleet Health Technology	7,788	11,495	11,291	10,327	10,535	10,710	10,916	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 1997 ACCOMPLISHMENTS:

- (U) (\$2,213) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continued the research and development of studies that validated the feasibility and efficacy of life sustainment and casualty stabilization interventions including metabolic down-regulation, hypothermia, hibernation triggers, and other technologies that control metabolic requirements, reduce oxygen consumption, and permit delayed resuscitation and evacuation to a fixed treatment facility in order to reduce the logistical burden of medical support in the field. Studies have demonstrated the feasibility of extending the "golden hour" via a metabolically down-regulated state for 2 and a half hours in large animals. Continued studies into the complications of hemorrhagic shock and late sequelae that may be prevented with early interventions.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0095

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Technology

- (U) (\$2,000) BLOOD AND BLOOD SUBSTITUTES: Continued clinical trials and obtained FDA approval for technologies that extend the refrigerated liquid storage time for red blood cell transfusion units from the current six (6) weeks to a shelf-life of sixteen (16) weeks minimum to dramatically reduce the logistical burden of continued blood unit replenishment in theater. Continued and completed aspects of the enzymatic conversion of red blood cells from any ABO/Rh type to universal O negative cells for eliminating specific blood group and type shortages and having universal transfusion compatibility. Completed the B to O conversion regimen for full FDA approvals. Continued the refinement of A to O conversion and begin clinical trials. Continued the development of Rh positive to Rh negative conversions. Continued studies to develop a one-step red blood cell freezing technology that permits immediate post-thaw transfusion without the necessity of pre-transfusion washing to improve the usability of frozen red cell units. 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 storage capabilities beyond the current five (5) days shelf-life for liquid platelets for controlling hemorrhage in casualties, and initiate clinical trials and field utilization testing for the products subsequent to FDA approvals. Continued the development of liposome encapsulated hemoglobin as an oxygen carrying blood substitute and initiate clinical trials of current formulations. Extended studies of stroma-free hemoglobin oxygen carriers specifically formulated to prevent vasoactive side effects. Continued studies on advanced hemostasis for arterial venous, and capillary bleeding in tissues and organs; provided hemostatic agents in formulations (gels, sponges, and foams) that may be easily delivered to casualty wound sites in combat environments; and tested hemostatic agents in large animal models of hemorrhage.
- (U) (\$1,200) 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. Specifically continued the evaluations of lymphocyte costimulatory molecules and pathways that permit inhibition and/or activation of specific lymphocyte subsets involved in immune responses that may enhance the elimination of immune based trauma complications and permit development of techniques for tissue, organ, and bone marrow transplantation subsequent to chemical/biological/radiation injuries. Continued the development of oral cytokine administration techniques that modulate and/or prevent septic sequelae following trauma. Began large animal studies to demonstrate the efficacy of oral cytokines in preventing complications from combat relevant trauma and hemorrhage.
- (U) (\$900) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Began formulation of vasopressin regimen for submission to the FDA for licensure. Continued 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 evaluate musculoskeletal injuries in extreme environments and military scenarios and develop methodologies to reduce and/or prevent these injuries. Continued to study the value of intervention techniques which preclude high risk individuals of musculoskeletal trauma.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0095

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Technology

- (U) (\$1,050) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continued to interface the EPISYS, SAMS and selected medical databases for advanced medical support planning and casualty management. Validated the relationships of these databases and ensure their effectiveness in military use environments. Continued to develop models for projecting casualty rates for various battle scenarios and war fighting intensities. Continued to investigate and model 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.
  - (U) (\$425) NAVY DENTAL EMERGENCIES: Continued efforts encompassing (1) the systematic investigation of problems related to the oral health, wellness, disease, and injuries of Navy and Marine Corps personnel that may adversely impact on deployment and dental emergencies requiring evacuation from remote Navy platforms; (2) the development of methods, materials, and products that increase operational readiness and improve dental care in the military setting; and (3) the collection and analysis of data to change or influence policy or doctrine. Continue development of multimedia diagnostic systems for corpsmen, risk assessment strategies and programs; and dental disease progression methods and diagnostics, and managed dental care systems.
2. (U) FY 1998 PLAN:
- (U) (\$2,600) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continue studies that validate the efficacy of life sustainment and stabilization interventions including metabolic down-regulation, hypothermia and hibernation triggers, that control metabolic requirements, reduce oxygen consumption, and permit delayed resuscitation. Test potential drug regimens that impact metabolic down-regulation and delayed resuscitation. Continue studies in large animal models into the medical complicating of hemorrhagic shocks and its late sequelae.
  - (U) (\$2,544) 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 from the current six (6) weeks to a shelf-life of sixteen (16) weeks. Complete aspects of the enzymatic conversion of red blood cells from any ABO/Rh type to universal O negative cells for eliminating specific blood group and type shortages and having universal transfusion compatibility. Complete the refinement of A to O conversion and transition Phase II/III clinical trials. Continue the development of Rh positive to Rh negative conversions. Continue studies to develop a one-step red blood cell freezing technology that permits immediate post-thaw transfusion without the necessity of pre-transfusion washing. 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, initiate clinical trials and field utilization testing for the products subsequent to FDA

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603706N      PROJECT NUMBER: R0095  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)      PROJECT TITLE: Fleet Health Technology

approvals with full Phase I/II/III clinical trials for freeze-dried platelets. Continue the development of liposome encapsulated hemoglobin as an oxygen carrying blood substitute and continue Phase I/II/III clinical trials of current formulations. Develop hemostatic agents in formulations for easy delivery to wounds in the combat environment and utilize hemostatic agents in large animal models and initiate clinical studies in trauma victims.

- (U) (\$2,100) MODULATION OF IMMUNE SYSTEM IN COMBAT CASUALTIES: Specifically continue the evaluations of lymphocyte costimulatory molecules and pathways that permit inhibition and/or activation of specific lymphocyte subsets involved in immune responses. Begin related clinical studies. Continue the development of oral cytokine administration techniques that modulate and/or prevent septic sequelae following trauma. Continue large animal studies to demonstrate the efficacy of oral cytokines in preventing complications from combat relevant trauma and hemorrhage and begin clinical trials.
  - (U) (\$1,800) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Continue testing formulation of vasopressin regimen in clinical trials for submission to the FDA for licensure. Continue studies to reduce or prevent cold related injuries for combat personnel, particularly related to non-freezing cold related injuries in the extremities. Continue to study the value of intervention techniques which preclude high risk individuals from becoming victims of musculoskeletal trauma.
  - (U) (\$1,537) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continue to interface selected medical databases for advanced medical support planning and casualty management. 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. Continue to investigate and model 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) (\$914) NAVY DENTAL EMERGENCIES: Continue 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 on deployment and dental emergencies requiring evacuation from remote Navy platforms. Complete development of multimedia diagnostic systems for corpsmen and maintain advanced information through system updates, continue risk assessment strategies and programs.
3. (U) FY 1999 PLAN:
- (U) (\$2,600) TREATMENT OF CASUALTIES TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Continue the research and development of studies that validate the feasibility and efficacy of life

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0095

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Technology

sustainment and casualty stabilization interventions. Continue testing potential drug regimens 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 and begin Phase I clinical trials

- (U) (\$3,101) 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 the development of Rh positive to Rh negative conversions. Continue studies to develop a one-step red blood cell freezing technology that permits immediate post-thaw transfusion without the necessity of pre-transfusion washing to improve the usability of frozen red cell units and development full-scale technique for one-step freezing for single red cell unit. 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. Complete the development of improved frozen and freeze dried platelet products with enhanced storage capabilities. Complete clinical trials and field utilization testing for the products subsequent to FDA approvals with full Phase I/II/III clinical trials for freeze-dried platelets. Complete the development of liposome encapsulated hemoglobin as an oxygen carrying blood substitute and continue Phase I/II/III clinical trials of current formulations.
- (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. Complete the evaluations of lymphocyte costimulatory molecules and pathways that permit inhibition and/or activation of specific lymphocyte subsets involved in immune responses. Continue large animal studies to demonstrate the efficacy of oral cytokines in preventing complications from combat relevant trauma and hemorrhage and begin clinical trials.
- (U) (\$1,600) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Complete testing formulation of vasopressin regimen in clinical trials for submission to the FDA for licensure. Complete studies to reduce or prevent cold related injuries for combat personnel, particularly related to non-freezing cold related injuries in the extremities. Complete studies to evaluate musculoskeletal injuries in extreme environments and military scenarios and develop methodologies to reduce and/or prevent these injuries. Continue to study the value of intervention techniques which preclude high risk individuals from musculoskeletal trauma.
- (U) (\$1,335) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Complete 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 use 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 casualty flows between echelons of

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603706N      PROJECT NUMBER: R0095  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)      PROJECT TITLE: Fleet Health Technology

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) (\$755) NAVY DENTAL EMERGENCIES: Complete efforts related to dental emergencies requiring evacuation from remote Navy platforms. Continue the collection and analysis of data to change or influence policy or doctrine. Continue studies for dental disease progression methods and diagnostics, and managed dental care systems.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	9,172	13,046	11,490
(U) Appropriated Value:	-	11,846	-
(U) Adjustments from FY 1998 PRESBUDG:	-1,384	-1,551	-199
(U) FY 1999 President's Budget Submit:	7,788	11,495	11,291

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 reductions results from the SBIR assessment (-26), revised economic assumptions (-11) and actual execution (-1,347). The FY 1998 reductions result from the Congressional Undistributed Reduction (-1,525) and revised economic assumptions (-26). The FY 1999 decrease results from Commercial Purchases Inflation Adjustment (-199).

(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 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.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in thousands)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0096 Fleet Health Standards	4,225	5,129	5,432	5,538	5,650	5,745	5,856	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 1997 ACCOMPLISHMENTS:

- (U) (\$837) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Initiated advanced development programs to deliver products that enhance the safety of Navy divers/submariners and extend the operational envelope by permitting faster decompression procedures and longer bottom time; developed preventive and treatment methods for oxygen toxicity; and enhanced protocols for improving submarine rescue operations.
- (U) (\$500) SPECIAL OPERATIONAL HUMAN PERFORMANCE GUIDELINES: Provided recommendations for use of biomedical countermeasures to counteract performance decrements associated with sustained operations. Provided field training course/material on fatigue countermeasures for Navy operations.
- (U) (\$450) MEDICAL STANDARDS FOR PERSONNEL SELECTION: Continued work in gender-neutral fitness standards for shipboard and aviation duty. Deployed a selection test battery for unmanned aerial vehicle operators.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0096

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Standards

- (U) (\$650) ENHANCE HUMAN PERFORMANCE: Delivered improved countermeasures to heat strain for shipboard engine room chemical/biological protective gear and firefighting personnel. Developed field cooling requirements to prevent body heat storage during physical activity and heat exposure while dressed in the Navy firefighting ensemble. Quantified the whole body cooling required to extend stay-time in the heat by 100 percent while wearing the Chemical Biological (CBR) ensemble. Evaluated the cooling capacity of advance design liquid cooling systems to reduce heat strain during exercise and heat exposure.
  - (U) (\$600) AVIATION/SPATIAL DISORIENTATION ATTRITION AND INJURY REDUCTION: Initiated program in identification and prevention of aircraft mishaps due to spatial disorientation, human performance and human factors problems.
  - (U) (\$500) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Conducted field measurement and computational dosimetry study of RF radiation exposures in Navy and Marine Corps operational environments. Determined ocular effects of pulsed microwave exposures.
  - (U) (\$200) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY : Developed guidelines for health promotion from longitudinal analysis of military lifestyle, diet and smoking cessation.
  - (U) (\$313) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY: Initiated identification of toxicants in shipboard fire smoke that cause acute respiratory distress and identify biological mechanisms involved. Initiated development of Neuromolecular Toxicity Assessment System (NTAS) for health hazard evaluation of neurotoxicants.
  - (U) (\$175) REDUCE ATTRITION AND INJURY RELATED TO INDUSTRIAL HYGIENE HAZARDS: Delivered validated expert system for shipboard industrial hygiene hazard recognition and survey reporting.
2. (U) FY 1998 PLAN:
- (U) (\$800) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Continue development programs to deliver products that enhance the safety of Navy divers/submariners and extend the operational envelope by permitting faster decompression procedures, longer bottom time, and submersed rescue operations.
  - (U) (\$533) DELIVER GUIDELINES: Provide recommendations for use of biomedical countermeasures to counteract performance decrements associated with sustained operations. Exploit current technology for evaluation of stimulant effects, susceptibility to sleep loss, and fatigue-related impairment. Field guidance for use of specific pharmacological agents during SUSOPS and bright light aboard submarines. Initiate development of field real-time alertness monitor.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0096

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Standards

- (U) (\$590) MEDICAL STANDARDS FOR SELECTION: Field an integrated updated database of medical conditions associated with, or precluding, service.
  - (U) (\$718) ENHANCED HUMAN PERFORMANCE: Field a model of the physical and perceptual stress of shipboard firefighting. Provide guidance for use of existing Physiological Heat Exposure Limits (PHEL) for women, including use of ice vests for microclimate cooling.
  - (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) (\$205) REDUCE ATTRITION AND INJURY RELATED TO HAZARDOUS MATERIALS: Initiate 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: Continue identification of toxicants and mechanisms involved with acute respiratory distress from shipboard fires. Continue development of NTAS along with delivery of analytical device that measures neurotransmitter level in near real-time.
  - (U) (\$405) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY/HAZARDOUS MATERIALS: Initiate testing, evaluation, and refinement of physiologically-based pharmacokinetic and pharmacodynamic models of shipboard exposures to cleaning solvents. Continue toxicological evaluation of chemicals associated with Navy workplace to develop exposure standards.
  - (U) (\$211) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY: Deliver guidelines for health promotion and physical readiness of active duty personnel.
  - (U) (\$483) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Deliver computational dosimetry model for RF radiation exposures. Deliver data on ocular effects of pulsed microwaves for development of exposure standards. Initiate testing and evaluation of chronic health effects of RF-induced body and limb currents from topside shipboard exposures; utilize results to develop exposure standards and guidelines.
3. (U) FY 1999 PLAN:
- (U) (\$864) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGEN TOXICITY: Continue development of programs to deliver products that enhance the safety of Navy divers/submariners. Advanced trials for biochemical decompression.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N

PROJECT NUMBER: R0096

PROGRAM ELEMENT TITLE: Medical Development (Advanced)

PROJECT TITLE: Fleet Health Standards

- (U) (\$537) DELIVER GUIDELINES: Continue to exploit current technology for evaluation of stimulant effects, susceptibility to sleep loss, and fatigue-related impairment. Continue development of field real-time alertness monitor. Perform field trials for developed technology.
- (U) (\$581) MEDICAL STANDARDS FOR SELECTION: Complete an integrated updated database of medical conditions associated with, or precluding, service.
- (U) (\$729) ENHANCED HUMAN PERFORMANCE: Provide guidance for use of existing (PHEL) for women, including use of ice vests for microclimate cooling.
- (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: Continue identification of toxicants and mechanisms involved with acute respiratory distress from shipboard fires. Continue development of Neuromolecular Toxicity Assessment System (NTAS).
- (U) (\$523) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY/HAZARDOUS MATERIALS: Continue testing, evaluation, and refinement of physiologically-based pharmacokinetic and pharmacodynamic models of shipboard exposures to cleaning solvents. Continue toxicological evaluation of chemicals associated with Navy workplace to develop exposure standards.
- (U) (\$200) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY: Evaluate current health and physical readiness level of Navy personnel.
- (U) (\$489) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Continue testing and evaluation of chronic health effects of RF-induced body and limb currents from topside shipboard exposures; utilize results to develop exposure standards and guidelines.

