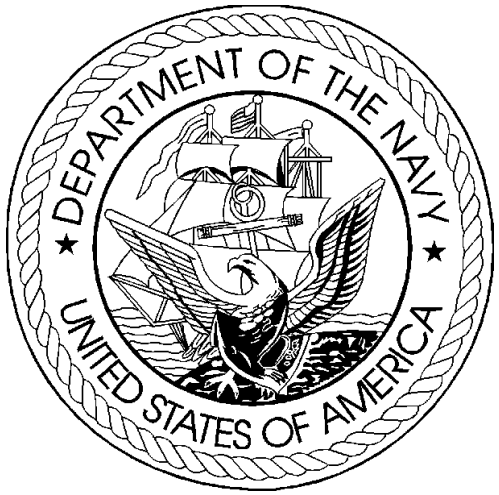
DEPARTMENT OF THE NAVY
FY 1998/1999 BUDGET ESTIMATES



JUSTIFICATION OF ESTIMATES

RESEARCH, DEVELOPMENT, TEST & EVALUATION - BUDGET ACTIVITIES 1-3 SCIENCE AND TECHNOLOGY (S&T)

FEBRUARY 1997

Department of the Navy
FY 1998/1999 RDT&E Program

Exhibit R-1

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

DATE: February 1997

R-1 Line Number	Program Element Number	Item Nomenclature	Budget Activity	Millions of Dollars FY 1996	FY 1997	FY 1998	FY 1999	Security Classification
1	0601152N	In-House Independent Lab Research	1	15.004	14.683	15.834	16.236	U
2	0601153N	Defense Research Sciences	1	356.512	337.463	366.283	383.397	U
		Total Basic Research		371.516	352.146	382.117	399.633	
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	46.015	31.921	32.273	38.833	U
4	0602121N	Surface Ship Technology	2	61.717	51.399	46.859	47.353	U
5	0602122N	Aircraft Technology	2	28.672	23.750	23.590	22.860	U
6	0602131M	Marine Corps Landing Force Technology	2	16.871	16.374	13.043	14.535	U
7	0602232N	C3 Technology	2	56.534	54.735	65.566	71.426	U
8	0602233N	Readiness Training & Env Quality Tech	2	47.773	47.561	31.762	33.120	U
9	0602234N	Materials, Electronics & Computer Technology	2	78.105	84.724	76.653	87.445	U
10	0602270N	EW Technology	2	17.133	21.535	22.810	24.707	U
11	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	52.057	47.967	51.033	57.875	U
12	0602315N	MCM, Mining & Special Warfare Technology	2	43.553	44.602	42.737	44.575	U
13	0602435N	Ocean & Atmospheric Technology	2	57.260	73.416	48.211	58.037	U
14	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	32.021	36.821	35.736	38.304	U
		Total Applied Research		537.711	534.805	490.273	539.070	
15	0603217N	Air Systems & Weapons Advanced Technology	3	64.938	36.749	35.093	37.541	U
16	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	57.471	57.903	43.320	48.094	U
17	0603270N	Advanced EW Technology	3	14.005	14.469	18.144	18.738	U
18	0603508N	Ship Propulsion System	3	17.734	32.185	39.737	46.297	U
19	0603640M	MC Advanced Technology Demo	3	26.148	61.127	34.178	39.617	U
20	0603706N	Medical Development (Advanced)	3	60.185	58.928	18.332	17.043	U
21	0603707N	Manpower, Pers, & Training Adv Tech Demo	3	15.772	18.490	18.812	21.641	U
22	0603712N	Environmental Quality & Logistics Adv Tech	3	21.971	39.294	18.249	20.072	U
23	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	46.430	44.099	54.785	61.844	U
24	0603782N	Shallow Water MCM Demos	3	47.786	40.807	41.602	44.492	U
25	0603792N	Advanced Technology Transition	3	76.503	69.052	87.285	97.269	U
26	0603794N	C3 Advanced Technology	3	23.241	28.030	23.768	17.880	U
		Total Advanced Technology Development		472.184	501.133	433.305	470.528	
		Total Science and Technology (S&T)		1,381.411	1,388.084	1,305.695	1,409.231	

Department of the Navy
FY 1998/1999 RDT&E Program
Alphabetic Listing

Exhibit R-1

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

DATE: February 1997

R-1 Line Number	Program Element Number	Item Nomenclature	Budget Activity	Millions of Dollars FY 1996	FY 1997	FY 1998	FY 1999	Security Classification
17	0603270N	Advanced EW Technology	3	14.005	14.469	18.144	18.738	U
25	0603792N	Advanced Technology Transition	3	76.503	69.052	87.285	97.269	U
15	0603217N	Air Systems & Weapons Advanced Technology	3	64.938	36.749	35.093	37.541	U
5	0602122N	Aircraft Technology	2	28.672	23.750	23.590	22.860	U
26	0603794N	C3 Advanced Technology	3	23.241	28.030	23.768	17.880	U
7	0602232N	C3 Technology	2	56.534	54.735	65.566	71.426	U
2	0601153N	Defense Research Sciences	1	356.512	337.463	366.283	383.397	U
22	0603712N	Environmental Quality & Logistics Adv Tech	3	21.971	39.294	18.249	20.072	U
10	0602270N	EW Technology	2	17.133	21.535	22.810	24.707	U
16	0603238N	Global Surv/Prec Strike/Air Defense Tech Demo	3	57.471	57.903	43.320	48.094	U
1	0601152N	In-House Independent Lab Research	1	15.004	14.683	15.834	16.236	U
21	0603707N	Manpower, Pers, & Training Adv Tech Demo	3	15.772	18.490	18.812	21.641	U
6	0602131M	Marine Corps Landing Force Technology	2	16.871	16.374	13.043	14.535	U
9	0602234N	Materials, Electronics & Computer Technology	2	78.105	84.724	76.653	87.445	U
19	0603640M	MC Advanced Technology Demo	3	26.148	61.127	34.178	39.617	U
12	0602315N	MCM, Mining & Special Warfare Technology	2	43.553	44.602	42.737	44.575	U
20	0603706N	Medical Development (Advanced)	3	60.185	58.928	18.332	17.043	U
13	0602435N	Ocean & Atmospheric Technology	2	57.260	73.416	48.211	58.037	U
8	0602233N	Readiness Training & Env Quality Tech	2	47.773	47.561	31.762	33.120	U
24	0603782N	Shallow Water MCM Demos	3	47.786	40.807	41.602	44.492	U
18	0603508N	Ship Propulsion System	3	17.734	32.185	39.737	46.297	U
3	0602111N	Surface/Aerospace Surv. & Weapons Technology	2	46.015	31.921	32.273	38.833	U
4	0602121N	Surface Ship Technology	2	61.717	51.399	46.859	47.353	U
11	0602314N	Undersea Surv. & Weapons Technology (R2/R3 Materials provided in Classified Budget Book)	2	52.057	47.967	51.033	57.875	U
23	0603747N	Undersea Warfare Advanced Technology (R2/R3 Materials provided in Classified Budget Book)	3	46.430	44.099	54.785	61.844	U
14	0602633N	Undersea Warfare Weapon Technology (R2/R3 Materials provided in Classified Budget Book)	2	32.021	36.821	35.736	38.304	U
		Total Science and Technology (S&T)		1,381.411	1,388.084	1,305.695	1,409.231	

RDT&E, Navy

Program and Financing (in Thousands of dollars) SUMMARY

Identification code 17-1319-0-1-051	Budget Plan (amounts for RESEARCH, DEV, TEST & EVAL actions programed)			
	1996 actual	1997 est.	1998 est.	1999 est.
Program by activities:				
Direct program:				
00.0101 Basic research	371,517	352,146	382,117	399,633
00.0201 Applied Research	537,711	534,805	490,273	539,070
00.0301 Advanced technology development	472,113	501,133	433,305	470,528
00.0401 Demonstration/validation	1,712,323	1,930,143	2,135,069	2,233,510
00.0501 Engineering and manufacturing development	2,347,827	2,143,869	2,085,768	2,032,475
00.0601 Management support	684,815	538,596	595,265	613,180
00.0701 Operational system development	2,345,195	1,855,062	1,489,225	1,467,918
00.9101 Total direct program	8,471,501	7,855,754	7,611,022	7,756,314
01.0101 Reimbursable program	123,806	121,831	125,000	125,000
10.0001 Total	8,595,307	7,977,585	7,736,022	7,881,314
Financing:				
Offsetting collections from:				
11.0001 Federal funds(-)	-121,737	-121,831	-125,000	-125,000
14.0001 Non-Federal sources(-)	-2,069			
17.0001 Recovery of prior year obligations				
Unobligated balance available, start of year:				
21.4002 For completion of prior year budget plans				
21.4003 Available to finance new budget plans	-11,600	-4,500		
21.4009 Reprograming from/to prior year budget plans	-22,369	4,590		
22.1001 Unobligated balance transferred to other accounts	1,000			
22.2001 Unobligated balance transferred from other accounts (-)	-2,500	-4,590		
Unobligated balance available, end of year:				
24.4002 For completion of prior year budget plans				
24.4003 Available to finance subsequent year budget plans	4,500			
25.0001 Unobligated balance expiring	2,915			
39.0001 Budget authority	8,443,447	7,851,254	7,611,022	7,756,314
Budget authority:				
40.0001 Appropriation	8,508,970	8,044,767	7,611,022	7,756,314
40.3601 Appropriation rescinded (unob bal)		-4,500		
40.7501 Reduction pursuant to P.L. 104-208 (-), 8037(e)		-24,834		
41.0001 Transferred to other accounts (-)	-95,788	-164,179		
42.0001 Transferred from other accounts	30,265			
43.0001 Appropriation (adjusted)	8,443,447	7,851,254	7,611,022	7,756,314