(U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	5,066	5,286	5,528

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603706N      PROJECT NUMBER: R0096  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)      PROJECT TITLE: Fleet Health Standards

(U) Appropriated Value:	-	5,286	-
(U) Adjustments from FY 1998 PRESBUDG:	-841	-157	-96
(U) FY 1999 President's Budget Submit:	4,225	5,129	5,432

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 reduction results from the SBIR assessment (-34), revised economic assumptions (-6) and actual execution (-801). The FY 1998 reduction results from the Congressional Undistributed Reduction (-145) and Economic Assumptions (-12). The FY 1999 reduction results from the Commercial Purchases Inflation Adjustment (-96).  
(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 Laboratory Independent Research)  
(U) PE 0601153N (Defense Research Sciences)  
(U) PE 0602233N (Human Systems Technology)  
(U) PE 0604771N (Medical Development (ENG))

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)

(U) COST: (Dollars in thousands)

PROJECT NUMBER & ACTUAL	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2332 Mobile Medical Device (M3)	3,730	1,941	2,005	0	0	0	0	CONT.	7,676

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: A program for assembling, deploying and implementing microelectronic monitoring devices and medical information technology capabilities into a modular mobile medical unit for field use.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$3,370) MOBILE MEDICAL DEVICE - CONGRESSIONAL PLUS-UP: A State-of-the-Art Review was completed to identify FDA approved devices and technology that could be demonstrated and their functionality verified. Using a variety of sources the functional requirements were defined. Individual care givers and medical professionals were surveyed and interviewed. Candidate features were assessed in the light of the new warfighting doctrine, the Forward Resuscitative Surgery Report, the Medical Readiness Strategic Plan, and Marine Corps Flag Reports. Using the requirements definition the M3(B) system was designed and system integration begun.

2. (U) FY 1998 PLAN:

- (U) (\$1,941) MOBILE MEDICAL DEVICE - CONGRESSIONAL PLUS-UP: Initiate augmentation of the current mobile medical monitoring device. Extend it's capability by supporting multiple patients (4-6 people) simultaneously;

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Budget Item Justification  
(Exhibit R-2, page 14 of 15)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603706N      PROJECT NUMBER: R2332  
PROGRAM ELEMENT TITLE: Medical Development (Advanced)      PROJECT TITLE: Mobile Medical Device

developing a wireless interface between patients and the central processor; developing the capacity to read and write to a high density personal information carrier; and implementing the upgrades necessary to obtain certification for use aboard aircraft. Additionally, incorporate the information for processing capability needed to support medical intelligence and provide medical situational awareness.

3. (U) FY 1999 PLAN:

- (U)(\$2,005) MOBILE MEDICAL DEVICE: Complete the development effort to deliver a multi-patient mobile medical monitoring system certified for use aboard aircraft.

(U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	3,836	0	0
(U) Appropriated Value:	0	0	0
(U) Adjustments from FY 1998 PRESBUDG:	-106	1,941	2,005
(U) FY 1999 President's Budget Submit:	3,730	1,941	2,005

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 reduction results from the SBIR assessment (-101) and revised economic assumptions (-5). The FY 1998 increase results from the Congressional Undistributed Reduction (-55), Economic Assumptions (-4) and Congressional Plus-Up (+2,000). The FY 1999 increase results from the Commercial Purchases Inflation Adjustment (-35) and S&T adjustment to fully fund completion of the development effort (+2,040).

(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 Laboratory Independent Research)  
(U) PE 0601153N (Defense Research Sciences)  
(U) PE 0602233N (Human Systems Technology)  
(U) PE 0604771N (Medical Development)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
(Exhibit R-2, page 15 of 15)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0542 Air Human Factors Engineering	1,134	783	1,091	1,123	1,154	1,180	1,211	CONT.	CONT.
R1770 Manpower and Personnel Development	3,457	3,476	4,166	4,271	4,359	4,432	4,517	CONT.	CONT.
R1771 Ship Human Factors Engineering	2,510	1,587	2,094	2,147	2,205	2,258	2,315	CONT.	CONT.
R1772 Education and Training Development	4,895	4,656	6,227	6,294	6,525	6,607	6,709	CONT.	CONT.
R1773 Simulation and Training Devices	6,006	5,810	7,464	6,979	7,147	7,261	7,396	CONT.	CONT.
R2378 Virtual Reality Environment/Training Research	0	3,581	0	0	0	0	0	0	3,581
R2379 Center for Integrated Manufacturing Studies	0	1,941	0	0	0	0	0	0	1,941
<b>TOTAL</b>	<b>18,002</b>	<b>21,834</b>	<b>21,042</b>	<b>20,814</b>	<b>21,390</b>	<b>21,738</b>	<b>22,148</b>	<b>CONT.</b>	<b>CONT.</b>

(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) Human Factors Engineering: These projects develop information management techniques, advanced interface technologies, and decision support systems, 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.

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Budget Item Justification  
(Exhibit R-2, page 1 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

3. (U) Education and Training Development: This project focuses on the acquisition and maintenance of complex skills through individual and team training technologies. It improves training efficiency and cost-effectiveness by applying operations research and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.

4. (U) Simulation and Training Devices: This project improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable training systems. The project develops and evaluates systems to improve advanced training, skill maintenance and mission rehearsal capability.

(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.

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Budget Item Justification  
(Exhibit R-2, page 2 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R0542 Air Human Factors Engineering	1,134	783	1,091	1,123	1,154	1,180	1,211	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops and demonstrates advanced human factors engineering (HFE) technology to improve the integration of the human in Navy airborne weapons systems. General goals 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. Prior work in this project has focused on developing and refining a pilot decision aiding architecture that allows for both data-driven as well as operator inputs into the decision making process. This task addressed the problem of integrating information from multiple aircraft to enhance performance in the multi-dimensional battle space.

(U) The current task focuses on mission essential requirements of precise navigation and rapid target acquisition in close air support (CAS) and precision strike missions. The requirement for first pass weapon delivery with a minimum of collateral damage makes both missions extremely demanding and requires that pilots work with accurate and timely information to plan and execute the mission.

(U) Currently, during the planning process, photographs are used to provide familiarity with the route, with significant terrain and cultural features along the route and in the target itself. There is no method to display this important information in the aircraft. This project will evaluate the benefits of displaying annotated satellite imagery in the aircraft for use in a CAS-like mission.

(U) Flight tests using this system will systematically evaluate improvements in navigation and targeting accuracy. Pilot opinion will also be used to evaluate the utility of on-board satellite imagery for CAS and precision targeting. The project will also demonstrate, in the laboratory, enhancements which integrate satellite imagery and terrain elevation data to form

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Budget Item Justification  
(Exhibit R-2, page 3 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and PROJECT NUMBER: R0542  
Training Advanced Technology PROJECT TITLE: Air Human Factors Engineering  
Development

pseudo-three dimensional (3-D) satellite imagery. The demonstration will also explore how to present a set of target images from a variety of aspects as a target identification aid.

(U) The payoff will be an advanced cockpit display format of satellite imagery and maps supporting navigation and targeting. This information is expected to improve geographic awareness (thus situational awareness also) and navigation accuracy by 10% or more. Additional payoffs might occur if operators could view the satellite imagery during planning, providing an opportunity for route familiarization and mission rehearsal. Laboratory experiments using pseudo 3-D imagery have shown decreases in response times for target recognition of 20%.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (\$395) Initiations:
  - (U) Combat Enhancement through Integrated Decision Support (CEIDS) - An applied research program, Tactical Decision-Making Under Stress (TADMUS), transitioned into this program element for a shipboard advanced technology demonstration. Emphasis is on improved user-computer interface and display design for anti-air warfare. Prototype display formats developed under the 6.2 program were modified and enhanced to be compatible with the hardware and software capabilities of shipboard combat systems.
- (\$739) Continuations:
  - (U) Image-Based Navigation (IBN) - Demonstrated that 3-D scene generation system can display satellite imagery from the viewpoint of the aircraft. Built 3-D Scene Generation System. The hardware and software necessary to display the satellite imagery in 3-D will be developed using algorithms previously developed for the Land Multisensor Correlator, a 6.2 Land Targeting Task of the Air Weaponry Technology Area (PE 0602111N). Integrated with Aircraft Avionics. This task includes integration of necessary hardware and software into the aircraft avionics.

2. (U) FY 1998 PLAN:

- (\$383) Continuations:
  - (U) In CEIDS task the re-hosted TADMUS software will be evaluated in a next generation TAC environment and new display parameters will be added based upon user evaluation from both laboratory and field tests. Approved

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Budget Item Justification  
(Exhibit R-2, page 4 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and PROJECT NUMBER: R0542  
Training Advanced Technology PROJECT TITLE: Air Human Factors Engineering  
Development

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.

- (\$400) Completions:
  - (U) In IBN task conduct a flight technology demonstration of on-board perspective view images with overlays for targeting and tactical decision making in a precision strike CAS mission environment.

3. (U) FY 1999 PLAN:

- (\$591) Initiations:
  - (U) Initiate a technology demonstration program to assess the utility of enhanced imagery to improve lethality while reducing the threat of information warfare.
- (\$500) Continuations:
  - (U) In CEIDS task complete at-sea demonstration of revised TADMUS display software for battle group personnel. In corporate all user evaluations in embedded training modules and then transition to Third Fleet Flag Ship. Begin development and testing of AEGIS application of TADMUS Decision Support Software.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	1,081	1,109	1,129
(U) Appropriated Value:	-	807	-
(U) Adjustments from FY 1998 PRESBUDG:	+53	-326	-38
(U) FY 1999 President's Budget Submit:	1,134	783	1,091

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 increase results from the actual execution (+54) and revised economic assumptions reduction (-1). The FY 1998 decrease results from the economic assumptions (-2) and Undistributed Congressional Reductions (-324). The FY 1999 reduction results from the Navy Working Capital Fund Surcharge correction (-7), Navy Working Capital Fund adjustment (-17), Commercial Purchase Inflation Adjustment (-19), Military & Civilian Pay Rates (+5).

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and PROJECT NUMBER: R0542  
Training Advanced Technology PROJECT TITLE: Air Human Factors Engineering  
Development

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(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 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1770 Manpower and Personnel Development	3,457	3,476	4,166	4,271	4,359	4,432	4,517	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 1997 ACCOMPLISHMENTS:

- (\$1,992) Initiations:
  - (U) Initiated Training Costs for Navy Personnel Models Project; capitalized on results from 6.2 research by utilizing the Enlisted Training Readiness Model to optimize the size of the Individuals Account based on criteria for fleet manning and readiness.
  - (U) Initiated Permanent Change of Station (PCS)/Temporary Duty Under Instruction (TEM DUINS) impact on Navy Personnel Unit Readiness Project; developed mathematical modeling techniques in assignment optimization to improve linkage between personnel unit readiness and PCS/TEM DUINS budgets; additionally, impacts on insufficient funding as relates to readiness were explored.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1770  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Manpower and Personnel Development  
Training Advanced Technology  
Development

- (U) Initiated Distribution System 2000 Prototyping Project; explored feasibility of using mathematical models, simulation methods, artificial intelligence, expert systems, heuristic and decision support systems in prototyping technologies for improving the Navy's personnel distribution and assignment processes.
- (U) Initiated Computer Communications Technology for Recruiting Project; identified and integrated into the design of an overall system architecture promising technologies to improve recruiting effectiveness.
- (U) Initiated Selection and Classification Management project; to improve the selection and classification processes and management tools, the percentage of A-school seats filled, the quality of person/job matches, and reducing attrition through better placement of candidates.
- (U) Initiated Enlisted Strategic Planning and Assessment project; to develop a long-range policy assessment system with five components: a long-range multidimensional policy testing and forecasting module, a short-term forecasting module, a system integration module, a data assessment module, and a knowledge-based user interface.

- (\$1,053) Continuations:

- (U) Developed client-server prototype for integrated access to active duty and reserve, officer and enlisted, personnel and billet file systems.
- (U) Developed officer accession planning prototype system that recognizes strength constraints, accession source mixes and prevailing recruiting conditions.
- (U) Developed integrated force structure/personnel prototype tool using Accordion Model proof of concept for enlisted community development.
- (U) Continue development of Manpower & Personnel (M&P) Vision project and data warehousing application for future M&P systems.

- (\$412) Completions:

- (U) Developed and implemented econometric models for allocating distribution-impacting pays and retention pays to new Navy skill groups, given changes in career paths, integrate with strength policy analysis model to allow economic variables to be systematically factored into policy analyses.

2. (U) FY 1998 PLAN:

- (\$2,611) Continuations:

- (U) Continue developing Manpower & Personnel Vision of the Future project, to include data warehousing and client/server technology for use by manpower/personnel managers.
- (U) Continue modeling development to improve enlisted community management and readiness.
- (U) Continue development of models, system/subsystem architecture, and management information and decision support systems for five (5) FY 1997 Initiations.

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Budget Item Justification  
(Exhibit R-2, page 8 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1770  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Manpower and Personnel Development  
Training Advanced Technology  
Development

- (\$865) Completions:
  - (U) Develop integrated pilot system for officer accession planning and personnel management.
  - (U) Complete PCS/TEM DUINS Model to provide improved decision making, bound resource expenditures per assignment cycle (every two weeks), and improve linkages between personnel unit readiness and PCS/TEM DUINS budgets.
  
- 3. (U) FY 1999 PLAN:
  - (\$1,555) Initiations:
    - (U) Determine feasibility of econometric modeling of bonus pays to influence retention and improve readiness.
    - (U) Initiate Simulation Modeling Tool for Manpower Requirements (SYM-BASE) project.
    - (U) Initiate development of the Execution Year Monitoring Model that will monitor the Student Portion of the Individuals Account (IA) during execution. Use of this model and the Enlisted Training Readiness Model will optimize the size of the IA based on criteria for fleet manning.
    - (U) Initiate, under the Manpower & Personnel Vision project, prototype development for future ADP systems through application of data warehousing technologies.
    - (U) Investigate and apply advanced survey technologies to develop new survey instruments (tools) for M&P policy decision makers.
    - (U) Initiate prototype development for assessing Total Force Manpower Management System (TFMMS) Change Requests.
    - (U) Initiate Shore-based Forces Attrition Model.
    - (U) Initiate comprehensive Officer Force Management environment project.
  
  - (\$556) Continuations:
    - (U) Continue development of software models and an integration model to link long and short range forecasting models to improve enlisted community management and readiness.
  
  - (\$2,055) Completions:
    - (U) Complete development of the Assessment Planning Model that will calculate personnel flows for training and their associated training costs.
    - (U) Conduct pilot testing, evaluate and demonstrate new prototype models/systems to support the Bureau of Naval Personnel Distribution Steering Group's business process reengineering effort for the Navy's next generation personnel distribution system.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N

PROJECT NUMBER: R1770

PROGRAM ELEMENT TITLE: Manpower, Personnel, and  
Training Advanced Technology  
Development

PROJECT TITLE: Manpower and Personnel Development

- (U) Demonstrate proof of concept of chosen technologies at recruiting stations, Military Entrance Processing Stations , and Chief of Naval Recruiting, as appropriate, to integrate and link recruiter/classifier advertising procedures and practices.
- (U) Complete development of Selection and Classification Management tools for Chief of Naval Recruiting.
- (U) Complete Modeling and Information Advances project to improve Enlisted Community management.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1770  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Manpower and Personnel Development  
Training Advanced Technology  
Development

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	3,836	3,964	4,206
(U) Appropriated Value:	-	3,583	-
(U) Adjustments from FY 1998 PRESBUDG:	-379	-488	-40
(U) FY 1999 President's Budget Submit:	3,457	3,476	4,166

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 decrease results from the revised economic assumptions (-5) and actual execution (-374). The FY 1998 decrease results from the economic assumptions (-8) and Congressional Undistributed Reductions (-480). The FY 1999 increase results from the Navy Working Capital Fund Surcharge correction (+17), Commercial Purchases Inflation Adjustment (-73) and Military & Civilian Pay Rates (+16).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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 Laboratory Independent Research)  
(U) PE 0601153N (Defense Research Sciences)  
(U) PE 0602233N (Human Systems Technology)  
(U) PE 0603007A (Human Factors, Personnel and Training Advanced Technology)  
(U) PE 0603227F (Personnel, Training, and Simulation Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1771 Ship Human Factors Engineering	2,510	1,587	2,094	2,147	2,205	2,258	2,315	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The goal of this project is to improve ship, task force and battle group operations by developing human factors technology for incorporation into operational systems and training programs. This technology is designed to reduce training and personnel requirements and to enhance mission performance in such areas as global surveillance, joint operations, mission planning, data fusion and Command and Control Warfare. The project supports Joint Chiefs of Staff Future Joint Warfighting Capabilities as well as requirements in several Joint Management Areas, including: Joint Space and Electronic Warfare/Intelligence (e.g., displays for integrating information from multiple sources); Joint Littoral/Strategic Sealift (e.g., aiding decision makers in complex tactical situations under stressful conditions); and Joint Surveillance (e.g., displaying information in formats optimized for the needs of different users).

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (\$150) Initiations:
  - (U) Display and User Enhancement Technologies (DUETS) - Evaluated the application of 3D visualization to specific warfare areas. While 3D rendering is becoming more available for high-end computer users, little data are available as to its best application in naval warfare. A requirements analysis was completed for selected warfare areas. This was combined with an

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N

PROGRAM ELEMENT TITLE: Manpower, Personnel, and  
Training Advanced Technology  
Development

PROJECT NUMBER: R1771

PROJECT TITLE: Ship Human Factors  
Engineering

assessment of the 3D rendering capabilities available in current and planned TAC computer systems. From these analyses, a prototype 3D rendering capability will be developed for the TAC suite.

- (\$1,945) Continuations:
  - (U) Continued development and user evaluation of the Advanced C2 Workstation (AWS). Completed integration of hardware, user-computer interface and ergonomic design of the workstation. Conducted demonstrations and user evaluation workshops.
  - (U) Acoustic Detection Aids (ADA) - Completed laboratory performance evaluation of Active Adjunct Processor displays with color-coded Doppler information, including surface duct and variable depression search displays. Developed a color-code recommendation for the multi-ping classification algorithms included in the Active Adjunct Processor. Developed a recommendation for the query-readout area of the human-system interface for the multi-ping classification system. Designed a laboratory evaluation of the performance of the recommended multi-ping classification interface.
  - (U) Completed development and prototype testing in both shore and afloat environments of the Command and Control Warfare Commander (C2WC) information management and planning module. Documented C2W module requirements. Transitioned software and requirements to Joint Maritime Command Information System (JMCIS) program.
  - (U) Collaborative Decision Technology (COLAB) - Usability evaluation of the application tools (OPNAV Requirements, Help, Training, and Activity) continued and overall before-after performance improvement measurements were determined. Prototype system installed at CINCLANTFLT.
- (\$415) Completions:
  - (U) Completed development and refinement of existing prototype architecture for CINCPAC Mission Analysis Political Military Anchor Desk (PMAD), particularly in the implementation of object-oriented linking. The database management system was improved and streamlined, and an advanced user interface was implemented. New collaborative tools were added, information manipulation and presentation tools were enhanced, and intelligent agent capabilities were added. Product transitions to Gaming and Simulation facility (J-53) at CINCPAC.

2. (U) FY 1998 PLAN:

- (\$450) Initiations:
  - (U) Human Performance Requirements and Testing in Early Ship Design and Acquisition (HPRT) Develop, demonstrate, and validate modeling and simulation tools to support the analysis, design, and evaluation for human performance in the early phases of ship design. Survey/incorporate existing modeling and simulation

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT NUMBER: R1771  
Training Advanced Technology      PROJECT TITLE: Ship Human Factors  
Development      Engineering

tools and applications appropriate for evaluating ergonomic and human performance requirements in a reduced manning environment.

- (\$600) Continuations:
  - (U) Design information management tools and select display graphics, icons and tactical symbols for the AWS. Innovative graphic formats will be sought which have value-added to enhance user performance. Visualization and auditory information management tools will be investigated to determine a candidate set for inclusion in the design phase. Initial focus will be on 2D and 3D visual and auditory information visualization tools.
  - (U) The DUETS task is deferred until FY 1999 due to insufficient funds.
- (\$537) Completions:
  - (U) Complete for the ADA task laboratory performance testing of the recommended multi-ping classification interface for the Active Adjunct Processor. Coordinate with Naval Undersea Warfare Center on the transition of laboratory tested interface recommendations into the Active Adjunct Processor design specifications.
  - (U) Complete final field testing of C2WC software in both ashore and afloat environments. Transition software and requirements to Joint Maritime Command Information System (JMCIS) program.
  - (U) Complete and document the integrated collaborative ORD/MNS package for the COLAB task. Install final versions at CINCLANTFLT N-8 as well as other Fleet and TYCOM commands in both the Atlantic and Pacific theater.

### 3. (U) FY 1999 PLAN:

- (\$869) Initiations:
  - (U) 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. Identify and map both visual and auditory alerting modalities onto ongoing tactical console operator task activities.
  - (U) Develop an improved doctrine system which will intelligently assist tactical console operators in doctrine development, evaluation, modification, visualization, and use. Provide a means to write doctrine statements using natural language terms and 3D object manipulation. Evaluation of doctrine will be assisted by graphically displaying the implications of each doctrine statement using 3D graphics and track symbology. Graphics associated with related systems will be integrated with doctrine visualization.
  - (U) Develop collaborative, intelligent, and mobile watchstander aids that utilize a hands-free, wireless, wearable computer that can operate anywhere on the ship and interface with all computer consoles throughout the ship. Provide users with the ability to request, be given, taken, or share information with other

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N

PROGRAM ELEMENT TITLE: Manpower, Personnel, and  
Training Advanced Technology  
Development

PROJECT NUMBER: R1771

PROJECT TITLE: Ship Human Factors  
Engineering

operators. System will incorporate natural interfaces such as eye gazes, finger pointing, voice, gestures, and grease pencils.

- (\$700) Continuations:
  - (U) Develop a plan for integrating, modifying, and augmenting identified available human performance models and tools for the HPRT task. Establish a Modeling and Simulation Human Performance Test station which will be a repository of all the applicable modeling and simulation tools needed for reduced manning performance evaluation. Validate models against new ship acquisition requirements.
  - (U) Enhanced user-computer interfaces will be developed for the DUETS 3D system. Software modifications, if required, will be made to JMCIS, the Common Operating Environment software, and the Joint Mapping Tool Kit, to allow operation with different device interfaces and to generate the 3D rendering displays.
- (\$525) Completions:
  - (U) Complete user evaluations and overall system integration of the AWS. Document design and complete user's manual. Transition the technology adopted by the OSAW to the next-generation TAC and UYQ-70 program.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	2,095	2,132	2,171
(U) Appropriated Value:	-	1,635	-
(U) Adjustments from FY 1998 PRESBDG:	+415	-545	-77
(U) FY 1999 President's Budget Submit:	2,510	1,587	2,094

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 increase results from the revised economic assumptions reduction (-3) and actual execution (+418). The FY 1998 decrease results from the Congressional Undistributed Reductions (-541) and economic assumptions (-4). The FY 1999 reduction results from the Navy Working Capital Fund Surcharge Correction (-17), Navy Working Capital Fund adjustment (-33), Commercial Purchases Inflation Adjustment (-37) and Military & Civilian Pay Rates (10).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N

PROGRAM ELEMENT TITLE: Manpower, Personnel, and  
Training Advanced Technology  
Development

PROJECT NUMBER: R1771

PROJECT TITLE: Ship Human Factors  
Engineering

(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 0602270E (Technology Development)
- (U) PE 0603226E (Advanced Distributed Simulation)
- (U) PE 0604703N (Manpower, Personnel, Training, Simulation and Human Factors)

D. (U) SCHEDULE PROFILE: Not applicable.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1772 Education and Training Development	4,895	4,656	6,227	6,294	6,525	6,607	6,709	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses requirements in the Shore Training Joint Support Areas by focusing advanced technology on the acquisition and maintenance of complex skills through both individual and team training. It applies operations research and instructional, cognitive, and computer sciences in order to address requirements for improving (a) training throughput, 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.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (\$4,695) Continuations:
  - (U) Finalized material assessment case-based training scenarios and embedded case-based learning strategies into virtual scenes for the training prototype. Converted DDG-51 remaining main engine spaces from computer aided design (CAD) drawings into virtual scenes (VE). Initiated testing and revision of the VE training prototype.
  - (U) Continued development/demonstration/evaluation of Interactive Multisensor Analysis Training (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 undersea warfare.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1772  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Education and Training  
Training Advanced Technology      Development  
Development

Implemented and continued evaluation of IMAT development of advanced air, surface, subsurface shore-based officer training. Initiated at-sea training for submarine, surface, and air anti-submarine warfare (ASW) exercises.