RDT&E, Navy

Program and Financing (in Thousands of dollars) SUMMARY

Identification code 17-1319-0-1-051		Obligations			
		1996 actual	1997 est.	1998 est.	1999 est.
	Program by activities:				
	Direct program:				
00.0101	Basic research	376,671	338,287	380,319	398,581
00.0201	Applied Research	516,813	574,559	492,946	536,141
00.0301	Advanced technology development	454,795	547,033	437,377	468,293
00.0401	Demonstration/validation	1,717,965	1,904,811	2,122,576	2,227,616
00.0501	Engineering and manufacturing development	2,349,662	2,134,153	2,089,256	2,035,669
00.0601	Management support	744,549	528,098	591,864	612,105
00.0701	Operational system development	2,265,328	1,956,980	1,511,178	1,469,191
00.9101	Total direct program	8,425,783	7,983,921	7,625,516	7,747,596
01.0101	Reimbursable program	129,842	125,000	125,000	125,000
10.0001	Total	8,555,625	8,108,921	7,750,516	7,872,596
	Financing:				
	Offsetting collections from:				
11.0001	Federal funds(-)	-122,295	-121,831	-125,000	-125,000
14.0001	Non-Federal sources(-)	-2,057			
17.0001	Recovery of prior year obligations	-18,694			
	Unobligated balance available, start of year:				
21.4002	For completion of prior year budget plans	-568,848	-605,401	-478,655	-464,161
21.4003	Available to finance new budget plans	-11,600	-4,500		
21.4009	Reprograming from/to prior year budget plans				
22.1001	Unobligated balance transferred to other accounts	1,000			
22.2001	Unobligated balance transferred from other accounts (-)	-2,500	-4,590		
	Unobligated balance available, end of year:				
24.4002	For completion of prior year budget plans	605,401	478,655	464,161	472,879
24.4003	Available to finance subsequent year budget plans	4,500			
25.0001	Unobligated balance expiring	2,915			
39.0001	Budget authority	8,443,447	7,851,254	7,611,022	7,756,314
	Budget authority:				
40.0001	Appropriation	8,508,970	8,044,767	7,611,022	7,756,314
40.3601	Appropriation rescinded (unob bal)		-4,500		
40.7501	Reduction pursuant to P.L. 104-208 (-), 8037(e)		-24,834		
41.0001	Transferred to other accounts (-)	-95,788	-164,179		
42.0001	Transferred from other accounts	30,265			
43.0001	Appropriation (adjusted)	8,443,447	7,851,254	7,611,022	7,756,314

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

Identification code 17-1319-0-1-051	Obligations			
	1996 actual	1997 est.	1998 est.	1999 est.
Relation of obligations to outlays:				
71.0001 Obligations incurred	8,431,273	7,987,090	7,625,516	7,747,596
72.1001 Orders on hand, SOY	-142,908	-161,573	-161,573	-161,573
72.4001 Obligated balance, start of year	5,155,440	4,313,313	4,509,333	4,896,362
74.1001 Orders on hand, EOY	161,573	161,573	161,573	161,573
74.4001 Obligated balance, end of year	-4,313,313	-4,509,333	-4,896,362	-5,052,077
77.0001 Adjustments in expired accounts (net)	130,748			
78.0001 Adjustments in unexpired accounts	-18,694			
90.0001 Outlays (net)	9,404,119	7,791,070	7,238,487	7,591,881

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

Identification code 17-1319-0-1-051		1996 actual	1997 est.	1998 est.	1999 est.
	Direct obligations:				
	Personnel compensation:				
111.101	Full-time permanent	43,493	43,735	42,937	41,311
111.301	Other than full-time permanent	3,501	2,480	2,390	2,437
111.501	Other personnel compensation	1,515	1,475	1,521	1,492
111.801	Special personal services payments	28	27	27	28
111.901	Total personnel compensation	48,537	47,717	46,875	45,268
112.101	Personnel Benefits: Civilian personnel	9,048	10,476	10,454	10,144
113.001	Benefits for former personnel	310	630	482	438
121.001	Travel and transportation of persons	20,199	20,623	21,056	21,498
122.001	Transportation of things	1,289	1,316	1,344	1,372
123.101	Rental payments to GSA	2,784	2,842	2,902	2,963
123.201	Rental payments to others	1,682	1,717	1,753	1,790
123.301	Communications, utilities, and miscellaneous charges	5,706	5,826	5,948	6,073
124.001	Printing and reproduction	412	421	430	439
125.101	Advisory and assistance services	246,995	238,054	224,235	220,989
125.201	Other services with the private sector	5,014,086	4,867,664	4,337,807	4,503,249
	Purchases goods/services (inter/intra) Fed accounts				
125.301	Purchase of goods/services from other Fed agencies	660,632	675,166	690,020	691,000
125.303	Purchases from revolving funds	2,152,752	1,843,022	2,005,149	1,959,183
126.001	Supplies and materials	7,607	7,767	7,930	8,097
131.001	Equipment	8,710	8,893	9,097	9,270
132.001	Land and structures	1,604	1,638	1,673	1,708
141.001	Grants, subsidies, and contributions	243,430	250,149	258,361	264,115
199.001	Total Direct obligations	8,425,783	7,983,921	7,625,516	7,747,596
	Reimbursable obligations:				
	Personnel Compensation:				
211.101	Full-time permanent	33,284	41,446	35,817	36,545
211.301	Other than full-time permanent	1,237	2,884	3,125	3,192
211.501	Other personnel compensation	551	800	785	807
211.801	Special personal services payments	7			
211.901	Total personnel compensation	35,079	45,130	39,727	40,544
212.101	Personnel Benefits: Civilian Personnel	7,150	8,500	7,400	7,537
213.001	Benefits for former personnel	201			
221.001	Travel and transportation of persons	3,404	3,475	3,548	3,623
222.001	Transportation of things	450	459	469	479
223.101	Rental payments to GSA	77	79	80	82
223.201	Rental payments to others	691	706	720	735
223.301	Communications, utilities, and miscellaneous charges	1,317	1,345	1,373	1,402
224.001	Printing and reproduction	196	200	204	209

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

Identification code 17-1319-0-1-051		1996 actual	1997 est.	1998 est.	1999 est.
225.201	Other services with the private sector	40,631	35,495	36,065	36,662
	Purchases goods/services (inter/intra) Fed accounts				
225.303	Purchases from revolving funds	20,248	8,778	14,151	12,017
226.001	Supplies and materials	10,729	10,965	11,184	11,419
231.001	Equipment	5,684	5,803	5,925	6,050
241.001	Grants, subsidies, and contributions	3,985	4,065	4,154	4,241
299.001	Total Reimbursable obligations	129,842	125,000	125,000	125,000
999.901	Total obligations	8,555,625	8,108,921	7,750,516	7,872,596

Comparison of FY 1996 Financing as reflected in FY 1997 Budget with 1996 Financing as Shown in the FY 1998 Budget

($ in Thousands)

	Financing per FY 1997 Budget	**Financing Per FY 1998 Budget**	**Increase (+) or Decrease (-)**
Program Requirements (Total)	8,494,534	8,471,501	-23,033
Program Requirements (Service Account)	(8,494,534)	(8,471,501)	(-23,033)
Program Requirements (Reimbursable)	110,000	123,806	+13,806
Appropriation (Adjusted)	8,604,534	8,595,307	-9,227

Explanation of Changes in Financing

($ in Thousands)

The Fiscal Year 1996 program has changed since the presentation of the FY 1997 budget as noted below:

1. Program Requirements (Total). There has been a net decrease to the appropriation (adjusted) of $9,227, 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 $23,033. This net change is comprised of an increase in program requirements ($23,033). These changes included a rescission to the FY 1996 program approved in the FY 1997 DoD Appropriations Act (-$4,500), a rescission for Administrative and Personal Services (-$6,739), a rescission to finance F-16 sales to Jordan (-$45,000) based on reduced inflation rates, reductions reflected on the FY 1996 DoD Omnibus Reprogramming Action to specific programs (-$10,600) and a general reduction based on lower inflation rates (-$2,506), a Supplemental Appropriation added funds to the Shallow Water MCM Demonstrations program (+$10,100), four transfers into the appropriation from a DoD central transfer account were effected to support the RDT&E Counter Drug program added funds (+$30,265), a transfer to consolidated the Non-Lethal Weapons Technology added funds (+$4,590), and the withdrawal of proposed rescissions to specific programs.

3. Program Requirements (Reimbursable). There has been a net increase to the appropriation of $13,808, as a result of changes in reimbursable program requirements ($13,806).

Comparison of FY 1996 Program Requirements as reflected in the FY 1997 Budget with FY 1996 Program Requirements as shown in the FY 1998 Budget

Summary of Requirements ($ In Thousands)

	Total Program Requirements per FY 1997 Budget	Total Program Requirements per FY 1998 Budget	Increase (+) or Decrease (-)
01 - Basic Research	377,362	371,516	-5,846
02 - Applied Research	541,372	537,711	-3,661
03 - Advanced Technology Development	444,655	472,184	+27,529
04 - Demonstration and Validation (DEM/VAL)	1,718,754	1,712,926	-5,828
05 - Engineering and Manufacturing Development (EMD)	2,396,003	2,344,798	-51,205
06 - RDTE Management Support	571,115	684,676	+113,561
07 - Operational Systems Development	2,370,501	2,347,690	-22,811
Total Fiscal Year Program	**8,494,534**	**8,471,501**	**-23,033**

Explanation by Budget Activity

($ In Thousands)

01. Basic Research (-$5,846) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$1,262), a rescission to finance F-16 sales to Jordan (-$2,004) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-$1,935), and other changes in program requirements which required minor reprogrammings (-$645).

02. Applied Research (-$3,661) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$353), a rescission to finance F-16 sales to Jordan (-$2,945) based on reduced inflation rates, a

transfer to support the Small Business Innovative Research (SBIR) program (-$8,371), and other changes in program requirements which required minor reprogrammings (+$8,008).

03. Advanced Technology Development (+$27,529) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$1,844), a rescission to finance F-16 sales to Jordan (-$2,528) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-$5,291), two reductions reflected on the FY 1996 DoD Omnibus Reprogramming Action against the Advanced Technology Transition program (-$4,800) and a general reduction based on lower inflation rates (-$1,200), and other changes in program requirements which required minor reprogrammings (-$3,108). Additionally, a Supplemental Appropriation added funds to the Shallow Water MCM Demonstrations program (+$10,100) and a proposed rescission to the AARGM program was withdrawn (+$36,300).

04. Demonstration and Validation (DEM/VAL) (-$5,828) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$1,587), a rescission to finance F-16 sales to Jordan (-$9,144) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-$15,807), a reduction reflected on the FY 1996 DoD Omnibus Reprogramming Action based on lower inflation rates (-$343), and other changes in program requirements which required minor reprogrammings (+$16,463). Additionally, a transfer to consolidated the Non-Lethal Weapons Technology added funds (+$4,590).