- (\$200) Completions:
  - (U) Completed development and demonstration of Navy training reservation system and yield management models and mission critical/readiness models to optimize the use of training pipeline resources and maximize responsiveness to fleet Navy Enlisted Classification manning requirements.
- 2. (U) FY 1998 PLAN:
  - (\$1,786) Initiations:
    - (U) Initiate development of Deployable Sonar Operator/Tactician Training (DSOT) using IMAT methodology. IMAT methods are being generalized for sonar and tactical-planning training for on-board use in submarine pre-deployment and exercise training.
  - (\$2,870) Completions:
    - (U) Complete IMAT development and evaluation in shore school based Undersea Warfare training.
    - (U) Implement VE Training for Engineering prototype training program at surface warfare officer's school (SWOS), Newport, for schoolhouse test and evaluation. Provide on-site user support and technical documentation to the SWOS instructors, evaluators, and students. Collect, evaluate, and analyze beta test data and document results. Conduct initial cost-benefit analysis for Integrated Logistic Support package. Draft and finalize life cycle management plan.
- 3. (U) FY 1999 PLAN:
  - (\$2,466) Initiations:
    - (U) Identify selection criteria and participateng training communities for initial development of a semiautomated means for measuring training performance, diagnosing deficiencies and addressing critical job skills for development of a computer based training effectiveness evaluation system.
    - (U) Develop a set of adaptive and self-organizing agents to aid the exercise control team in the planning, real-time control, data collection and exercise analysis for training in distributive simulation environments.
    - (U) Develop computer-based training that provides qualities reasoning skills about circuits and troubleshooting of systems.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1772  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Education and Training  
Training Advanced Technology      Development  
Development

- (\$3,761) Continuations:
  - (U) DSOT development and evaluation, including on-board data collection, will be accomplished through iterative development and field testing. 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. The exercise data will be compared with expert protocols to determine the extent to which users evaluate more or different tactical alternatives and the depth and detail of their situational explanations and tactical plans.

B. (U) PROGRAM CHANGE SUMMARY

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	5,678	5,266	6,435
(U) Appropriated Value:	-	4,799	-
(U) Adjustments from FY 1998 PRESBUDG:	-783	-610	-208
(U) FY 1999 President's Budget Submit:	4,895	4,656	6,227

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 decrease results from the revised economics assumptions reduction (-7) and actual execution (-776). The FY 1998 decrease results from the Congressional Undistributed Reductions (-599) and economic assumptions (-11). The FY 1999 decrease results from the Navy Working Capital Fund Surcharge correction (+26), fully fund project M (-135), Commercial Purchases Inflation Adjustment (-110) and Military & Civilian Pay Rates (11).

(U) Schedule: Not applicable.  
(U) Technical: Not applicable.

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

(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 Laboratory Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0604703N (Personnel, Training, Simulation, and Human Factors)
- (U) PE 0603007A (Human Factors, Personnel, and Training Advanced Technology)

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N

PROJECT NUMBER:

R1772

PROGRAM ELEMENT TITLE: Manpower, Personnel, and  
Training Advanced Technology  
Development

PROJECT TITLE:

Education and Training  
Development

(U) PE 0603227F (Personnel, Training, and Simulation Technology)

(U) PE 0605798D (Joint Services Manpower and Personnel Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1773 Simulation and Training Devices	6,006	5,810	7,464	6,979	7,147	7,261	7,396	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 training and mission rehearsal capability by applying advanced simulation technology and innovative instructional concepts to the design of training systems. 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 (C4 & 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:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (\$1,312) Initiations:
  - (U) Initiated development of Transportable Strike/Assault Rehearsal System (TSTARS) for precision strike. Selected training and mission rehearsal requirements, simulation components and supporting databases. Began development and adaptation of physics based models for forward looking infrared radar (FLIR), radar, and night visions devices for real time training applications.
- (\$4,694) Continuations:

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DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1773  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Simulation and Training  
Training Advanced Technology      Devices  
Development

- (U) Demonstrated, tested and evaluated Shipboard Instructor Training (SITS) task hand held tactical aid onboard ships in support of afloat training and Battle Force Tactical Trainer (BFTT) in order to improve tactical team training and complex decision making. Incorporated scenario preparation module and automatic debrief guides in order to support event-based training approach in deployed systems.
- (U) Demonstrated innovative instructional and simulation techniques for sonar employment training using COTS hardware in order to greatly improve training and to reduce training system costs by a factor of ten and improve detection range and accuracy.
- (U) Demonstrated an automated performance recording system to greatly improve deployable tactical training and decision making. Continue the development of a human performance model in order to automate performance assessment of individual and team skills.
- (U) Demonstrated improved virtual environment for submarine piloting technology demonstration system in order to provide better training to reduce the potential of ship-handling errors and save lives and property.
- (U) Demonstrated initial embedded training capabilities (automated assessment, diagnosis and feedback) for Aegis application.

3. (U) FY 1998 PLAN:

- (\$665) Initiations:
  - (U) Develop and demonstrate an automated, deployable, multimedia system for training tactical knowledge and decision making skills. Select 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.
- (\$1,800) Continuations:
  - (U) Demonstrate Transportable Strike/Assault Rehearsal System for precision strike. Continue development and adaptation of physics based models for FLIR, radar, and night vision devices for real time training applications. Evaluate training mission rehearsal requirements, simulation components and supporting data bases.
- (\$3,345) Completions:
  - (U) Implement innovative instructional and simulation techniques for sonar employment training using COTS hardware in order to greatly improve training and to reduce training system costs by a factor of ten and improve detection range and accuracy.
  - (U) Implement automated performance recording and assessment of individual and team skills in order to greatly improve deployable tactical training and decision making.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1773  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Simulation and Training  
Training Advanced Technology      Devices  
Development

- (U) Implement improved virtual environment for submarine piloting technology demonstration system in order to provide better training to reduce the potential of ship-handling errors and save lives and property. Demonstrate connection to ship handling trainer for team training.
- (U) Implement vastly improved shipboard instructor support based on new technology onboard a ship in support of afloat training and BFTT in order to improve tactical team training and complex decision making.

#### 4. (U) FY 1999 PLAN:

- (\$3,492) Initiations:
  - (U) Initiate the development of the training function of readiness. To develop this relationship, training effectiveness will be determined from Measures of Effectiveness (MOEs)/Measure of performance (MOPs) data, which in turn will be investigated for their ability to predict readiness. Readiness indicators, or criteria, will be derived from performance during operational exercises.
  - (U) Initiate the development of a Training Continuum Readiness Model in order to optimize training and manpower resource decisions. This model will lead to increased readiness by having Navy Ships, submarines, and aircraft manned with the right people with the correct amount of training.
  - (U) Initiate the development of Virtual Environment officer of the deck (OOD) 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.
- (\$1,932) 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.
- (\$2,040) Completions:
  - (U) Implement Transportable Strike/Assault Rehearsal System for precision strike using validated training mission rehearsal requirements, simulation components and supporting data bases.

#### B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	5,800	6,341	7,700
(U) Appropriated Value:	-	5,988	-
(U) Adjustments from FY 1998 PRESBUDG:	+206	-531	-236
(U) FY 1999 President's Budget Submit:	6,006	5,810	7,464

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Budget Item Justification  
(Exhibit R-2, page 23 of 24)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603707N      PROJECT NUMBER: R1773  
PROGRAM ELEMENT TITLE: Manpower, Personnel, and      PROJECT TITLE: Simulation and Training  
Training Advanced Technology      Devices  
Development

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 increase results from the revised economic assumptions reduction (-7), actual execution (+213). The FY 1998 decrease results from the Congressional Undistributed Reductions (-518) and economic assumptions (-13). The FY 1999 increase results from the Navy Working Capital Fund Surcharge correction (+32), fully fund project M (-136) and Commercial Purchases Inflation Adjustment (-132).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(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 Laboratory Independent Research)
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0603216A (Synthetic Flight Simulator Devices Development)
- (U) PE 0603227F (Personnel, Training and Simulation Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	13,357	11,941	16,102	20,012	20,883	21,231	21,606	CONT.	CONT.
R2206 Environmental Requirements Advanced Technology (ERAT)	4,758	3,818	4,719	5,923	6,056	6,170	6,301	CONT.	CONT.
R2337 Smart Base	18,655	6,064	0	0	0	0	0	0	24,719
R2338 Nickel-Zinc Battery	931	0	0	0	0	0	0	0	931
R2380 Proton Exchange Membrane Fuel Cell	0	1,698	0	0	0	0	0	0	1,698
R2384 Visualization of Technical Information	0	1,941	98	73	0	0	0	0	2,112
<b>TOTAL</b>	<b>37,701</b>	<b>25,462</b>	<b>20,919</b>	<b>26,008</b>	<b>26,939</b>	<b>27,401</b>	<b>27,907</b>	<b>CONT.</b>	<b>CONT.</b>

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 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, maintenance, electronics logistics and replenishment.

(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

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

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.

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	13,357	11,941	16,102	20,012	20,883	21,231	21,606	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 would 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, such as Materials & Process and Ground & Sea Vehicles. This project responds to the Defense Science & Technology Strategy Areas of: 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 will typically fall into one of the following categories: electronics logistics, amphibious logistics, waterfront structures, and replenishment. 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 1997 ACCOMPLISHMENTS:

- (U) Sustainable Hardware and Affordable Readiness Practices (SHARP):
  - (U) (\$830) Demonstrated advanced electronic packaging cooling and interconnect techniques for support of high performance electronics. Tasks included high temperature packaging, advanced thermal interconnects, advanced convection cooling, dual use advanced photonics technology and high throughput interconnects.
  - (U) (\$727) Developed methods to capture electronic circuit assembly design with all of its constituent elements, independent of technology.
  - (U) (\$750) Continued development/technology insertion and demonstration of "AA" low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) (\$530) Developed/evaluated commercial and/or military photonics components and processes for application in advanced avionics systems.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) (\$745) Demonstrated improved repairability and logistics support in cost efficient and timely, transportable techniques and processes for replacing nonprocurable/unreliable electronic circuit assemblies. Specific tasks include mixed mode modeling and simulation and assisting weapon system designers in using commercial off the shelf (COTS) products.
- (U) (\$540) Evaluated the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.
- (U) Real-Time Infrared System Test Set (RTIR):
  - (U) (\$1,215) Demonstrated full scale RTIR test set in a realistic field environment and began transition to weapon systems programs. Performed optics upgrade fabrication and performed system integration.
- (U) Laser Weld Repair of Naval Materials:
  - (U) (\$860) Developed and demonstrated a laser repair cell utilizing a 3-dimensional telerobotic manipulator. Began transition of dual-use technology to government and commercial activities. Completed integration of 3-dimensional laser cell components. Constructed the working cell and developed a software control interface.
- (U) Diamond Film as Electronic Module Substrate:
  - (U) (\$320) Performed thermal, electrical and environmental module and enclosure tests and demonstrations. Performed module and enclosure integration, tested the thermal and environmental enclosures, and performed an end-of-project demonstration.
- (U) Battery Charger/Analyzer:
  - (U) (\$636) Developed battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.
- (U) Next Generation Test Generator (NGTG):
  - (U) (\$700) Developed and demonstrated the capability to perform fault diagnostics using neural network technology to develop test program set software for electronic systems.
- (U) Advanced Lighterage for High Sea State Operations:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) (\$1,580) Continued effort to demonstrate and evaluate improved lighterage platforms and connector systems.
  - (U) Waterfront Structures Repair and Upgrading:
    - (U) (\$1,946) Continued effort to demonstrate improved performance of new technology for waterfront structures.
  - (U) Gas Turbines Intelligent Lubrication Monitoring System:
    - (U)(\$170) Developed and demonstrated an approximate reasoning system for monitoring the lubrication system of a gas turbine engine.
  - (U) Water Mitigators for Ordnance Facilities:
    - (U) (\$408) Developed design criteria for water mitigators in ordnance facilities to reduce exposure of personnel and property to unacceptable risks of injury and damage from accidental explosions.
  - (U) D-Day Mobile Fuel Distribution:
    - (U) (\$700) 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.
  - (U) Low Cost Radio Frequency (RF) Power Measurement Devices:
    - (U) (\$700) 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.
2. (U) FY 1998 PLAN:
- (U) (\$2,000) Condition Base Maintenance (CBM) ACI:
    - (U) Continue advanced development of material for CBM oil analysis and machinery diagnostics.
  - (U) (\$200) Affordability:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) 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) CINC Support:
  - (U) Fleet/Force CINC Commands will evaluate and provide feedback on selected "mature" technologies.
- (U) SHARP:
  - (U) (\$502) Demonstrate 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) (\$565) Continue development/technology insertion and demonstration of "AA" low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) (\$300) Develop/evaluate commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) (\$700) Continue to demonstrate improved repairability and logistics support in cost efficient and timely, transportable techniques and processes for replacing nonprocurable/unreliable electronic circuit assemblies.
  - (U) (\$493) Evaluate the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.
- (U) NGTG:
  - (U) (\$100) Develop and demonstrate the capability to perform fault diagnostics using neural network technology to develop test program set software for electronic systems.
- (U) Advanced Lighterage for High Sea State Operations:
  - (U) (\$975) Continue effort to demonstrate and evaluate improved lighterage platforms and connector systems.
- (U) Waterfront Structures Repair and Upgrading:
  - (U) (\$948) Continue effort to demonstrate improved performance of new technology for waterfront structures.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) RTIR:
    - (U) (\$780) Complete optics upgrade fabrication, and perform system integration for Real Time Infrared Test Set.
  - (U) Battery Charger/Analyzer:
    - (U) (\$823) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.
  - (U) Water Mitigators for Ordnance Facilities:
    - (U) (\$531) Develop design criteria for water mitigators in ordnance facilities. Reduce exposure of personnel and property to unacceptable risk of injury and damage from accidental explosions.
  - (U) D-Day Mobile Fuel Distribution:
    - (U) (\$987) 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) Low Cost RF Power Measurement Devices:
    - (U) (\$795) 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) Naval Total Asset Visibility (NTAV):
    - (U) (\$550) Demonstrate the concepts of wide-area asset visibility using radio frequency identification (RFID) technology and interoperability with logistics command and control systems.
  - (U) Laser Weld:
    - (U) (\$400) Complete demonstration of a laser repair cell utilizing a 3-dimensional telerobotic manipulator.
3. (U) FY 1999 PLAN:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) SHARP:
  - (U) (\$1,049) Continue development/technology insertion and demonstration of "AA" low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) (\$959) Develop/evaluate commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) (\$1,269) Continue to demonstrate improved repairability and logistics support in cost efficient and timely, transportable techniques and processes for replacing nonprocurable/unreliable electronic circuit assemblies.
  - (U) (\$869) Continue to evaluate the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.
  - (U) (\$908) Investigate above-deck radar system components to determine causes and potential solutions for corrosion of connectors/interconnectors.
- (U) Battery Charger/Analyzer:
  - (U) (\$1,097) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.
- (U) D-Day Mobile Fuel Distribution:
  - (U) (\$1,236) 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) Low Cost RF Power Measurement Devices:
  - (U) (\$1,370) 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) NTAV:

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Budget Item Justification  
(Exhibit R-2, page 8 of 16)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) (\$1,750) Continue to demonstrate the concepts of wide-area asset visibility using (RFID) technology and interoperability with logistics command and control systems.
- (U) Built-In Calibration (BIC) for Micro Electro Mechanical Systems (MEMS) Sensors:
  - (U) (\$1,055) Develop and demonstrate BIC technology for MEMS sensors.
- (U) Advanced Logistics Configuration Management System:
  - (U) (\$1,400) 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) (\$3000) Affordability:
  - (U) Affordable Hight 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.

## B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	13,535	14,314	15,277
(U) Appropriated Value:	-	12,745	-
(U) Adjustments from FY98 PRESBUDG:	-178	-2,373	+825
(U) FY 1999 President's Budget Request:	13,357	11,941	16,102

## (U) CHANGE SUMMARY EXPLANATION:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

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) Funding: FY 1997 change reflects revised economic assumptions (-17) and actual execution updates (-161). FY 1998 change reflects Congressional undistributed (-346), revised economic assumptions (-27) and fiscal constraints (-2,000). FY 1999 change reflects a Navy Working Capital Fund (NWCF) adjustments (-85), commercial purchase inflation adjustments (-319), a realignment of the Affordability program to match the changing warfare and mission priorities (+3,200), S&T adjustment to fund Vector (-2,000) and Military and Civilian Pay Rates (+29).

(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 0602233N (Readiness Training & Environmental Quality Technology)

(U) PE 0602234N (Materials, Electronics, and Computer Technology)

(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2206 Environmental Requirements Advanced Technology (ERAT)	4,758	3,818	4,719	5,923	6,056	6,170	6,301	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 DoD begin to lower overall compliance and cleanup costs. The Defense Technology Area Plan (DTAP) responds to the growing concern of restriction on peacetime operations and the cost of compliance from 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 waste 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 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 1997 ACCOMPLISHMENTS:

- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) (\$1,091) Initiated multi-national program for full scale pierside treatment demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.
- (U) Marine Mammal Mitigation:

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Budget Item Justification  
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Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROJECT NUMBER: R2206

PROGRAM ELEMENT TITLE: Environmental Quality &  
Logistics Advanced Technology

PROJECT TITLE: Environmental Requirements  
Advanced Technology

- (U) (\$897) Initiated development of mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals and began development of safety criteria for the impact of environmental sound on marine mammals.
  - (U) Automated Underwater Hull Maintenance/Monitoring System:
    - (U) (\$1,761) Continued development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.
  - (U) Shipboard Non-Oily Wastewater Treatment:
    - (U) (\$368) Completed and delivered shipboard demonstration of selected wastewater minimization technologies; transitioned to Naval Sea Systems Command (NAVSEA) for acquisition/implementation.
  - (U) Thermoacoustic Cooling:
    - (U) (\$641) Initiated development and demonstration of a three-ton capacity thermoacoustic refrigeration unit for shipboard application.
2. (U) FY 1998 PLAN:
- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
    - (U) (\$904) Continue 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) Marine Mammal Mitigation:
    - (U) (\$774) Continue 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) Automated Underwater Hull Maintenance/Monitoring System:
    - (U) (\$1,152) Continue development and integration of hull sensors, cleaning tools and toxic paint capture and treatment technologies to automated underwater vehicle.
  - (U) Thermoacoustic Cooling:

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N

PROJECT NUMBER: R2206

PROGRAM ELEMENT TITLE: Environmental Quality &

PROJECT TITLE: Environmental Requirements

Logistics Advanced Technology

Advanced Technology

- (U) (\$988) Continue development and demonstration of a three-ton capacity thermoacoustic refrigeration unit for shipboard application.

### 3. (U) FY 1999 PLAN:

- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) (\$843) Demonstrate multi-national program for full scale pierside demonstration of shipboard generated blackwater and graywater by advanced combined aeration and membrane technologies.
- (U) Marine Mammal Mitigation:
  - (U) (\$1,771) 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) Thermoacoustic Cooling:
  - (U) (\$1,377) Demonstrate a three-ton capacity thermoacoustic refrigeration unit for shipboard application.
- (U) Innovative Coatings Husbandry Technologies:
  - (U) (\$728) Demonstrate a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

### B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	5,621	3,935	4,795
(U) Appropriated Value:	-	3,504	-
(U) Adjustments from FY98 PRESBUDG:	-863	-117	-76
(U) FY 1999 President's Budget Request:	4,758	3,818	4,719

### (U) CHANGE SUMMARY EXPLANATION:

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603712N      PROJECT NUMBER: R2206  
PROGRAM ELEMENT TITLE: Environmental Quality &      PROJECT TITLE: Environmental Requirements  
Logistics Advanced Technology      Advanced Technology

(U) Funding: FY 1997 adjustments reflect revised economic assumptions (-7), and actual execution updates (-856). FY 1998 reflects Congressional undistributed (-108) and changes in economic assumptions (-9). FY 1999 adjustments reflect Navy Working Capital Fund (NWCF) surcharge correction (-3), and changes in inflation rates (-83) and Military & Civilian Pay Rates (+10).

(U) Schedule: Not applicable.

(U) Technical: Marine Mammal Mitigation effort strengthened.

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 (Readiness Training & Environmental Quality Technology)

(U) PE 0602234N (Materials, Electronics, and Computer Technology)

(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N  
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2384 Visualization of Technical Information	0	1,941	98	73	0	0	0	0	2,112

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Develop a cost-effective automated conversion 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 DoD-Industry initiative for making cost-effective use of computer technology and interoperability.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS: Not Applicable.

2. (U) FY 1998 PLAN: (Congressional Plus-up)

- (U) (1,941) Develop 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 MIL-D-87269..

3. (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.

B. (U) PROGRAM CHANGE SUMMARY:

(U) FY 1998 President's Budget:	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
	0	0	0

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

Date: February 1998

BUDGET ACTIVITY: 3      PROGRAM ELEMENT: 0603712N      PROJECT NUMBER: R2384  
PROGRAM ELEMENT TITLE: Environmental Quality &      PROJECT TITLE: Visualization of Technical  
Logistics Advanced Technology      Information

(U) Appropriated Value:	-	2,000	-
(U) Adjustments from FY98 PRESBUDG:	0	-59	-2
(U) FY 1999 President's Budget Request:	0	1,941	98

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 changes reflect Congressional Plus-up (+2,000), general reductions (-55) and economic assumptions (-4). FY 1999 adjustments reflect Commercial Purchases Inflation Adjustment (-2).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

D. (U) SCHEDULE PROFILE: Not applicable.

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Budget Item Justification  
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# UNCLASSIFIED



# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N

PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2226 Mine and Expeditionary Warfare Advanced Technology	40,005	36,148	41,710	48,930	45,965	46,862	47,940	CONT.	
R2340 Power Blade	842	0	0	0	0	0	0	842	842
R2381 LCAC GPU-5 Gunpod		728	0	0	0	0	0	728	728
TOTAL	40,847	36,876	41,710	48,930	45,965	46,862	47,940	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 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 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.

R-1 Line Item 26

Budget Item Justification  
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# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N

PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) Task SW MINE COUNTERMEASURES (MCM) Demonstration (DEMO) was begun in FY 1992 and was designed to determine the applicability of the Magic Lantern Deep Water mine detection system in the Surf Zone/Beach Zone (SZ/BZ) environment. This task was completed in FY 1995.

(U) Task ADVANCED MINE AND OBSTACLE CLEARANCE was begun in FY 1993 and includes the technology demonstration known as EXPLOSIVE NEUTRALIZATION (EN). EN has as its focus to enhance the neutralization of mines and obstacles in the SZ/BZ by enhancing the existing or scheduled Marine Corps and Navy systems. EN addresses technologies required to meet the SW MCM Operational Requirements Document (ORD), Revision 1, dated 16 DEC 1994. There are four basic foci: enhanced line charge deployment using larger rocket motors from Landing Craft, Air Cushion (LCAC), enhanced deployment of explosive net arrays into the SZ with dual rockets from LCAC, advanced fire control, and glider-deployed explosive net arrays with shape charges for the BZ. EN is scheduled to be completed in FY 1998, and will transition to PE 0603502N.

(U) Task ADVANCED MINE SWEEPING was begun in FY 1993 and includes the technology demonstration known as ADVANCED LIGHTWEIGHT INFLUENCE SWEEP SYSTEM (ALISS). ALISS has as its focus to develop superconducting magnets and acoustic transducers suitable for sweeping influence mines that are capable of targeting a particular class of ships. The technologies developed are designed to be lightweight, modular, with low logistical requirements and, with appropriate scaling, could be deployed on a variety of platforms. ALISS addresses requirements outlined in the SW MCM ORD, Revision 1, dated 16 December 1994. ALISS is currently scheduled for completion and transition to PE 0603502N in FY 1998.

(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.

(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

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Budget Item Justification  
(Exhibit R-2, page 2 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N

PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

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 will be 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 (JCOS) and a Command, Control, Communications, Computers and Intelligence (C4I) 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 ranging 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 /Ultra HF, 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, AND FIRE CONTROL 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) 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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Budget Item Justification  
(Exhibit R-2, page 3 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N

PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

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.

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Budget Item Justification  
(Exhibit R-2, page 4 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2226 Mine and Expeditionary Warfare Advanced Technology	40,005	36,148	41,710	48,930	45,965	46,862	47,940	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 1997 ACCOMPLISHMENTS:

- (U) (\$12,289) ADVANCED MINE and OBSTACLE CLEARANCE: Demonstrated at-sea deployment of inert line charge and SZ array from air cushion platform using fire control algorithms and control of LCAC. Demonstrated SZ neutralization in Joint Countermine ACTD. Began transition of the explosive array technology to PE 0603502N for integration with tactical delivery systems. Completed fabrication of final sub-scale BZ net array and delivery system.
- (U) (\$7,860) ADVANCED MINE SWEEPING: Completed fabrication and final laboratory testing of acoustic and magnetic subsystems. Began implementation and integration aboard technology demonstration test platform.
- (U) (\$5,980) ADVANCED DEGAUSSING: Completed analysis of test results of ship deperming and algorithm development of degaussing controllers. Completed corrosion current source reduction analyses for MCM ships. Completed stray, and eddy current source reduction analyses for MCM ships. Initiated closed loop degaussing tests with on-board sensor suite on a surface combatant to develop prediction algorithms.
- (U) (\$2,696) ADVANCED SURVEILLANCE/RECONNAISSANCE: Utilized advanced sensors to measure critical battle space parameters and quantified their effectiveness. Demonstrated capabilities in automatic target recognition and multi-sensor data fusion. Participated in JCM ACTD Demo.

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Budget Item Justification  
(Exhibit R-2, page 5 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

- (U) (\$1,200) MODELING AND SIMULATION: Completed modeling and simulation to investigate the military utility of potential Mine and Expeditionary Warfare systems. Provided background for selection of prototyping projects.
- (U) (\$7,000) JCM ACTD: Conducted first major JCM ACTD operational demonstration on the East Coast of the United States in conjunction with Commander in Chief, United States Atlantic Command component forces in a Joint Task Force Exercise. Demonstrated enhanced near-term/near shore countermine capabilities. Began analysis of demonstration data. Completed planning and other preparations for the second demonstration. Completed planning for support of "residual" equipment.
- (U) (\$1,480) ADVANCED AIRBORNE TARGET DESIGNATOR: Began effort to integrate laser rangefinder aboard helicopter with Global Positioning System (GPS), and radio communication links back to fire control coordinator. Initiated packaging and configuration design studies. Conducted lab testing of prototype hardware and software.
- (U) (\$1,400) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Performed limited communication system interoperability tests in a laboratory and range environment. Developed a simulation characterizing network performance in an operational environment.
- (U) (\$100) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Initiated packaging studies and cost analyses of radar, signal processor and data link.

## 2.(U) FY 1998 PLAN:

- (U) (\$6,400) ADVANCED MINE AND OBSTACLE CLEARANCE: Demonstrate 1/5 scale BZ array (inert) and deployment system. Transition to PE 0603502N. Demonstrate inert explosive line charges, SZ array, fire control in JCM ACTD Demo.
- (U) (\$4,200) ADVANCED MINE SWEEPING: Complete integration of acoustic and magnetic subsystems on platform. Conduct final tests of both systems and perform field tests. Demonstrate ALISS technologies in the JCM ACTD. Transition to PE 0603502N.