05. Engineering and Manufacturing Development (EMD) (-$51,205) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$517), a rescission to finance F-16 sales to Jordan (-$12,682) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-$42,566), a reduction reflected on the FY 1996 DoD Omnibus Reprogramming Action against the New Design SSN Development program (-$5,800), and other changes in program requirements which required minor reprogrammings (+$10,360).

06. RDTE Management Support (+$113,561) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$273), a rescission to finance F-16 sales to Jordan (-$3,063) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (+$109,696), and other changes in program requirements which required minor reprogrammings (+$7,201).

07. Operational Systems Development (-$22,811) - Changes to this budget activity resulted from a rescission for Administrative and Personal Services (-$903), a rescission to finance F-16 sales to Jordan (-$12,634) based on reduced inflation rates, a transfer to support the Small Business Innovative Research (SBIR) program (-$32,250), and other changes in program requirements which required minor reprogrammings (-$2,789). Additionally, four transfers into the appropriation from a DoD central transfer account were effected to support the RDT&E Counter Drug program added funds (+$30,265). Additionally, a rescission was effected in the FY 1997 DoD Appropriations Act (-$4,500).

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

($ In Thousands)

	Financing per FY 1997 Budget	**Financing Per FY 1998 Budget**	**Increase (+) or Decrease (-)**
Program Requirements (Total)	7,334,734	7,855,754	+521,020
Program Requirements (Service Account)	(7,334,734)	(7,855,754)	(+521,020)
Program Requirements (Reimbursable)	110,000	121,831	+11,831
Appropriation (Adjusted)	**7,444,734**	**7,977,585**	**+532,851**

Explanation of Changes in Financing

($ in Thousands)

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

1. Program Requirements (Total). There has been a net increase to the appropriation (adjusted) of $532,851, 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 $521,020, resulting from changes in program requirements as a result of Congressional appropriation changes in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$164,179)(Section 8136), a general undistributed reduction of 2 percent (-$164,179) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$3,822)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC)(-$13,299)(Section 8037(h)), a rescission to finance force protection requirements
(-$7,713)(Section 8138), and net changes to specific program changes (+$874,212).

3. Program Requirements (Reimbursable). There has been a net increase to the appropriation of $11,831, as a result of changes in reimbursable program requirements ($11,831).

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

Summary of Requirements ($ in Thousands)

	Total Program Requirements per FY 1997 Budget	**Total Program Requirements per FY 1998 Budget**	**Increase (+) or Decrease (-)**
01 - Basic Research	387,213	352,146	-35,067
02 - Applied Research	463,465	534,805	+71,340
03 - Advanced Technology Development	449,342	501,133	+51,791
04 - Demonstration and Validation (DEM/VAL)	1,740,955	1,930,143	+189,188
05 - Engineering and Manufacturing Development (EMD)	2,048,657	2,143,869	+95,212
06 - RDTE Management Support	558,440	538,596	-19,844
07 - Operational Systems Development	1,686,662	1,855,062	+168,400
Total Fiscal Year Program	**7,334,734**	**7,855,754**	**+521,020**

Explanation by Budget Activity
($ in Thousands)

01. Basic Research (-$35,067) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$7,344)(Section 8136), a general undistributed reduction of 2 percent (-$7,344) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally

Financed Research and Development Centers (FFRDC)(-$34)(Section 8037(e)), a rescission to finance force protection requirements (-$345)(Section 8138). Congress also specifically reduced the Defense Research Sciences program (-$20,000).

02. Applied Research (+$71,340) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$11,155)(Section 8136), a general undistributed reduction of 2 percent (-$11,155) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$214)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC)(-$212)(Section 8037(h)), a rescission to finance force protection requirements (-$524)(Section 8138). Congress also specifically added funds to start or continue 26 specific initiatives (+$94,600).

03. Advanced Technology Development (+$51,791) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$10,450)(Section 8136), a general undistributed reduction of 2 percent (-$10,450) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$272)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC)(-$348)(Section 8037(h)), a rescission to finance force protection requirements (-$491)(Section 8138). Congress also specifically added funds to start or continue 15 specific initiatives (+$106,400), while reducing one program (-$34,424). Additionally, changes in program requirements required minor reprogrammings (+$1,826).

04. Demonstration and Validation (DEM/VAL) (+$189,188) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$40,282)(Section 8136), a general undistributed reduction of 2 percent (-$40,282) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$859)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC)(-$1,546)(Section 8037(h)), a rescission to finance force protection requirements (-$1,891)(Section 8138). Congress also specifically added funds to start or continue 20 specific initiatives (+$270,551), while reducing three programs (-$6,144).

Additionally, funds were increased in support of the Near Term Mine Warfare Plan (+$6,285), as well as other changes in program requirements which required minor reprogrammings (+$3,356).

05. Engineering and Manufacturing Development (EMD) (+$95,212) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$44,947)(Section 8136), a general undistributed reduction of 2 percent (-$44,947) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$282)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC) (-$6,522)(Section 8037(h)), a rescission to finance force protection requirements (-$2,116)(Section 8138). Congress also specifically added funds to start or continue 35 specific initiatives (+$243,700), while realigning one program (-$25,000) and reducing two programs (-$11,700). Additionally, funds were decreased in support of the Near Term Mine Warfare Plan (-$6,285), as well as other changes in program requirements which required minor reprogrammings (-$6,689).

06. RDTE Management Support (-$19,844) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$11,274)(Section 8136), a general undistributed reduction of 2 percent (-$11,274) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$1,956)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC) (-$1,111)(Section 8037(h)), a rescission to finance force protection requirements (-$528)(Section 8138). Congress also specifically added funds to start or continue 3 specific initiatives (+$4,500). Additionally, changes in program requirements required minor reprogrammings (+$1,799).

07. Operational Systems Development (+$168,400) - Changes to this budget activity resulted from the following Congressional undistributed reductions reflected in the FY 1997 DoD Appropriations Act. These changes included a general undistributed RDT&E reduction of 2 percent (-$38,727)(Section 8136), a general undistributed reduction of 2 percent (-$38,727) to finance Defense Business Operating Fund (DBOF) operating shortfalls (Section 8120), an undistributed reduction for Federally Financed Research and Development Centers (FFRDC)(-$205)(Section 8037(e)), an undistributed reduction for non-Federally Financed Research and Development Centers (non-FFRDC)(-$3,560)(Section 8037(h)), a rescission to finance force protection requirements (-$1,817)(Section 8138). Congress also

specifically added funds to start or continue 19 specific initiatives (+$257,929), while reducing two programs (-$5,700). Additionally, changes in program requirements required minor reprogrammings (-$793).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 1

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Ocean Sciences	571	587	636	623	634	650	672	693	CONT.	CONT.
Advanced Materials	1,850	1,883	2,025	1,985	2,020	2,069	2,138	2,207	CONT.	CONT.
Information Sciences	1,143	1,163	1,255	1,231	1,252	1,283	1,325	1,368	CONT.	CONT.
Sustained Programs	11,440	11,050	11,918	12,397	12,685	12,970	13,393	13,843	CONT.	CONT.
TOTAL	15,004	14,683	15,834	16,236	16,591	16,972	17,528	18,111	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.

(U) This program responds to the Joint Littoral 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 Maritime Support of Land Forces 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 Joint Surveillance 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 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 1996 ACCOMPLISHMENTS:

- (U) ($571) Ocean Sciences responded to the Maritime Support of Land Forces JMA by studying remote sensing of water mass structures and currents, including surface fluxes and Langmuir circulation, small-scale Ocean-Atmosphere interaction, and current estimation from space, rain, and scattering.

- (U) ($1,850) Advanced Materials responded to the Joint Littoral JMA by tailoring polymers at the molecular level to achieve reduced submarine acoustic signatures, and responded to the Joint Strike JMA by enhancing the orientation stability in nonlinear optical polymers.
- (U) ($1,143) Information Sciences responded to the Joint Strike and Surveillance JMA's by advancing the knowledge and skills of computational statistics as applied to image processing, and responded to the Joint Littoral JMA by examining new classification techniques for threat neutralization.
- (U) ($11,440) Sustaining Programs responded to the Joint Strike, Joint Littoral and Maritime Support of Land Forces JMA's by describing the underlying physics of the detonation process which will lead to new and novel warhead designs with desired degree of lethality, and responded to the Readiness, Support and Infrastructure JMA by investigating biomedical preventions and treatments for operational injuries due to decompression and oxygen toxicity, heat and cold exposure, spatial disorientation, fatigue, hazardous materials, and radiation.

2. (U) FY 1997 PLAN:

- (U) ($587) Ocean Sciences will respond to the Joint Littoral JMA by investigating very-shallow-water physics as it relates to the performance of mine countermeasure sensors.
- (U) ($1,883) Advanced Materials will respond to the Maritime Support of Land Forces and Joint Strike JMA's by investigating shock induced damage and failure mechanisms, at the atomic level, in metals used in warheads and in armor.
- (U) ($1,163) Information Sciences (signal processing and statistical sciences) will respond 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 will respond to Joint Strike JMA by developing new signal and imaging processing algorithms to improve effectiveness of autonomous target recognition/guidance.
- (U) ($11,050) Sustaining Programs will respond to Joint Strike JMA by studying supersonic turbine engine combustion technology and improved energetic materials; will respond to the readiness, support and infrastructure JMA by researching biomedical methods for disease prevention and treatment, wound repair, blood

loss, hemorrhagic and septic shock, transplantation, and musculoskeletal injury; and will respond to the Joint Littoral JMA by developing advanced processing technologies for mine countermeasure operations in SW and VSW.

3. (U) FY 1998 PLAN:

- (U) ($636) Ocean Sciences will respond to the Joint 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) ($2,025) Advanced Materials will respond to the Joint Littoral Warfare JMA in the undersea battlespace dominance area by molecular modeling of new sonar transducer materials and the use of tessellation theory to design efficient multi-element transducers.
- (U) ($1,255) Information Sciences will respond to the Joint Littoral 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) ($11,918) Sustaining Programs will respond to the maritime support of land forces and joint 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.