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Budget Item Justification  
(Exhibit R-2, page 6 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

- (U) (\$5,100) ADVANCED DEGAUSSING: Complete tests of closed-loop degaussing algorithms, advanced deperming, and stray field minimization technologies. Begin transition to PEs 0603513N, 0603502N, and to the LPD-17 program.
- (U) (\$3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue utilizing advanced sensors to measure critical battle space parameters and quantify their effectiveness. Demonstrate increased timeliness and utility by participation in JCM ACTD Demo. Begin focused efforts upon beach topography, off-shore currents, and surf conditions in real-time.
- (U) (\$1,000) MODELING AND SIMULATION: Initiated modeling and simulation to conduct concept based assessment of potential Mine and Expeditionary Warfare technologies. The effort will emphasize 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 (OMFTS), Sea Dragon).
- (U) (\$7,000) JCM ACTD: Finalize plans for and conduct second major JCM ACTD demonstration. Build on lessons learned from Demonstration I and emphasize clandestine mine surveillance/reconnaissance and detection capabilities. Demonstrate complete JCOS and C4I appliqué. Complete analysis of Demonstration I data; begin analysis of Demonstration II data. Begin support for "residual" equipment left with operational forces for further evaluation.
- (U) (\$1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Initiate field tests with live fires to determine accuracy of targeting to results fire locations. Complete documentation of field test results and quantification of localization accuracy.
- (U) (\$1,800) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue performing communication system interoperability tests in a laboratory and range environment. Develop prototype mobile route for airborne platforms.
- (U) (\$1,348) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Demonstrate emerging COTS technologies for real-time management and visualization of the Littoral Battlespace. Quantify capabilities and conduct assessment of potential increase in effectiveness and commensurate reduction of vulnerabilities of expeditionary forces.

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Budget Item Justification  
(Exhibit R-2, page 7 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

- (U) \$4,000) MINE IDENTIFICATION: Initiate effort to identify mines from Air Mine Countermeasures (AMCM) helicopters using underwater laser imaging techniques. The approach to be used will modify commercial off-the-shelf laser imaging technologies, such as Streak Tube Imaging Laser (STIL), Laser Imaging Detection and Ranging (LIDAR), receiver array technologies, and pulsed-power lasers to acquire images for underwater mine identification. Receiver design will be multi-spectral to enable fluorescence measurements for enhanced identification range. Planned efforts include modification of existing lasers to provide the necessary power and pulse width (for three dimensional imaging and ambient light rejection) modification of receiver components, and to conduct laboratory testing of individual components.

### 3.(U) FY 1999 PLAN:

- (U) (\$3,770) ADVANCED DEGAUSSING: Complete all efforts in advanced deperming, closed loop degaussing, and algorithm development and documentation. Complete transition to PEs 0603513N, 0603502N, and the LPD-17 construction program.
- (U) (\$3,500) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue focusing efforts on environmental parameters, including offshore bathymetry, optical clarity, and other essential elements of information appropriate to amphibious assaults.
- (U) (\$1,500) MODELING AND SIMULATION: Continue simulation based concept based assessment of expeditionary and mine warfare technologies. 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.
- (U) (\$2,700) JCM ACTD: Complete analysis of Demonstration II data. Document demonstration results. Continue logistics support for ACTD "residual" equipment left with operational forces. Complete JCOS and C4I documentation. Incorporate "user" comments into final ACTD documentation.
- (U) (\$1,800) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete field tests with live fires to determine accuracy of targeting to resulting fire locations. Complete documentation of field test results and quantification of localization accuracy.

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Budget Item Justification  
(Exhibit R-2, page 8 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

- (U) (\$3,500) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Complete communication system interoperability tests in a laboratory and range environment. Fabricate and demonstrate system with prototype mobile route for airborne platforms in operational context.
- (U) (\$3,000) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Initiate limited range and laboratory tests of moving target indicator radar with small size, weight, and power requirements suitable for unmanned aerial vehicle (UAV) applications. Based upon limited tests, determine if the accuracy and resolution of the radar targeting subsystem is appropriate for PGM. Develop and begin integrating radio link.
- (U) (\$4,140) 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) (\$3,600) VSW/EOD RECONNAISSANCE: Initiate integration of diver-portable detection, classification, and identification technologies such as diver-portable sonars, underwater imaging lidar, and autonomous underwater vehicles. 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. Technologies include distributed, autonomous systems and advanced acoustic, electro-optic, and signal processing for mine detection, classification, and identification. Initiate development of a system for neutralization of mines. Candidate systems being considered include: directed energy, focused pressure shock waves , and articulated tracked vehicles for neutralization of bottom and close-tethered mines. Actual system concept and design will determined based upon technical maturity, operational viability, and anticipated cost of operation.
- (U) (\$5,169) SZ/BZ 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/BZ environments. Candidate systems now being considered include: small, tracked vehicles that randomly search the SZ/BZ areas and parachute-deployed explosive nets with shape charges capable of

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Budget Item Justification  
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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

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  
Tehnology

neutralizing combined obstacle and mine fields. Actual system concept and design will determined based upon technical maturity, operational viability, and anticipated cost of operation.

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$39,801	\$41,602	\$44,492
(U) FY 1998 Appropriated Value:	-	\$37,602	-
(U) Adjustments from 1998 PRESBUDG:	\$204	-\$5,454	\$-2,782
(U) FY 1999 President's Submit:	\$40,005	\$36,148	\$41,710

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 increase consists of SBIR assessment (-\$825), Revised Economic Assumption (-\$49), actual execution updates (+\$1,078). The FY 1998 reduction consists Fiscal Constraint Reduction (-\$4,000), economic assumptions (-\$83), Congressional Undistributed Reductions (-\$1,368), and NWCF Surcharge Correction (-\$3). The FY 1999 reduction consists of NWCF Corrections/Adjustments (-\$64), Commercial Purchase Inflation Adjustment (-\$770), Military and Civilian Pay Rates (+\$52), and Science and Technology adjustment for Vector (-\$2,000).

(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 0602131M (Marine Corps Landing Force Technology)  
(U) PE 0602314N (Undersea Warfare Surveillance Technology)  
(U) PE 0602315N (MCM, Mining and Special Warfare Technology)  
(U) PE 0602435N (Oceanographic and Atmospheric Technology)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N  
PROGRAM ELEMENT TITLE: Mine and Expeditionary  
Warfare Advanced Technology

PROJECT NUMBER: R2226  
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(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.

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Budget Item Justification  
(Exhibit R-2, page 11 of 11)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603792N

PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1889 Advanced Technology Demonstration	67,244	65,277	74,392	76,316	77,958	79,559	81,340	CONT.	CONT.
R2290 SLICE	1,866	0	0	0	0	0	0	0	9,758
R2382 Fast Patrol Craft	0	9,500	0	0	0	0	0	0	9,500
R2383 High Frequency Surface Wave Radar (HFSWR)	0	3,881	0	0	0	0	0	0	3,881
R2411 SWATH Technology Development	0	4,852	0	0	0	0	0	0	4,852
<b>TOTAL</b>	<b>69,110</b>	<b>83,510</b>	<b>74,392</b>	<b>76,316</b>	<b>77,958</b>	<b>79,559</b>	<b>81,340</b>	<b>CONT.</b>	<b>CONT.</b>

(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, Joint Warfighting Strategy and Capabilities Assessments, Joint Mission Area/Support Area Assessments, and the Science and Technology Requirements Roundtables. 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

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Budget Item Justification  
(Exhibit R-2, page 1 of 10)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603792N

PROGRAM ELEMENT TITLE: Advanced Technology Transition

structure. 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 TRANSITION 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.

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Budget Item Justification  
(Exhibit R-2, page 2 of 10)

# UNCLASSIFIED

# UNCLASSIFIED

FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603792N  
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R1889 Advanced Technology Demonstration	67,244	65,277	74,392	76,316	77,958	79,559	81,340	CONT.	CONT.

(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, Joint Warfighting Strategy and Capabilities Assessments, Joint Mission Area/Support Area Assessments, and the Science and Technology Requirements Roundtables. 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. The Navy S&T program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

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Budget Item Justification  
(Exhibit R-2, page 3 of 10)

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FY 1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1998

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603792N

PROJECT NUMBER: R1889

PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT TITLE: Advanced Technology Demonstration

## (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$4,500) EAGER (PREFERENTIAL ACQUISITION DECOY) -- Completed ATD: completed preliminary testing, assembled demonstration vehicle, integrated vehicle and payload, and conducted final demonstration.
- (U) (\$4,000) SHALLOW WATER (SW) TORPEDO GUIDANCE AND CONTROL -- Completed ATD: demonstrated the complete SW detection/classification/homing processing system using the MK50 and ADCAP sensors.
- (U) (\$380) AVIATION VEHICLE DIAGNOSTICS SYSTEM -- Completed ATD: demonstrated technology on H46 and H60 vehicles
- (U) (\$7,900) ADVANCED ENCLOSED MAST/SENSOR SYSTEM -- Completed ATD: fabricated at-sea mast, installed and conducted initial performance demonstration of at-sea mast; transitioned to advanced development for extended at-sea trials.
- (U) (\$4,835) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Continued ATD: completed performance assessment and hardware/software simulation activities.
- (U) (\$4,500) TACTICAL AIRCRAFT DIRCM -- Continued ATD: final preparations set in place for demonstration of advanced laser-based countermeasures against infrared seeking missiles through flight testing and field demonstrations of developed hardware and countermeasures techniques.
- (U) (\$5,295) COMPETENT MUNITIONS FOR THE 5" GUN -- Continued ATD: conducted inertial guidance fuse package demonstration.
- (U) (\$3,769) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Continued ATD: conducted demonstration of an advanced training prototype system.
- (U) (\$5,000) ADVANCED ELECTRONIC COUNTERMEASURES (ECM) TRANSMITTER FOR SHIP DEFENSE -- Continued ATD: completed fabrication, assembled and conducted component/subsystem testing.
- (U) (\$5,500) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SUPER HIGH FREQUENCY (SHF) PHASED ARRAY ANTENNA -- Continued ATD: built X-band module and performed design qualification tests.
- (U) (\$2,050) SMART SKINS ARRAY -- Continue ATD: conduct initial design, preliminary design review activities.
- (U) (\$4,388) LOW COST MISSILE SYSTEM -- Initiated ATD to demonstrate performance capability of a low cost, wingless and finless tactical missile to deliver payload at supersonic speeds. Performed design of airframe, actuator, control system and combustor and began fabrication of subsystems.
- (U) (\$3,950) MULTIFUNCTION ELECTROMAGNETIC RADIATING SYSTEM (MERS) -- Initiated ATD to demonstrate a low cost, shipboard antenna system that merges several sensors into a single antenna system. Completed antenna design and initiated fabrication of performance model.

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PROJECT NUMBER: R1889

PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) (\$2,765) "BEST BUY"-LOW COST CAPABILITY MULTIPLICATION FOR FIVE-INCH FIRE SUPPORT PROJECTILES -- Initiated ATD to demonstrate a high capacity projectile utilizing a high lift-to-drag composite airframe for launch from a five-inch gun. Designed and fabricated quick-connect joint which connects payload and propellant sections.
  - (U) (\$4,078) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Initiated ATD to demonstrate real-time connectivity with subsurface platforms operating at speed and depth using undersea tactical communications links with useful ranges and data rates. Defined system architecture including data rate/range capabilities, allocated frequencies and bandwidth. Developed interconnect and tested principal elements in local at-sea tests.
  - (U) (\$2,378) ADVANCED COMMUNICATIONS INTELLIGENCE (COMINT) VOICE PROCESSING -- Initiated ATD to demonstrate speech processing system to automatically interpret, sort and prioritize intercepted voice COMINT signals. Completed system design and performance trade-off; assembled and integrated algorithms.
  - (U) (\$1,956) Selected and performed planning for FY 1999-start ATDs. Conducted independent reviews of on-going ATD programs.
3. (U) FY 1998 PLAN:
- (U) (\$1,000) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Complete ATD: conduct simulation of flight time response and maneuver levels.
  - (U) (\$500) TACTICAL AIRCRAFT DIRCM -- Complete ATD: conduct flight testing and field demonstrations of developed hardware and countermeasures techniques.
  - (U) (\$4,231) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Complete ATD: conduct final demonstration of shipboard prototype and evaluate system performance.
  - (U) (\$4,500) ADVANCED ECM TRANSMITTER FOR SHIP DEFENSE -- Complete ATD: complete system integration, lab and field testing, and conduct final demonstration.
  - (U) (\$4,500) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SHF PHASED ARRAY ANTENNA -- Complete ATD: complete X-band antenna array fabrication; conduct demonstration in marine environment.
  - (U) (\$2,781) SMART SKINS ARRAY -- Continue ATD: fabricate Advanced Development Model (ADM) and conduct ADM ground test/analysis.
  - (U) (\$4,300) COMPETENT MUNITIONS FOR THE 5" GUN -- Continue ATD: complete laboratory testing of inertial-only guidance fuse package and global positioning system/inertial guidance fuse package.
  - (U) (\$6,095) LOW COST MISSILE SYSTEM -- Continue ATD: complete fabrication of subsystems. Integrate subsystems,

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- conduct aerodynamic/wind tunnel testing, hardware-in-the-loop simulation and booster insensitive munitions testing.
  - (U) (\$6,050) MERS -- Continue ATD: complete fabrication of performance model and conduct mast mock-up performance tests; build demonstration model and perform component shipboard environmental tests.
  - (U) (\$5,700) "BEST BUY" -- Continue ATD: fabricate and test composite airframe; fabricate and test high lift-to-drag airframe.
  - (U) (\$5,600) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Continue ATD: demonstrate 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 COMINT VOICE PROCESSING -- Continue ATD: fabricate and assemble voice processor components; conduct subsystem testing.
  - (U) (\$2,000) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS, AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Initiate ATD to demonstrate DNA vaccines designed to protect against complex, multistage microorganisms or against multiple simple pathogens. Perform gene cloning to produce human-use plasmids.
  - (U) (\$3,990) LOW OBSERVABLE MULTI-FUNCTION STACK -- Initiate ATD to demonstrate a surface ship composite exhaust stack having embedded multi-function satellite communication array antennas. Complete stack and antenna designs.
  - (U) (\$3,000) RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS) -- Initiate 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. Conduct tower demonstration of projectile lethality against key mine types.
  - (U) (\$4,900) AFFORDABLE ARRAY TECHNOLOGY -- Initiate ATD to demonstrate an affordable, reliable, and all-optical acoustic sensor/array technology for reconfigurable large aperture sonar arrays. Conduct lake tow test for baseline of thinline system noise.
  - (U) (\$2,130) Select and perform planning for FY 2000-start ATDs. Conduct independent reviews of on-going ATD programs.
4. (U) FY 1999 PLAN:
- (U) (\$4,000) SMART SKINS ARRAY -- Complete ATD: conduct F/A-18 ADM flight testing to demonstrate operational utility.
  - (U) (\$1,800) COMPETENT MUNITIONS FOR THE 5" GUN -- Complete ATD: conduct flight testing of a low cost, highly accurate guidance and control package for the standard 5" gun projectile.
  - (U) (\$4,508) LOW COST MISSILE SYSTEM -- Complete ATD: complete system integration and conduct flight tests.
  - (U) (\$5,600) "BEST BUY" -- Complete ATD: conduct long-range firing demonstration of projectiles ability to dispense submunitions over target area.

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PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) (\$4,400) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Complete ATD: demonstrate multi-net connectivity between submarines, ships, and aircraft at ranges up to 110 nmi.
- (U) (\$4,000) ADVANCED COMINT VOICE PROCESSING -- Complete ATD: perform system integration with ES-3 aircraft and conduct flight demonstration of automated voice processing system.
- (U) (\$5,000) ANTI-TORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Continue as an ATD coupled with NATO effort: continue simulation based design and begin at-sea tests in realistic environments.
- (U) (\$4,700) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Continue ATD: Complete gene modified plasmid production and characterization of pre-erythrocytic, and combination pre-erythrocytic and erythrocytic plasmid vaccines; seek Food and Drug Administration investigational new drug approval for these new vaccines.
- (U) (\$4,500) RAMICS -- Continue ATD: perform complete system integration of rapid fire gun, LIDAR and interface. Demonstrate targeting of the actual gun on a static platform.
- (U) (\$4,400) AFFORDABLE ARRAY TECHNOLOGY -- Continue ATD: conduct high speed self-noise tow test of a thinline acoustic module; implement miniaturized optical transmitter/receiver; conduct reeling test of prototype array design.
- (U) (\$5,100) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: demonstrate a surface ship composite exhaust stack having embedded multi-function satellite communication array antennas. Conduct shipboard component testing.
- (U) (\$5,000) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Initiate ATD to demonstrate full-scale plasma-arc pyrolysis system for controlled thermal destruction of shipboard wastes. Design and test feed subsystem in lab-scale reactor; demonstrate process control with various waste feed mixtures.
- (U) (\$3,500) 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) (\$4,200) ADVANCED LINEAR MOTOR -- Initiate ATD: demonstrate an aircraft recovery system using linear motor technology.
- (U) (\$4,350) 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.
- (U) (\$4,000) REDUCED SHIPS' CREW BY VIRTUAL PRESENCE -- Initiate ATD: demonstrate at sea an automated system providing environmental, machinery, structural and personnel situational awareness.
- (U) (\$3,800) SHIPBOARD MULTIFUNCTION/MULTIBAND RECEIVE SHARED APERTURE - Initiate ATD: develop and demonstrate radar, electronic warfare and communication functions in a phased array.

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PROJECT NUMBER: R1889

PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

- (U) (\$1,534) Select and perform planning for FY 2001-start ATDs. Conduct independent reviews of on-going ATD programs.

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PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	67,134	87,285	97,269
(U) Appropriated Value:		67,285	
(U) Adjustments from FY 1998 PRESBUDG:	110	-22,008	-22,877
(U) FY 1999 President's Budget Submission:	67,244	65,277	74,392

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 increase due to Execution Adjustments (+\$670), Small Business Innovation Research Assessment (-\$478) and Revised Economic Assumptions (-\$82). FY 1998 decrease due to Congressional Fiscal Constraints reduction (-\$20,000), Economic Assumptions (-\$149), and Congressional Undistributeds (-\$1,859). FY 1999 decrease reflects S&T Adjustments (-\$21,449), Navy Working Capital Fund (NWCf) Adjustments (-\$175), Commercial Purchases Inflation Adjustment (-\$1,316), and Military and Civilian Pay Adjustments (+\$63).

(U) Schedule: Not applicable.

(U) Technical: FY 1998 and outyear reductions force significant curtailment of ongoing and new-start ATDs.

(U) In addition several ATDs have been delayed at least one year:

- Anti-Torpedo Torpedo Technology for Surface and Submarine Applications
- Plasma-Arc Pyrolysis of Shipboard Solid Waste
- Long Endurance Low Frequency Acoustic Source

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

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PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

(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, Control, Intelligence, Surveillance + Recon (C3ISR))
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0602234N (Materials, Electronics & Computer Technology)
- (U) PE 0602270N (Electronic Warfare Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602435N (Oceanographic & Atmospheric Technology)
- (U) PE 0602633N (Undersea Warfare Weapon Technology)

D. SCHEDULE PROFILE: Not applicable.

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PROGRAM ELEMENT: 0603794N

PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 COMPLETE	TO PROGRAM	TOTAL
X2091 Space and Electronic Warfare (SEW) Advanced Technology	15,036	14,374	21,364	21,999	22,469	22,920	23,435	CONT.	CONT.
R2239 Advanced Targeting	16,754	7,245	930	923	915	929	947	CONT.	CONT.
TOTAL	31,790	21,619	22,294	22,922	23,384	23,849	24,382	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) develops Command, Control and Communications (C<sup>3</sup>) 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. The focus of this PE is to provide high quality of service information connectivity using maturing technology to optimally support all warfare needs. Efforts include development of command and control (C2) systems, high capacity communications; real time information processing of time critical tactical information; complex information processing support for deliberate precision weapons engagements; wide and local area networks of DII compatible computer work stations; distributed multi-level secure systems to process information with the full range of security classifications; integrated voice/data/video communications for optimum human systems interfaces; algorithms for specific target identification; interactive collaborative decision aids; low signature communications antennae and low probability of intercept communications to enhance platform survivability; C<sup>3</sup> embedded training; and automated processes to reduce associated manpower requirements.

(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<sup>3</sup> systems with high quality and certifiable quality of service to support joint war fighting operations, involving land units, ships, aircraft, and submarines. C<sup>3</sup> 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.

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PROGRAM ELEMENT: 0603794N

PROGRAM ELEMENT TITLE: C3 Advanced Technology

1. (U) SEW Advanced Technology (X2091) -- This project is pursuing work in communications apertures, computer networking, information security, and high quality of service information processing. Efforts will develop:
  - (a) Low observable, high data rate communications 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.
  - (b) State-of-the-art telecommunications technologies for high data rate over the air communications.
  - (c) High capacity information networks using commercially developed advanced information handling techniques such as Asynchronous Transfer Mode (ATM)/Synchronous switches and Optical Network technologies for multi-media communications that meet unique military data transfer requirements. 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. High speed 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.
  - (e) 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.
  - (f) Software Programmable Digital Electronics to replace conventional radios for all communications and Information Warfare.
  - (g) Lightweight, low signature Radar Cross Section (RCS) aperture that integrates the functions of the existing Ultra-High Frequency (UHF) Line of Sight (LOS) Communications, Joint Tactical Information Distribution System (JTIDS), Combat Direction Finding (DF), and Identity Friend or Foe (IFF) apertures.

(U) This program will match maturing information technologies with operational warfighting requirements to procure modern C4ISR capability based on an accelerated acquisition cycle. In addition to developing discrete techniques to perform C3 functions, this PE will provide systems engineering resources to integrate and demonstrate these functions with systems and platforms which they support. Interoperability with Joint C4ISR architectures and appropriate weapons systems will be emphasized. The land and sea based components of the Maritime Battle Center as well as fleet assets will be the primary demonstration vehicles for technologies developed under this PE.

2. (U) Advanced Targeting (R2239) -- This project is pursuing evaluation of current and emerging technologies to improve communications 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

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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) Advanced Targeting-Extending Littoral Battlespace (ELB): The ELB Advanced Concept Technology Demonstration (ACTD) will demonstrate/exploit emerging technologies (commercial and government) for use in the theatre-wide, real-time management of ELB. ELB will confirm the capabilities and potential applications to achieve a significant increase in effectiveness and a commensurate reduction of vulnerabilities of expeditionary forces.

(c) Radio Frequency (RF) Systems The RF System activity was established to identify shipboard and airborne overall RF system concepts, evaluate the required technologies to implement each concept, and produce a plan to develop an open system testbed architecture to demonstrate multifunction concepts.

(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.

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PROGRAM ELEMENT: 0603794N

PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 COMPLETE	TO PROGRAM	TOTAL
X2091 Space and Electronic Warfare (SEW) Advanced Technology	15,036	14,374	21,364	21,999	22,469	22,920	23,435	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 sensors 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.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$480) Specification Tools for Software Requirement (STSR): Transitioned robust toolset to New Nuclear Powered Attack Submarine (SSN) Program, multi-level security developers and commercial organizations. Evolved toolset into a production strength tool.
- (U) (\$540) Multi-Level Security (MLS): Tested and evaluated network security requirements resulting from the FY 1996 MLS Strike planning comparisons against assurance strategy/security architecture and security policy.

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Project Number: X2091

Project Title: (SEW)

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- (U) (\$984) Automated Integrated Communication Systems (AICS): Conducted analysis and specification of Communication Plan (COMMPLAN) processing requirements. Developed integration framework for AICS and Joint Maritime Communications (JMCOMS)/Automated Digital Network System (ADNS), Integrated Network Manager (INM). Developed architecture for Web-based management of INM. Implemented SNMPv2 prototype with security features. Conducted advanced planning and procurement to conduct a FY 1998 demonstration of AICS in conjunction with the Joint Power Protection/Real Time Support (JPP/RTS) land-based test site.
- (U) (\$2,185) Multifunctional Multibeam Broadband Antenna (MMBA): Performed initial development, cost analysis and risk reduction of multi-band and multi-beam ultra-high frequency (UHF)/L/K Band Satellite Communication (SATCOM) antennas.
- (U) (\$633) JPP/RTS: Initiated design and development of techniques to provide temporal and spatial management of real-time joint intelligence, surveillance, and reconnaissance information and injection into joint power projection planning, battle management and combat systems.
- (U) (\$2,005) JPP/RTS: In conjunction with national programs, conducted Joint Navy/Marine Corps AH-1 flight demonstration to assess advanced cockpit information management, situation awareness, and air-ground targeting capability in Commandant's Warfighting Laboratory Exercise Sea Dragon, Hunter Warrior.
- (U) (\$2,702) JPP/RTS: Demonstrated and tested 622 megabit per second local area networks (LAN) prototype supporting Asynchronous Transfer Mode (ATM) aware advanced planning, intelligence, and shipboard interior communications systems at Naval Strike Warfare Center (NSAWC), Fallon, NV. Designed improved power projection planning and execution segments identified for transition to the strike coordination module of the Joint Mission Planning System.
- (U) (\$2,220) JPP/RTS: Conducted dome simulator demonstration at helmet-mounted display and synthetic environment capability for Strike Fighter Weapons School Pacific Instructors. Developed mission management technology insertion device that provided open, modular architecture for incorporation of advanced processors from Air Force electronics programs, modular electronics and programmable digital electronics. Demonstration unit provided improved aircraft mission management capabilities and use of national and theater data for re-targeting and was configured for demonstration in AV-8B Harrier.

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PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: X2091

Project Title: (SEW)

Advanced Technology

- (U) (\$770) JPP/RTS: In conjunction with combat system advanced development for DD-21, conducted Phase I of the C4I/Combat system demonstration. Demonstration consisted of critical experiments integrating C4ISR systems within the computational resources of the combat system and exchanging real time off-board targeting information.
  - (U) (\$1,036) JPP/RTS: Outfitted additional carrier ready room on the CVN-71 USS Theodore Roosevelt with advanced planning and visualization suite and supported the demonstration during deployment. Completed evaluation documentation.
  - (U) (\$508) JPP/RTS: Provided engineering support to the Naval Sea Systems Command (NAVSEA) Topside Design Branch as related to LPD17 Advanced Enclosed Mast/Sensor (AEM/S) design.
  - (U) (\$508) Supported Technology Transition Works (TECHWORKS); effort to develop and implement a new system engineering process in a commercial-off-the-shelf (COTS) environment. Concept used an integrated approach incorporating operational, technical and systems architectural constructs, resulting in improved efficiency and enhanced capabilities in the current acquisition environment.
  - (U) (\$465) Chief of Engineering (CHENG): Developed and updated Naval C4ISR implementation guidance. Developed and updated Naval C4ISR mission to incorporate an overarching operational, systems, technical and information architecture. Conducted associated C4ISR analyses and studies.
2. (U) FY 1998 PLAN:
- (U) (\$829) Verification & Validation of Mission Critical Systems (VVMCS): Demonstrate capability for specifying information processing timing and accuracy requirements. Develop an enhanced simulator for measuring system behavior based on timing and accuracy requirements as well as functional requirements. Study commercial real time and guaranteed delivery software tools for capability to satisfy C<sup>3</sup> needs particularly in the area of certifying delivery of time critical ISR to remote units to serve SC-21 mission needs.
  - (U) (\$830) Topside: initiate efforts to support the design, development and validation testing of low signature (Radar Cross-Section, Infrared, and Radio-Frequency) ships. Efforts include the development of an Electro-Magnetic Interference Minimization Tool, identification of ship mission support equipment and their characteristics (bandwidth, EIRP, G/T, duration, beam pattern, etc.), development of the Commander's Ship Susceptibility Decision

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PROGRAM ELEMENT: 0603794N

PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: X2091

Project Title: (SEW)

Advanced Technology

Aid, and test facility design (assessing "deal" mix of modeling & simulation and test & evaluation) with a supporting implementation Plan of Action and Milestones.