4. (U) FY 1999 PLAN:

- (U) ($623) Ocean Sciences will respond to the Joint Littoral 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) ($1,985) Advanced Materials will respond to the Joint Strike and Joint Littoral 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) ($1,231) 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 joint strike and joint surveillance JMA s, with enhanced detection probability and diminished tracking time in cluttered environments and in the presence of false targets.
- (U) ($12,397) Sustaining Programs will respond to the Strike Warfare and Command, Control and Communications JMAs by investigating the three-dimensional effects of loss mechanisms in non-ideal, thin-film, integrated waveguide structures for opto-electronic applications.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	15,390	15,309	16,525	17,102
(U) Adjustments from FY 1997 PRESBUDG:	-386	-626	-691	-866
(U) FY 1998/1999 PRESBUDG Submission	15,004	14,683	15,834	16,236

(U) CHANGE SUMMARY EXPLANATION:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 1

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

(U) Funding: FY 1996 reduction reflects Jordanian F-16 financing rescission (-$18); and internal DON adjustments (-$366). FY 1997 adjustments reflect Congressional undistributed reduction (-$626). FY 1998 adjustments reflect internal DON realignments (+$906); and Navy Working Capital fund (NWCF) and minor rate adjustments (-1,597). FY 1999 reductions reflect internal DON adjustments (-$712) and NWCF and minor rate adjustments (-$154).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E:

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 1

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Ocean Science	135,750	129,938	137,085	142,568	146,668	150,041	153,543	157,190	CONT.	CONT.
Advanced Materials	56,247	56,630	61,466	63,925	66,482	69,141	71,907	74,783	CONT.	CONT.
Information Sciences	39,797	39,391	42,755	44,465	46,244	48,094	50,018	52,019	CONT.	CONT.
Sustained Programs	124,718	111,504	124,977	132,439	135,028	136,217	137,443	138,726	CONT.	CONT.
TOTAL	356,512	337,463	366,283	383,397	394,422	403,493	412,911	422,718	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 Joint Strike JMA through research leading to better structural materials to increase platform survivability; automated target recognition algorithms to improve identification of friend or foe (IFF), and to help improve real-time targeting under camouflage conditions; and physics and chemistry foundations for improved multispectral, all-weather

sensors and electronics. Responses to the Forward Engagement/Deterrence and Joint Littoral 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 and Intelligence/Information Warfare (C4I/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 Counter Proliferation/Weapons of Mass Destruction (CP/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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 1

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

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

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is funded under BASIC RESEARCH because it encompasses scientific study and experimentation directed 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 1996 ACCOMPLISHMENTS:

- (U) ($135,750) Ocean Sciences responded to Joint Strike JMA requirements by investigating on scene techniques for atmospheric nowcasts and forecasts of the battlespace environment for clutter reduction, improved tactical decision making and operational planning, and to Joint Littoral JMA requirements by developing coastal models and sensors leading to improved prediction of battlespace conditions for acoustic and electro-optical propagation and inversion to allow reliable detection of targets, mines and obstacles in shallow water environments. These and related efforts also responded to the Forward Engagement/Deterrence JMA through improved mobility, awareness and sustainability.
- (U) ($56,247) Advanced Materials responded to the Joint Strike and Intelligence/Surveillance/Reconnaissance JMAs by investigating wide bandgap semiconduction materials for ultra-linear, wide bandwidth, low noise, high efficiency amplifiers and for power electronic building blocks; new electronic materials for processing massive amounts of information at high speeds; improved acoustic imaging materials for mine detection in turbulent water; and superconducting materials for superdirective antenna arrays and stable oscillators for radar. Materials responded to Readiness and Support/Infrastructure JMAs by increasing research in corrosion-resistant materials and coatings that can survive in the marine environment and exceed requirements in environmental regulations.

- (U) ($39,797) Information Sciences responded to Joint Strike JMA requirements by exploring algorithms using nonlinear inverse techniques to detect weak signals amid clutter and jamming, multi-spectral and wideband modulation algorithms to analyze the sensed field, and missile aimpoint selection algorithms to improve performance of multi-spectral seekers; and by extending the science base for information management and tactical decision.
- (U) ($124,718) Sustaining Programs responded to the Joint Strike and Intelligence/Surveillance/Reconnaissance JMAs through exploring biological and machine vision to develop neural models supporting visual processing for real time retargeting and rapid mission planning; biomimetics to develop unique enzymatic sensors for detecting hazardous chemicals; silicon-based neural networks for automated pattern recognition; and nonlinear control for seaborne crane operation for cargo transfer in sea state three.

2. (U) FY 1997 PLAN:

- (U) ($129,938) Ocean Sciences will respond to Forward Engagement/Deterrence, Joint Littoral and Intelligence/Surveillance/Reconnaissance JMAs by advanced studies of littoral internal waves, shoaling surface waves, and benthic processes, and by exploring concepts and techniques for autonomous ocean sampling from unmanned platforms for improved undersea surveillance, mine detection, and countermeasures. It will respond to the Joint Strike JMA by applying a range of advanced techniques to assimilate data into complex environmental models so that actual environmental measurements can be reconciled with models in real time for improved system design and performance, an uncluttered tactical picture, realistic training, doctrine development, and tactical decision making.
- (U) ($56,630) Advanced Materials will respond to Joint Strike JMA requirements by investigating high temperature superconducting materials in magnetic anomaly detectors for enhanced mine countermeasures; advanced metals and ceramic composites for lightweight and unmanned underwater vehicles (UUV) used in sea-land assault; and lightweight structural materials for engines and missile frames to improve range and operational capabilities.

- (U) ($39,391) Information Sciences will respond to Joint Strike and Joint Littoral JMAs by exploring a variety of artificial intelligence approaches, including neural networks, knowledge-based systems, and pattern recognition methods, to help automate target identification and decision-making, to automate and enhance training/simulation technologies, and to facilitate man-machine interactions; by applying recent theories to achieve the capability to track many targets over long periods of time; by refining numerical and computational techniques using massively parallel processing/networked work stations for near real-time electromagnetic prediction, and by developing fast, nonlinear algorithms for complex mission planning. Manpower/Personnel and Training JSA requirements will be addressed by programs integrating intelligent computer assisted instruction techniques with virtual environment and multi-media interfaces to enable embedded training and enhance operational performance in a variety of operational domains.
- (U) ($105,620) Sustaining Programs will respond to the Joint Strike and Intelligence/Surveillance/Reconnaissance JMAs by investigating the principles required for high energy, high efficiency, high repetition rate, very short pulse, miniaturized lasers for rapid, wide area reconnaissance sensors essential for effective mine countermeasures; particle wave applications in high precision gyroscopes for navigation systems; and design of super-quantum well focal plane arrays for simultaneous multi-spectral infrared (IR) detection. Biomedical investigators will respond to Readiness JSA requirements through new approaches to combat casualty care, improved immunophysiology, and enhanced military operational medicine.
- (U) ($5,884) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($137,085) Ocean Sciences will respond to Joint Littoral requirements by undertaking experiments to identify and understand processes unique to marginal and semi-enclosed seas (e.g., Red Sea, Mediterranean, Okhsotsk, and Persian Gulf) to support higher resolution environmental nowcasts/forecasts, improved mine drift prediction, and

improved acoustic/nonacoustic antisubmarine warfare environmental information; and by continuing development of advanced models coupled to remote sensor observations for higher resolution, improved coastal waves prediction.

- (U) ($61,466) Advanced Materials will respond to Forward Engagement/Deterrence 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.
- (U) ($42,755) Information Sciences will respond to Joint 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 Maritime Support through development of mathematical and computational tools for analysis, estimation, and prediction of oceanographic and meterological environmental conditions on the regional scale.
- (U) ($124,977) Sustaining Programs will respond to Joint Strike by investigating techniques for radio frequency clutter suppression for ship defense and missile seekers, and multi-spectral sensors/data fusion in support of avionics and weapons. They will respond to C4I/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.

4. (U) FY 1999 PLAN:

- ($142,568) 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 Joint 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.

- ($63,925) 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 leading to new material properties. It will respond to Joint Strike requirements through continued studies of improved energetic materials to achieve higher lethality with reduced weight.
- ($44,465) Information Sciences will respond to Joint 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.
- ($132,439) Sustaining Programs will respond to Support/Infrastructure requirements through hybrid modeling analysis of genetic logic to yield control of shipboard processes, including bioreactors/biomaterials; tools for adaptive intelligent systems, such as autonomous agents and unmanned vehicles; and (responding also to Counter Proliferation/WMD requirements) rapid, rational identification of molecular targets for therapeutic interventions against old and new chemical biological defense (CBD) agents.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	361,972	371,904	386,127	410,684
(U) Adjustments from FY 1997 PRESBUDG:	-5,460	-34,441	-19,844	-27,287
(U) FY 1998/1999 PRESBUDG Submission	356,512	337,463	366,283	383,397

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect SBIR assessment (-$1,935); year-end update (-$1,844); Administrative and Personnel Services reduction (-$1,262); and a Jordanian F-16 financing rescission (-$419). FY 1997 adjustments

reflect a general Congressional Reduction (-$20,000); general RDT&E reduction (-$7,038); Navy Working Capital Fund (NWCF) and minor rate adjustments (-$7,403). FY 1998 adjustments reflect DON internal adjustments (-$5,232); NWCF and minor rate adjustments (-$7,603); Inflation reduction (-$998); Military and Civilian Pay Rates (+$293); and Defense Science Technology adjustment (-$6,304). 1999 adjustments reflect an internal DON realignment (-$17,088); NWCF and minor rate adjustments (-$796); transfer to NTIP (-$3,956); Defense Science and Technology adjustment (-$4,519); Inflation
(-$1,308); and Military and Civilian Pay Rates (+$380).

(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)
(U) PE 0601102F (Air Force Defense Research Sciences)
(U) PE 0601152N (In House Laboratory Independent Research)
(U) PE 0602111N (Surface/Aerospace Surveillance & Weapons Technology)
(U) PE 0602121N (Surface Ship Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronics & Computer Technology)
(U) PE 0602314N (Undersea Surveillance & Weapons Technology)
(U) PE 0603207N (Air/Ocean Tactical Applications)
(U) PE 0603785N (Combat Systems Oceanographic Performance Assessment)
Activities are coordinated through Tri-Service 6.1 Reliance Scientific Planning Groups.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 1

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Surface/Aerospace Surveillance & Weapons Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	FY 1997 ESTIMATE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY2002 ESTIMATE	FY2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
Surface/Aerospace Surveillance & Weapons Technology	46,015	31,921	32,273	38,833	39,780	40,492	41,396	42,301	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element was restructured by transferring the Surface and Aerospace Surveillance Technology portion of this program element with the exception of the FY 1995 Congressional plus-up for Multi-Spectral Shipboard Surveillance Technology to Program Element (P.E.) 0602232N, Space and Electronic Warfare Technology. This restructured P.E. will support future weapons systems for surface and air platforms for Naval Warfare relating to the Joint Mission Area of Joint Strike and Joint Littoral Warfare. Specifically:

(U) The Joint 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 warheads, and precision targeting.