- (U) (\$630) AICS: Update AICS network management architecture document and the AICS system segment specification documents with results of FY97 testing. Conduct operational demonstration of ATM hardware. Produce AICS Network Management Architecture Document and the AICS System Segment Specification Document incorporating FY98 updates.
- (U) (\$835) High Data Rate Communications (HDCR): Develop 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 Afloat Telecommunications Service (ATS). Identify and modify (if needed) a spread spectrum modem. Perform initial antenna pointing and link margin testing at sea. Perform HDR CDMA modem studies resulting in a specification for a HDR modem that will be designed to maximize the number of users in a given satellite transponder bandwidth.
- (U) (\$1,290) (TECHWORKS): Identify and implement the processes and resources needed to reduce the development and demonstration time for key technologies. Develop and demonstrate leading edge information processing and display technologies in a workstation environment that supports collaborative planning staff operations.
- (U) (\$2,390) Multifunctional Multi-beam Broadband Antenna (MMBA): Conduct extra high frequency (EHF) Satellite Communications (SATCOM)/GBS two-dimensional (2D) Receive Only Antenna sub-array demonstration. Conduct ultra high frequency (UHF) SATCOM/International Maritime Satellite (INMARSAT) sub-array demonstration to include hybrid reliability study and tracking/hand-off demonstration. Continue design and development of the antennas.
- (U) (\$630) Command and Control Multi-User in a Virtual Environment (C2 MUVE): Design, develop and demonstrate a set of robust Collaborative Workstation components for use within the JMCIS/GCCS Common Operating Environment (COE) in support of Distributed Group Collaboration (DGC).
- (U) (\$2,080) JPP/RTS: Integrate advanced visualization and correlation commercial-off-the-shelf/government-off-the-shelf (COTS/GOTS), prototype management and injection of real-time C4I and ISR information into battle management and combat systems in Joint Power projection planning and execution systems. Conduct demonstration at SPAWAR Systems Center, San Diego (SSC SD) with extensions to national information sources and Battle Labs.

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- (\$1,280) JPP/RTS: In conjunction with Navy and Joint programs, conduct in-flight demonstration of real time C4ISR information for special warfare planning and pilot rescue in H-60R at NSAWC, Fallon, NV.
  - (U) (\$2,690) JPP/RTS: Conduct Phase II of the C4I/Combat System demonstration for SC-21. This phase will provide real-time classified information sources, off-board communications links, and improved information integration to support over-the-horizon targeting in Joint littoral operations and validate DD-21 C4ISR systems concepts.
  - (U) (\$580) Maritime Battle Center (MBC): Initiate efforts to develop a Maritime Battle Center Innovation and Technology Transition Process. Advanced Operational Concepts/Scenarios, Future Battleship/Dial-a-ship, Dynamic Network Management, and Network Visualization/Presentation will be investigated.
  - (U) (\$310) CHENG: Develop and update Naval C4ISR implementation guidance. Develop and update Naval C4ISR mission to incorporate an overarching operational, systems, technical and information architecture. Conduct associated C4ISR analyses and studies.
3. (U) FY 1999 PLAN:
- (U) (\$1,030) VVMCS: Demonstrate advanced capability for verifying critical functional properties using model checking technology. Demonstrate an initial capability of commercial software tools for guaranteed C4ISR information delivery.
  - (U) (\$2,080) TOPSIDE: Continue efforts to develop the Electro-Magnetic Interference Minimization tool. Complete identification of ship mission support equipment and their characteristics (bandwidth, EIRP, G/T, duration, beam pattern, etc.) and make equipment and operational procedure recommendations to ship platform developers. Support development of new Tactics, Techniques and Procedures resulting from platform developer decisions. Demonstrate the Commander's Ship Susceptibility Decision Aid and get user feedback. Complete test facility design (assessing "ideal" mix of modeling & simulation and test & evaluation) and supporting implementation Plan of Action and milestones. Support stand-up of the test facility.
  - (U) (\$1,080) HDRC: Development of prototype system based on FY-98 efforts. Hardware implementation and testing of components and assembly and test of full up prototype system with special emphasis on ATS or other Navy assets.

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- (U) (\$2,500) TECHWORKS: Integrate Techworks Demonstration with tactical systems for at-sea experiments aboard USS Coronado. Identify and prototype high leverage/return technologies.
- (U) (\$3,350) MMBA: Complete design and begin fabrication and testing of UHF/L/K/Q Band Planar Phased Array SATCOM antennas.
- (U) (\$580) C2 MUVE: Develop an interactive 3-D environment using a client-server object-oriented architecture with the capability to share data, tools and information interactively among multiple planners.
- (U) (\$2,000) JPP/RTS: Identify and incorporate advanced correlation, fusion, and target recognition tools and demonstrate an advanced visualization prototype of shipboard integration of real-time ISR sources for SC-21, CVN-X, and following ships.
- (U) (\$2,791) JPP/RTS: Conduct major integrated demonstration of real-time planning and execution capabilities in conjunction with C4I/Combat System demonstration, Air Force battle management demonstrations Joint Forces Air Component Commander (JFACC) Advanced Concept Technology Demonstration (ACTD), national intelligence, and battlefield visualization demonstrations. Evaluate information timeliness, consistency, and quality of service from multiple sensor-shooter perspectives.
- (U) (\$5,080) Multi-function Electromagnetic Radiating System (MERS): Develop a lightweight, low signature (RCS) aperture that integrates the functions of the existing UHF LOS Communications, JTIDS, Combat DF, and IFF apertures. Will complete construction of antenna and conduct sea trials.
- (U) (\$873) Distributed Wireless Networking (DWN): Identify, develop, and integrate leading edge Commercial-Off-The Shelf (COTS) distributed wireless networking technologies that will be support distributed Staff Planning Operations in a tactical environment. At a minimum the following issues will be addressed: Security, Survivability, Mobility, Portability, Reliability, and Scalability.

B. (U) PROGRAM CHANGE SUMMARY:

FY 1997

FY 1998

FY 1999

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DATE: February 1998

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PROGRAM ELEMENT: 0603794N  
PROGRAM ELEMENT TITLE: C3 Advanced Technology

Project Number: X2091  
Project Title: (SEW)  
Advanced Technology

(U) FY 1998 President's Budget:	15,723	16,301	16,932
(U) Appropriated Value		14,901	
(U) Adjustments from FY 1998 PRESBUDG:	-687	-1,927	4,432
(U) FY 1999 President's Budget Submission:	15,036	14,374	21,364

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments reflect a Small Business Innovation Research (SBIR) transfer (-124), actual execution update (-544), and Revised Economic Assumptions (-19). FY 1998 adjustments reflect Congressional Undistributed reductions (-494), FY98 Fiscal Constraint Reduction (-1,400), and Economic Assumptions (-33). FY 1999 adjustments reflect S&T adjustments (-5,049), Navy Working Capital Fund (NWCFF) adjustment (-168), transfer MERS Advanced Technology (+10,000) from 0603792N, Commercial Purchases Inflation adjustment (-377), and Military and Civilian Pay Rates (+26).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED 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.

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DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N

PROJECT NUMBER: R2239

PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT TITLE: Advanced Targeting (C3I)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1997 ACTUAL	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2239 Advanced Targeting	16,754	7,245	930	923	915	929	947	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. The Advanced Concept Technology Demonstration (ACTD) for Extending the Littoral Battlespace (ELB) will demonstrate/exploit technologies (commercial and government) for use in theater-wide, real time communications management. ELB will confirm capabilities and potential applications of technologies to significantly increase the effectiveness of expeditionary forces, and provide a commensurate reduction of vulnerability to those forces through improved communications for Command and Control (C2), sensors, and fire and targeting information. The Radio Frequency (RF) System initiative will identify future overall shipboard and airborne RF systems concepts, and evaluate the required technologies to implement each concept. The RF systems initiative will produce a plan to develop an open system testbed architecture to evaluate and demonstrate future multifunction concepts and enabling technologies associated with improving RF Systems.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1997 ACCOMPLISHMENTS:

- (U) (\$3,839) DEMONSTRATION 5 RISK REDUCTION : Initiated pre-deployment risk reduction events. These events were planned to verify platform and communications interoperability prior to Demonstration 5. Demonstration 5 is to be

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PROJECT TITLE: Advanced Targeting (C3I)

conducted outside of the Continental United States and demonstrated the added capability of targeting continuous wave communications emitters. Additional refinements and upgrades to the signal processing and data fusion algorithms based on the results from previous demonstrations will be integrated into the processing system. Demonstration 5 includes developing specifications and acquisition of a Communication Intelligence (COMINT) target emitter capable of emulating a broad variety of COMINT transmitters.

- (U) (\$4,182) PSTS SYSTEMS ENGINEERING: Completed requirements analysis, operations concept developed, test planning and test procedures, and scheduling for Demonstration 5. In addition, systems engineering tasks initiated in FY96 were continued. These studies included basic and applied science study to determine the effects of the ionosphere on the transmission and geolocation of emitters; analysis to quantify and understand the subtle interactions among PSTS collection systems; empirical analysis of near real-time post collection knowledge of corrections to system errors to single source techniques; and other relevant system engineering trade studies.
- (U) (\$1,283) PSTS COMINT DATA FORMATTING: Translated COMINT data into format usable by common signal processor.
- (U) (\$689) PSTS INTEGRATED SENSOR TASKING (IST): Continued development of an IST effort to provided the capability to coordinate the collection management of tactical and national assets to support tactical exploitation of PSTS capabilities.
- (U) (\$1,749) EXTENDING LITTORAL BATTLESPACE (ELB) SYSTEMS ARCHITECTURE: Preliminary ELB system architecture definition and requirements activities were initiated.
- (U) (\$481) ELB SYSTEMS ENGINEERING: Completed the preliminary evaluation of potential implementation scenarios for the planned July 1998 Demonstration of ELB. This evaluation determined the availability for the planned demonstration of current and emerging technologies in the areas of Command Control (C2) for sensors, and fire and targeting requirements.
- (U) (\$1,652) ELB PLANNING AND DEFINITION: Demonstration planning activities were initiated, and participation scenarios were evaluated for FY1999 demonstrations.
- (U) (\$225) ELB CONOPS: Activities were initiated to begin an ELB Concept of Operations (CONOPS).

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PROGRAM ELEMENT: 0603794N

PROJECT NUMBER: R2239

PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT TITLE: Advanced  
Targeting (C3I)

- (U) (\$1,000) RADAR FREQUENCY (RF) SYSTEMS TESTBED ARCHITECTURE: Initiated testbed architecture, near, mid, and far term tactical systems definition by the participating industry teams and Naval Research Laboratory.
  - (U) (\$350) RF SYSTEMS REQUIREMENTS: Generated a comprehensive requirements database.
  - (U) (\$500) RF SYSTEMS-SYSTEMS DEFINITION: The open system architecture definition was initiated with the support of the Office of Secretary of Defense (OSD) open system architecture team.
  - (U) (\$350) RF SYSTEMS ENABLING TECHNOLOGIES: Initiated a solicitation for Advanced Multifunction Radio Frequency System (AMRFS) critical enabling technology efforts that would mature technologies for insertion into the planned testbed.
  - (U) (\$454) Collaborative Decisions Support Studies: Development of Software Test Tools for Collaborative decision making for emerging technologies.
2. (U) FY 1998 PLAN:
- (U) (\$4,656) DEMONSTRATION 5: Demonstration 5 will be conducted at sites in Korea and the Persian Gulf, 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 will be integrated into the processing system.
  - (U) (\$2,423) SYSTEMS ENGINEERING: Requirements analysis, operations concept development, test planning and test procedures, and scheduling for Demonstration 5 will be completed. System engineering studies required to meet Demonstration 5 and to support technology transition will be completed.
  - (U) (\$166) TECHNOLOGY TRANSFER: Complete documentation and configuration management of final PSTS systems including the tactical testbed.
3. (U) FY 1999 PLAN:
- (U) (\$930) LOGISTICS SUPPORT: Provide engineering, operations and maintenance support for deployed PSTS systems.

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DATE: February 1998

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603794N

PROJECT NUMBER: R2239

PROGRAM ELEMENT TITLE: C3 Advanced Technology

PROJECT TITLE: Advanced Targeting (C3I)

B. (U) PROGRAM CHANGE SUMMARY:

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) FY 1998 President's Budget:	\$12,299	\$ 7,467	\$ 948
(U) Appropriated Value	-	7,467	
(U) Adjustments from FY 1998 PRESBDG:\$	4,455	-222	-18
(U) FY 1999 President's Budget Submission:	\$16,754	\$ 7,245	\$930

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1997 adjustments reflect Revised Economic Assumptions (-15), and actual execution updates (+4,470). FY 1998 adjustments reflect Congressional Undistributed Reductions (-205), and Economic Assumptions (-17). FY1999 adjustments reflect Naval Working Capital Fund (NWCF) adjustment (-2), and Commercial Purchase Inflation Adjustment (-16).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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.

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