(U) The Joint 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..

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Surface/Aerospace Surveillance & Weapons Technology

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

(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 1996 ACCOMPLISHMENTS:

- (U) ($10,916) SHIP DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Initiated:
    - (U) Precision track Radio Frequency (RF) technology; Design and analysis of precision track concepts for targeting supersonic anti-ship threats.
    - (U) Investigations into feasibility of gun weapon system based on the Ram Accelerator concept that can exceed 20MJ in muzzle energy while satisfying the constraint that the gun barrel not exceed 25 feet of length (length of 5 Mk 54 Gun Barrel).
  - (U) Continued:
    - (U) Reactive material warhead efforts by designing baseline warhead.
    - (U) Miniature RF Guidance Technology Development by designing and fabricating a breadboard millimeter wave receiver/antenna and developing processor and precision range resolution algorithms.

-- (U) Fabrication, test & evaluation of breadboard low cost, lightweight, Infrared Focal Plane Array (IRFPA) test-bed tracker for self-defense weapon fire control investigation.
-- (U) Low altitude Infrared (IR) Fuze development by conducting system integration tests over sea surface.

- (U) Completed:
-- (U) Fabrication and test of barrel and chamber sealing mechanism for multi-purpose composite launcher.
-- (U) Hydro-code and small scale lethality test and evaluation of explosively generated water columns for water barrier Ship Based-defense.
-- (U) Test plans for IRFPA testbed.
-- (U) Validation of multipath and clutter model for miniature RF guidance effort.

• (U) ($8,582) FREE ELECTRON LASER (FEL): (Congressional plus-up)
- (U) Initiated:
-- (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.

• (U) ($8,752) AIR SUPERIORITY:
- (U) Initiated:
-- (U) Development of aerodynamic prediction code techniques including computational fluid dynamic code development and experimental wind tunnel experiments that are needed to predict the aerodynamic performance of non-axisymmetric missile airframe shapes at high angles of attack flight conditions and over a speed regime from transonic up to Mach 3.5.
-- (U) Application of structural composites (fiber reinforced, resin-matrix composite materials) for developing lightweight, low cost missile airframe design concepts that will satisfy low-to-high temperature (1000 deg. F), high strength (>300ksi), and high stiffness requirements (for high gs:>60g) of future Air-to-Air tactical missiles.

-- (U) Development of improved combustion initability prediction model that can be used to reduce the likelihood of combustion initability problems in solid rocket motor propulsion systems.

- (U) Continued:
  - -- (U) Hardware-in-the-Loop (HWIL) simulations and system level tests of IR and RF Guidance-Integrated Fuse (GIF) breadboard hardware for improved air-to-air missile lethality.
  - -- (U) Investigation of coherent fiber bundle scene transformation technique for IR scene generation.
  - -- (U) Off Axis fire control architecture investigations.
  - -- (U) Diamond dome strength improvement and polishing demonstrations.
- (U) Completed:
  - -- (U) HWIL simulation of Lock-on-after-Launch (LOAL) components for improved air-to-air combat survivability.
  - -- (U) Demonstration of tracker and image processor for IR GIF effort.
  - -- (U) Multisensor algorithm development for off axis fire control.
  - -- (U) Remote stabilization algorithm testing.

- (U) ($1,905) INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY (IHPRPT) (Congressional Plus-up): (Funds to be executed in FY 1997 to forward fund FY 1997 requirements.)
  - (U) Initiated:
    - -- (U) Develop candidate propellant formulations using ammonium dinitramide (ADN) oxidizer. Design and bench test high temperature, high strength composite rocket motor cases and a compact 3-axis thrust vector control system. Goal of efforts is to increase delivered energy by +3% and improve mass fractions by +10% (year 2000 IHPRPT goal).

- (U) ($11,341) STRIKE AND ANTI SURFACE WARFARE (ASUW) WEAPONRY:
  - (U) Initiated:
    - -- (U) Demonstration of brassboard high frequency band Synthetic Aperture Radar (SAR).
    - -- (U) Land battle damage indication SAR tests and change detection algorithms.

-- (U) Feasibility studies for an adaptive warhead concept that will reduce the number of different warhead types from three to one to address the wide spectrum of surface target types, thus alleviating a significant vertical launch system load out problem.
-- (U) Development of subsonic and supersonic, low drag, low Radar Cross Section (RCS), and blended body airframe concepts that provide 20% drag reduction and 50% range increase over conventional design.
-- (U) Precision weapon targeting and fire control investigations that assure 3 meter Circular Error of Probability (CEP) against fixed, relocatable, and moving targets.
-- (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) Propulsion and Guidance and Control (G&C) technology feasibility investigations for a future long range, Mach 6+, Vertical Launch System (VLS) compatible, quick response, and time critical counter force weapon.

- (U) Continued:
-- (U) Application of parallel distributed processing techniques for timely routing, mission planning and adaptive mission control for cruise missile applications.
-- (U) Solid Fuel Air Explosives (SFAE) warhead technology development.

- (U) Completed:
-- (U) Defense Advanced Research Projects Agency (DARPA) WARBREAKER environment simulations of parallel processing algorithms for near real-time mission planning and adaptive in-flight mission re-planning capabilities for future Navy smart weapons.
-- (U) Adaptive Mission Control efforts in parallel processing task with transition of adaptive Strike Planner, target recognition processor, and mission database to Cruise Missile Real Time Retargeting Demonstration task under Project R0447, PE 0603217N.
-- (U) Target confirmation algorithms for ships in port.
-- (U) Target selection module and aimpoint selection algorithms for land targets.

• (U) ($2,614) NAVAL SURFACE FIRE SUPPORT (NSFS):

- (U) Initiated:
  -- (U) Development of a low cost strapdown IR imaging seeker to provide terminal guidance for gun launched NSFS Weapon System.
- (U) Continued:
  -- (U) Efforts in long range gun launched rocket propulsion technology initiated in FY 1995 under Strike and ASUW weaponry by conducting rocket motor sub-system preliminary design feasibility assessments.

- (U) ($1,905) LONG RANGE PROJECTILE (Congressional Plus-up): (Funds to be executed in FY 1997 to forward fund FY 1997 requirements.)
  - (U) Initiate:
    -- (U) This increase, jointly planned with the Army, was to significantly extend the range of gun-launched precision guided munitions by providing for developmental testing of new rocket motor propellants using nano-meter metal powders. New formulations in explosives will be tested which will lead to significant enhancements in projectile warhead lethalities and effectiveness. Additionally, projectile mating joint technologies will be demonstrated which will facilitate more efficient projectile designs.

2. (U) FY 1997 PLAN:

- (U) ($6,340) SHIP BASED DEFENSE IN SUPPORT OF SURFACE BATTLESPACE:
  - (U) Continue:
    -- (U) Test and evaluation of breadboard low cost, lightweight, IRFPA test-bed tracker.
    -- (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 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) Complete:
  -- (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.
  -- (U) IRFPA test bed tracker effort by field testing tracker and innovative non-uniformity compensation technique.

- (U) (3,209) INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY (IHPRPT) (includes $1,000 FY 1997 Congressional Plus-up): ($2,000 to be executed in FY 1998 to forward fund FY 1998 requirements.)

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 IHPRPT national goals as well as Navy goals for tactical missile propulsion technology and will hence forth be described under the IHPRPT heading.

- (U) Initiate:
  -- (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) Continue:
  -- (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) ($1,908) AIR SUPERIORITY:
  - (U) Continue:
    - -- (U) Aerodynamic advanced prediction code development for transonic high angle of attack applications including non-axisymetric body configurations and nonlinear modes. Aero prediction codes in this regime needs further development especially for high angles of attack.
    - -- (U) RF 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.
  - (U) Complete:
    - -- (U) Investigation of coherent fiber bundle scene transformation techniques for 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) ($9,806) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    - -- (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: Analysis of requirements and design for a strike seeker using concurrent engineering techniques to reduce design and prototype fabrication times.

-- (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)Continue:
-- (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.
-- (U) Land battle damage indication SAR testing and change detection algorithms.

- U) Complete:
-- (U) Documentation of bistatic SAR high frequency band brassboard.

• (U) ($4,571) NSFS: ($2,000 to be executed in FY 1998 to forward fund FY 1998 requirements.)
- (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) Continue:
-- (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) ($6,000) FREE ELECTRON LASER (FEL) CONGRESSIONAL PLUS-UP:
- (U) Continue:
-- (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.

- (U) ($87) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($7,510) 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) Ram Accelerator technology by conducting design studies for high pressure gas management, computational fluid dynamic modeling of in-bore high pressure combustion processes, and other hypervelocity gun trade studies.
-- (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) ($3,312) 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-axisymetric body configurations and nonlinear modes.
-- (U) Propellant formulation investigations started in FY96 with IHPRPT Congressional plus-up funding and expand ingredients base to include CL-20 and poly gamma CDN.

- (U) Complete:
-- (U) Diamond dome strength improvements and polishing demonstrations.
-- (U) Combustion instability investigations and demonstrations of motor tests to validate instability models.

• (U) ($2,922) Integrated High Payoff Rocket Propulsion Technology (IHPRPT):

- (U) Initiate:
  - -- (U) Investigation of 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 IHPRPT 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) ($9,990) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    - -- (U) Development of composite technology for high speed missiles.
    - -- (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) 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) 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) Empirical modeling of detonation process, fuel optimization, and warhead designs for reactive materials for solid fuel air explosive warhead.
-- (U) Air and surface explosives technology development to include CL-20 applications.
-- (U) Data compression techniques for video images of battle damage.
-- (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) ($8,539) NSFS:

- (U) Initiate:
-- (U) Feasibility assessment of high strength composite barrels for Naval gun applications.

- (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) Assessment of high strength composite barrels for Naval gun applications.
-- (U) Long range projectile aerodynamic studies.
-- (U) Hypersonic rocket motor design.
-- (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.

4. (U) FY 1999 PLAN:

- (U) ($9,365) 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:
    - -- (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) 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 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) ($4,277) 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-axisymetric body configurations, nonlinear modes and core aeroprediction studies.

- (U) ($3,568) INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY (IHPRPT):
  - (U) Initiate:
    -- (U) Evaluation of NF_2 as an ingredient for Phase II propellant formulations (Phase II goal - 7% increase in specific impulse).
    -- (U) 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.
  - (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) ADN Phase II propellant ingredient investigation.
    -- (U) Advanced nozzle technology investigation.
    -- (U) On-command pintle thrust magnitude control.

- (U) ($11,821) STRIKE AND ASUW WEAPONRY:
  - (U) Initiate:
    -- (U) Thermal management technology development for high speed missiles

- (U) Continue:
  - -- (U) Development of composite technology for high speed missiles.
  - -- (U) Air and surface explosives technology development to include CL-20 and other advanced energetic materials.
  - -- (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) 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) Empirical modeling of detonation process for reactive materials for solid fuel air explosive warhead.
  - -- (U) High speed weapon propulsion, guidance and control, and airframe investigations for time critical targets.
  - -- (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) ($9,802) NSFS:
  - (U) Initiate:
    - -- (U) Integration of miniaturized GPS/Electronics Counter Counter Measures (ECCM) concept into new projectile design, including fabrication and testing
  - (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) Investigation into high strength, long wearing, and light weight materials for future naval long life gun barrels.
-- (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.
-- (U) Hypersonic Rocket Motor risk reduction technology support.

(U) PROGRAM CHANGE SUMMARY

	FY 1996	FY 1997	FY 1998	FY1999
(U) FY 97 President's Budget:	42,313	26,312	34,680	37,490
(U) Adjustments from FY1997 PRESBUDG:	+3,702	+5,609	-2,407	+1,343
(U) FY 1998/1999 PRESBUDG Submission:	46,015	31,921	32,273	38,833

(U) CHANGE SUMMARY EXPLANATION:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Surface/Aerospace Surveillance & Weapons Technology

(U) Funding: FY 1996 adjustments reflect a Jordanian F-16 financing rescission (-49); SBIR assessment (-248); and changes in program requirements (+3,999). FY 1997 adjustments reflect Congressional plus-ups for Free Electronic Laser (+6,000) and IHPRPT (+1,000) and a combination of Navy Working Capital Fund (NWCF) and minor rate adjustments (-1,391). FY 1998 adjustments reflect an increase due to restructuring of program (+1,000); NWCF and minor rate adjustments (-617); reductions based on a FY 1996 funded program acceleration (-$4,088); fact-of-life rate adjustment (-$1,000); a Defense Science and Technology adjustment (+2,380); and Inflation adjustment (-82). FY 1999 adjustments reflect NWCF and minor rate adjustments (-513); and DoD-directed Defense Science Technology adjustment (+2,000); and Inflation adjustment (-144).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

(U) OTHER PROGRAM FUNDING SUMMARY: Not Applicable

(U) RELATED RDT&E: This P.E. adheres to Tri-Service Reliance agreements with oversight provided by the JDL. This P.E.

(U) CONVENTIONAL AIR/SURFACE WEAPONRY:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602203F (Aerospace Propulsion)
(U) PE 0602232N (C3 Technology)
(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)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602111N
PROGRAM ELEMENT TITLE: Surface/Aerospace Surveillance & Weapons Technology

(U) PE 0603004A (Weapons and Munitions Advanced Technology)
(U) PE 0603216F (Aerospace Propulsion and Power Technology)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603640M (Marine Corps Advanced Technology Demonstration)
(U) PE 0603790D (NATO Research and Development)
(U) This is in accordance with the ongoing Reliance joint planning processes.

(U) SCHEDULE PROFILE: Not applicable.

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Surface Ship Technology	61,717	51,399	46,859	47,353	48,928	49,646	51,057	52,284	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides for surface ship and submarine technology developments that contribute to meeting the 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 missile and cruise missiles to the United States and deployed forces.

(U) This PE develops affordable hull, mechanical, and electrical (HM&E) technology options for both surface ships and submarines, and logistics technology and environmental protection for all Navy platforms and those shore facilities that directly support them.

(U) The surface ship and submarine (HM&E) portion of this program is divided into four technology thrusts: Structural Systems, Power and Automation, Signature Control, and Maneuvering and Seakeeping. They include electromagnetic and acoustic signature reduction, structural and weapon related survivability improvement, electrical and mechanical system efficiency, damage control, hydrodynamics, and propulsion alternatives. In addition, affordability for reduced acquisition and life-cycle costs is being pursued in 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."

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

(U) Beginning in FY 1998 funding for Logistics and Environmental Quality technology will moved from PE 0602233N to this more appropriate PE.

(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 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 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 (CNO) prioritized Navy user and Science and Technology (S&T) 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; and providing the capability to sustain Naval forces anywhere in a timely and environmentally compliant manner.

(U) Due to broad scope of efforts included in this Program Element, the programs described in the Accomplishments and Plans sections are representative selections of 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.

B. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

1. (U) FY 1996 ACCOMPLISHMENTS:

(U) ($3,696) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATED:

- (U) Development of fully probabilistic reliability based design procedure. (Reliability Based Ship Structural Design Guidelines)
- (U) Exploration of the multi-use capabilities (protection/signature reduction) of topside composite armor to increase survivability. (Protection System Design Guidelines)

(U) CONTINUED:

- (U) Evaluation of structural alternatives for economical installation of distributive systems modules. (Affordable Metallic Ship Structural Systems)
- (U) Evaluation of coupled finite-element/finite-difference analytic methods for predicting the response of ship structures to weapons. (Protection System Design Guidelines)

(U) ($15,000) CURVED PLATE TECHNOLOGY (Congressional Add):

- (U) Development, design, contruction and testing of full scale prototype equipment essential to evaluating and developing curved plate technology for naval applications. (Affordable Metallic Ship Structural Systems)

(U) ($5,673) SURFACE SHIP POWER AND AUTOMATION:
(U) INITIATED:

- (U) Development of integrated time-progressive flooding sensors and software. (Integrated Damage Control System)

(U) CONTINUED:

- (U) Demonstration of feasibility of a contra-rotating scale model homopolar motor. (Electric Propulsion Concepts)
- (U) Demonstration of a single zone of the Advanced Concept Electrical System architecture and validate simulations. (Advanced Concept Electrical Systems)

- (U) Demonstration of diesel structural components fabricated from non-ferrous and composite materials. (Power Conversion Systems)
- (U) Demonstration of high power density fuel cell with diesel desulfurization and reformer. (Power Conversion Systems)
- (U) Demonstration of hull integrity fiber optic sensor. (Integrated Damage Control System)

(U) COMPLETED:

- (U) Assessment of fuel cells on non-combatants. (Power Conversion Systems).
- (U) Conceptual design for a new family of shock hardened air-circuit breakers. (Power Conversion Systems).

(U) ($4,869) SURFACE SHIP SIGNATURE CONTROL:
(U) CONTINUED:

- (U) Development of analytical techniques for prediction of the Radar Cross Section (RCS) due to 2nd and 3rd order scattering phenomena such as cavities and surface traveling waves. (Topside Low-Signature Concepts)
- (U) Development of guidelines for ship topside shaping for Infrared (IR) signature control. (Topside Low-Signature Concepts)
- (U) Development of advanced quiet rudder design concept. (Underwater Low-Signature Concepts)
- (U) Development of fluid system quieting techniques using active control technology. (Underwater Low-Signature Concepts)
- (U) Development of improved magnetic sensors to support advanced degaussing systems. (Underwater Low-Signature Concepts)

(U) COMPLETED:

- (U) Transition of broadband high-frequency embedded antenna concept for the Advanced Enclosed Mast/Sensor System (PE 0603792N). (Topside Low-Signature Concepts)

(U) ($1,124) SURFACE SHIP MANEUVERING AND SEAKEEPING:
(U) INITIATED:

- (U) Cooperative US and Netherlands project on Propeller Tip Vortex Cavitation reduction. (Hydrodynamic Analytical Methods)

(U) CONTINUED:

- (U) Development of methods to predict the motions of damaged ships and ships in deep water. (Hydrodynamic Analytical Methods)

(U) ($5,072) SUBMARINE SIGNATURE CONTROL:
(U) INITIATED:

- (U) Development of acoustic technology to provide submarine hull structures with intrinsic acoustic performance benefit. (Advanced Hull Concepts)
- (U) Development of design tools to predict far-field acoustic signatures. (Signature Assessment)
- (U) Development of methods for in-situ characterization and evaluation of acoustic materials. (Acoustic Materials)

(U) CONTINUED:

- (U) Demonstration of concept for control of electromagnetic signatures at depth. (Electromagnetic (EM) Signature Reduction)
- (U) Validation of analysis models for development of a low self-noise sonar bow dome and design of quarter-scale acoustically transparent dome. (Self Noise)
- (U) Demonstration of accurate, cost effective methods for evaluating payload launcher systems noise. (Payload Launch Quieting)

(U) COMPLETED:

- (U) Feasibility assessment of acoustic holography imaging technology for evaluation of signature reduction concepts. (Signature Assessment)
- (U) Transition sensor technology for active control of machinery truss and rafts. (Acoustic Silencing)
- (U) Demonstration and validation of target strength simulation capability; transition design tool development to the Hydrodynamics/Hydroacoustics Technology Center. (Acoustic Silencing)

(U) ($4,170) SUBMARINE STRUCTURAL SYSTEMS:
(U) INITIATED:

- (U) Development and evaluation of machinery cradle concept for shock. (Machinery Truss Support System)
- (U) Development of analysis methods to predict UNDEX behavior of multi-compartment pressure hulls. (Hull Shock Strength)
- (U) Development of design methods for layered multi-functional structural systems for low signature non-pressure hull structures. (Low Signature Structures)

(U) CONTINUED:

- (U) Verification of dynamic response models of coatings subjected to shock loading. (Shock Coatings)
- (U) Development of integrated shock/acoustic equipment mount concepts for decks and machinery supporttrusses. (Equipment Shock)
- (U) Demonstration and validation of models to assess dynamic response of acoustically-coated structures subjected to shock loads. (Hull Shock Strength)
- (U) Development of failure model criteria for steel pressure hulls under close-in shallow water UNDEX. (Shallow Water UNDEX)

(U) COMPLETED:

- (U) Development of new underwater explosion pressure sensor technology and transitioned to Navy shock community. (Hull Shock Strength)

(U) ($5,340) SUBMARINE POWER AND AUTOMATION:
(U)INITIATED:

- (U) Development of quiet environmentally safe, small-device (payload) launcher to support littoral operations and environmental regulations. (Payload Launch)
- (U) Development and demonstration of power modulation and other technologies to actively control electric motor noise. (Electric Drive)
- (U) Evaluation of technologies to support quiet electrically powered actuation of steering and diving functions. (Steering & Diving)

- (U) Development of adaptive magnetic bearings for increased bearing life and noise control. (Machinery Reliability)

(U) CONTINUED:

- (U) Verification of electric motor analysis tools in development of intermediate-scale permanent magnet motor. (Electric Drive)
- (U) Demonstration of quieting multiple noise tonals in pumps by magnetic bearings. (Machinery Quieting)

(U) COMPLETED:

- (U) Development of simulation models of advanced electric distribution system components for an electric submarine. (Electric Power Distribution)
- (U) Evaluation of acoustic performance of hypocyclic speed reducer in zone distributed hydraulic systems. (Distributed Hydraulics)

(U) ($5,406) SUBMARINE MANEUVERING AND SEAKEEPING:

(U) INITIATED:

- (U) Evaluation of physics-based maneuvering tools for prediction of submarine trajectory. (Maneuvering Predictions)
- (U) Concept development of control systems and appendages having improved control authority and jam resistance. (Maneuvering Systems)

(U) CONTINUED:

- (U) Selection of technologies to provide for a low cost propulsor concept. (Low Cost Propulsor)
- (U) Evaluation of hydrodynamic and hydroacoustic performance at small-scale of first generation full-stern/integrated propulsor concept. (Full Stern/Integrated Propulsor)
- (U) Assessment of maneuvering characteristics of first generation full stern concept for verification of maneuvering analytical predictions. (Full Stern/Integrated Propulsor)
- (U) Development of models to predict near-field downstream flow features from hull feature inflow conditions. (Wakes)

(U) ($9,451) Power Electronic Building Blocks (PEBB):
(U) INITIATED:

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

(U) COMPLETED:

- (U) Development of first-generation demonstration modules for function of PEBB. (Advanced Concept Electrical Systems)

(U) ($1,916) INTERACTIVE ELECTRONIC TECHNICAL MANUALS:

- (U) Demonstration of weapons systems Interactive Electronic Technical Manuals for Embedded Test Procedures.
- (U) Demonstration of weapons systems Interactive Electronic Technical Manual for Advanced Maintenance.

2. (U) FY 1997 PLAN:

(U) ($2,937) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATE:

- (U) Initiate corrosion studies and producibility of advanced double hull structure using non-magnetic stainless steel. (Affordable Metallic Ship Structural Systems)

(U) CONTINUE:

- (U) Demonstration of a model for reactive gas flow in non-burst compartments following an explosion. (Protection System Design Guidelines)

(U) COMPLETE:

- (U) Transition of probabilistic hull strength design method to Naval Sea Systems Command (NAVSEA). (Affordable Metallic Ship Structural Systems)

- (U) Evaluation of low cost/high quality composite hull structures for mine hunters and small combatants. (Affordable Composite Ship Structural Systems)
- (U) Development of analytically-based design tool to predict weapons loading and structural response of hulls to non-contact underwater explosions. (Protection System Design Guidelines)
- (U) Total ship design options for destroyer/cruiser survivability which account for passive hardening and equipment architectures. (Protection System Design Guidelines)

(U) ($3,182) SURFACE SHIP POWER AND AUTOMATION:
(U) CONTINUE:

- (U) Development of advanced damage control sensors to measure flow rates of air and water. (Integrated Damage Control Systems)
- (U) Demonstration of non-chemical acting alternative to HALON 1301 with zero ozone depletion potential. (Integrated Damage Control System)

(U) COMPLETE:

- (U) Development of damage control algorithms that will predict vertical fire and smoke movement. (Integrated Damage Control Systems)
- (U) Demonstration of permanent magnet propulsion system on a patrol craft. (Electric Propulsion Concepts).

(U) ($4,406) SURFACE SHIP SIGNATURE CONTROL:
(U) INITIATE:

- (U) Initiate evaluation of high-performance ship hull concepts which meet low-observable requirements. (Topside Low-Signature Concepts)

(U) CONTINUE:

- (U) Development of Radar Diffuse Surface (RDS) Concepts as alternatives to traditional Radar Absorbing Material (RAM). (Topside Low-Signature Concepts)
- (U) Development of exhaust air system quieting technique utilizing active control. (Underwater Low-Signature Concepts)

- (U) Development of Low RCS and IR signature stack suppression system. (Topside Low-Signature Concepts)
- (U) Development of performance prediction algorithms for IR coatings. (Topside Low-Signature Concepts)
- (U) Development of propeller quieting techniques for operating in littoral areas. (Underwater Low-Signature Concepts)

(U) COMPLETE:

- (U) Development of electromagnetic (EM) compatibility analysis models and interference reduction techniques for ultra-wide band and wide band radio frequency systems. (EM Compatibility Design Guidelines)
- (U) Transition of advanced rudder design to NAVSEA for full-scale evaluation. (Underwater Low-Signature Concepts)

(U) ($1,713) SURFACE SHIP MANEUVERING AND SEAKEEPING:
(U) CONTINUE:

- (U) Conducting parametric design studies on Tip Vortex Cavitation reduction cooperative US/Netherlands project. (Hydrodynamic Analytical Methods)
- (U) Development and assessment of point design of a Vertical Axis Propulsor. (Innovative Hull Form and Propulsion Concepts)

(U) COMPLETE:

- (U) Powering tests of Vertical Axis Propulsor. (Innovative Hull Form and Propulsion Concepts)

(U) ($3,304) SUBMARINE SIGNATURE CONTROL:
(U) INITIATE:

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

(U) CONTINUE:

- (U) Select and analytically evaluate concepts to provide hull structures with intrinsic acoustic performance benefit. (Advanced Hull Concepts)
- (U) Development of design tools to predict far-field acoustic signatures. (Signature Assessment)

- (U) Assessment of in-situ methods to characterize acoustic coatings. (Acoustic Materials)
- (U) Demonstration of proof-of-concept for control of far-field EM signatures. (EM Signature Reduction)
- (U) Fabrication and testing of quarter-scale acoustically transparent sonar bow dome. (Self-noise)

(U) COMPLETE:

- (U) Transition methods to evaluate payload launcher system noise to NAVSEA. (Payload Launcher Quieting)

(U) ($3,059) SUBMARINE STRUCTURAL SYSTEMS:

(U) INITIATE:

- (U) Development of pressure hull concepts that incorporate features for acoustic advantage. (Hull Modifications)
- (U) Development of advanced reconfigurable sail concepts. (Sail)

(U) CONTINUE:

- (U) Development of design methods for layered multi-functional structural systems for low signature non-pressure hull structures. (Low Signature Structures)
- (U) Development of machinery cradle concept for shock. (Machinery Truss Support System)
- (U) Development of integrated shock/acoustic mount concepts for trusses and rafts. (Equipment Shock)
- (U) Development of methods to predict UNDEX behavior of multi-compartment pressure hulls. (Hull Shock Strength)
- (U) Validate analysis capabilities to evaluate response of acoustically coated hull to shock loading. (Hull Shock Strength)
- (U) Integration of criteria for failure models for steel pressure hulls under close-in shallow water UNDEX in analysis tools. (Shallow Water UNDEX)

(U) COMPLETE:

- (U) Transition of capability to evaluate response of acoustically coated hull to shock loading. (Hull Shock Strength)

(U) ($2,937) SUBMARINE POWER AND AUTOMATION:

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PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

(U) INITIATE:
- (U) Development of flow visualization technology and design tools for fluid systems. (Piping Systems)
- (U) Development of technology to automate operator functions for non-propulsion related machinery systems. (Automation)

(U) CONTINUE:
- (U) Prototype development of environmentally safe small payload launcher. (Launch Concepts)
- (U) Demonstration of technologies for quieting of electric motor noise. (Electric Drive)
- (U) Evaluation of power and response time performance of electrically powered actuator technologies for reduced cost and improved reliability steering and diving systems. (Steering & Diving)
- (U) Development of adaptive magnetic bearing for reduced maintenance. (Machinery Reliability)
- (U) Verification of electric motor design and analysis tools. (Electric Drive)

(U) COMPLETE:
- (U) Demonstrate broadband pump noise quieting using magnetic bearings. (Machinery Quieting)

(U) ($2,937) SUBMARINE MANEUVERING AND SEAKEEPING:

(U) INITIATE:
- (U) Development of technology to predict propulsor side forces for maneuvering impact. (Maneuvering Systems)

(U) CONTINUE:
- (U) Select jam resistant maneuvering concepts for development. (Maneuvering Systems)
- (U) Radio controlled model experimentation to validate physics-based maneuvering tools. (Maneuvering Predictions)
- (U) Demonstration of low cost propulsor concept feasibility in small-scale laboratory experiments. (Low Cost Propulsor)
- (U) Develop full-stern/integrated propulsor second generation concept, based upon first generation design performance. (Full Stern/Integrated Propulsor)

- (U) Development of models to predict near-field downstream flow features from hull feature inflow conditions. (Wakes)

(U) COMPLETE:

- (U) Transition unsteady flow analysis for evaluating non-acoustic wake signatures to Hydrodynamic/Hydroacoustic Technology Center. (Wakes)

(U) ($8,300) PEBB:
(U) INITIATE:

- (U) Evaluation of computational testbed for advanced concept electrical system simulation. (Advanced Concept Electrical System)

(U) CONTINUE:

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

(U) COMPLETE:

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

(U) ($624) SMALL BUSINESS INNOVATION RESEARCH:

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

(U) ($6,000) PEBB TECHNOLOGY CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U) Complete computational virtual design and analysis testbed for electrical system simulation within total ship system context. (Advanced Concept Electrical Systems)

(U) ($1,000) VISION TECHNOLOGY (SHIP TECHNOLOGY AUTOMATED SYSTEMS MONITORING) CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U) Incorporate state of the art video processing hardware and software into Interactive Electronic Technical Manuals (IETM)

(U) ($1,000) NATURAL LANGUAGE PROCESSING (COMPUTER BASED MAINTENANCE AIDS) CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U) Demonstrate the use of natural language processing in IETM.

(U) ($5,000) SURFACE SHIP COMPOSITE MATERIAL CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U)Initiate testing on four half-scale composite corvette mid-ship sections.

(U) ($1,000) POWER NODE CONTROL CENTERS CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U) Development of power node control centers for advanced integrated distribution system fault detection, switching, reconfiguration, and control. (Advanced Concept Electrical Systems)

(U) ($4,000) LANDING SHIP/CAUSEWAY CONGRESSIONAL PLUS-UP:
(U) COMPLETE:

- (U) Develop 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)

3. (U) FY 1998 PLAN:

(U) ($3,877) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATE:

- (U) Development of advanced lightweight structures. (Affordable Metallic Ship Structural Systems)
- (U) Development of composite secondary structure design guidelines. (Affordable Composite Ship Structural Systems)

(U) CONTINUE:

- (U) Demonstration and evaluation of failure prediction tool for composite Glass Reinforced Plastic (GRP) panels. (Affordable Composite Structural Systems)
- (U) Development of advanced double hull joint detail concepts using stainless steel. (Affordable Composite Structural Systems)

(U) COMPLETE:

- (U) Numerical analysis and experimental testing of composite internal decks. (Affordable Composite Ship Structural Systems)
- (U) Development of balanced magazine protection concepts to significantly reduce probability of mass detonation. (Protection System Design Guidelines)

(U) ($4,200) SURFACE SHIP POWER AND AUTOMATION:
(U) INITIATE:

- (U) Development of advanced concepts in damage control/firefighting. (Integrated Damage Control Systems)

(U) CONTINUE:

- (U) Demonstrate detailed simulation of machinery plant control system. (Advanced Concept Electrical System)

(U) COMPLETE:

- (U) Transition of design guidelines for high power diesel-fed fuel cell to PE 0603508N. (Power Generation Systems)

(U) ($5,815) SURFACE SHIP SIGNATURE CONTROL:
(U) INITIATE:

- (U) Development of Radio Frequency (RF)/IR prediction models for evolving threats. (Topside Low-Signature Concepts)
- (U) Development of machinery silencing techniques. (Underwater Low-Signature Concepts)

(U) CONTINUE:

- (U) Evaluation of high-performance ship hull concepts which meet low-observable requirements. (Topside Low-Signature Concepts)
- (U) Development of lightning protection system concepts for non-metallic structures. (EM Compatibility Design Guidelines)

(U) COMPLETE:

- (U) Development of Low RCS and IR signature stack suppression system. (Topside Low-Signature Concepts)
- (U) Development of performance prediction algorithms for IR coatings. (Topside Low-Signature Concepts)
- (U) Development of composite structure integration concepts for communication sensors. (EM Compatibility Design Guidelines)

(U) ($2,261) SURFACE SHIP MANEUVERING & SEAKEEPING:
(U) CONTINUE:

- (U) Conducting parametric design studies on Tip Vortex Cavitation reduction cooperative US/Netherlands project. (Hydrodynamic Analytical Methods)
- (U) Development of improved performance non-conventional hull forms. (Innovative Hull Form and Propulsion Concepts)

(U) COMPLETE:

- (U) Development and assessment of point design of a Vertical Axis Propulsor. (Innovative Hull Form and Propulsion Concepts)

(U) ($4,361) SUBMARINE SIGNATURE CONTROL:
(U) CONTINUE:

- (U) Development of technology to predict in real-time the far-field acoustic signature from on-board measurements. (Signature Condition)
- (U) Experimentally evaluate, at small-scale, concepts to provide hull structures with intrinsic acoustic benefit. (Advanced Hull Concepts)
- (U) Development of prototype laser doppler vibrometer technology to characterize acoustic coating 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) Evaluation of acoustically transparent sonar bow dome concept and transition concept and design methodology to NAVSEA. (Self Noise)

(U) ($4,038) SUBMARINE STRUCTURAL SYSTEMS:
(U) INITIATE:

- (U) Verification of UNDEX prediction methods for multi-compartment pressure-hulls using small-scale models. (Hull Shock Strength)
- (U) Development of elastomeric shutterway concept for reduced launcher cost and maintenance. (Launch Concepts)
- (U) Development of hull concepts for increased shock strength. (Hull Shock Strength)

(U) CONTINUE:

- (U) Development of pressure hull concepts that incorporate features for acoustic advantage. (Hull Modifications)
- (U) Development of concepts for advanced reconfigurable sails. (Sail)
- (U) Demonstrate at large-scale machinery cradle concepts for integrated shock and acoustic performance . (Machinery Truss Support System)
- (U) Development of algorithms for integrated shock/acoustic mount concepts for trusses and rafts. (Equipment Shock)

- (U) Fabricate and test small-scale models to verify methods to predict UNDEX behavior of multi-compartment pressure hulls. (Hull Shock Strength)

(U) COMPLETE:

- (U) Development and verification of design methods for layered multi-functional non-pressure hull structures. (Low Signature Structures)
- (U) Verification of failure criteria for pressure hulls subject to close-in shallow water UNDEX and transition to NAVSEA. (Shallow Water UNDEX)

(U) ($3,877) SUBMARINE POWER AND AUTOMATION:
(U) INITIATE:

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

(U) CONTINUE:

- (U) Characterize manning function to support development of technology to automate operator functions for non-propulsion related machinery. (Automation)
- (U) Development of flow visualization and design tools for fluid systems. (Piping Systems)
- (U) Evaluation of prototype environmentally safe small payload launcher to support littoral operations and environmental regulations. (Payload Launch)
- (U) Evaluation of power and response performance of candidate electrically powered actuator technologies for reduced cost improved reliability steering and diving systems. (Steering & Diving)
- (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. (Electric Drive)

(U) COMPLETE:

- (U) Complete demonstration of electric motor quieting technologies and transition to Ship and Submarine HM&E Advanced Technology Program. (Electric Drive)

(U) ($3,876) SUBMARINE MANEUVERING AND SEAKEEPING:
(U) CONTINUE:

- (U) Validate blade concept for acoustic and powering performance. (Low Cost Propulsor)
- (U) Laboratory demonstrations of maneuvering concepts having improved control authority and jam resistance. (Maneuvering Systems)
- (U) Assess powering and maneuvering performance of second generation full-stern concept. (Full Stern/Integrated Propulsor)

(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. (Wakes)
- (U) Validate propulsor side force technology and transition to Hydrodynamic/Hydroacoustic Technology Center. (Maneuvering Concepts)
- (U) Radio controlled model tests to validate physics-based maneuvering tools and transition tools to Hydrodynamics/Hydroacoustics Technology Center. (Maneuvering Systems)

(U) ($6,000) PEBB:
(U) INITIATE:

- (U) Development of third generation PEBB demonstration modules for form, fit, and function. (Advanced Concept Electrical Systems)

(U) CONTINUE:

- (U) Evaluation of second-generation PEBB demonstration modules for form and function. (Advanced Concept Electrical Systems)

(U) COMPLETE:

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

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PROGRAM ELEMENT: 0602121N
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(U) ($8,554) LOGISTICS AND ENVIRONMENTAL QUALITY TECHNOLOGY:
(U) INITIATE:

- (U) Development of microwave plasma generation technology of atomic oxygen for shipboard waste treatment systems.
- (U) Development of low surface energy, non-fouling membranes for shipboard wastewater treatment systems.
- (U) Development of process controllers for shipboard waste treatment systems.
- (U) Development of a reliable, automated pressure boosting mechanism for extending the pumping range of ship-to-shore transfer of fuels and other liquids.
- (U) Development of microwave assisted paint removal technology from aircraft composite parts and systems.
- (U) Development of measurement and diagnostics capability to support emerging and advanced technologies.
- (U) Development of structural rope mechanics.

(U) CONTINUE:

- (U) Development of enhanced copper speciation and fate methodology for marine environments.
- (U) Rapidly Installed Breakwater (RIB) System to provide for sheltered areas for the transfer of cargo from ships to lighters.
- (U) Development of sensors and prognostics for real-time status monitoring for combat system high power microwave tubes.
- (U) Development of an array of metal oxide-based gas sensor elements capable of distinguishing different gases in a gas mixture.
- (U) Development of open-sea connectors and rigging systems for high sea state pontoon and causeway systems.
- (U) At-sea tests correlating subbottom engineering soil properties with acoustic emissions surveys.
- (U) Electochemical pre/post treatment technology development of ship liquid wastes.
- (U) Development of supercritical fluid technology for advanced treatment of ship bilgewater.
- (U) Development of automated dry dock paint application, overspray control and collection technologies.

- (U) Development of decontamination cleaning of surfaces technology for PCBs and other toxic substances.
- (U) Development of environmentally sound substitue steam catapult lubricant.
- (U) Development of advanced Indutrial Wastewater Treatment Plant (IWTP) technologies for pollution prevention.
- (U) Enhancement of crane control technologies resulting in reduced manpower and increased equipment performance.
- (U) Development of infrared imaging system test equipment and calibration methods to support Navy infrared surveillance systems.
- (U) Development of prognostics for real-time status monitoring and troubleshooting for high-power microwave tubes in combat systems.
- (U) Development of pier lateral stability.
- (U) Development of collaborative infrastructure assessment tool.
- (U) Development of electroset desktop manufacturing of parts.
- (U) Development of vertical launch system rearming mechanism.
- (U) Development of high power microwave built-in test set.

(U) COMPLETE:

- (U) Fuel additive formulation for NOx reduction in gas turbine and diesel engines; transition to NAVSEA, PE 0603721N for implementation and commercializaiton.
- (U) Develop and demonstrate generic repair and inspection processes for engine composite applications.
- (U) Develop and demonstrate a programmable objective minimum resolvable temperature difference (MRTD) test set to support Navy IR surveillance systems.
- (U) Probability technique to assess the stability of low freeboard pontoon systems in open seas for efficient cargo layout and loading.
- (U) Improve the capability for the selection, procurement, and application of replaceable electronic or mechanical components.

4. (U) FY 1999 PLAN:

(U) ($3,993) SURFACE SHIP STRUCTURAL SYSTEMS:
(U) INITIATE:

- (U) Development of fitness for service based structural maintenance guidelines. (Reliability Based Design Guidelines)
- (U) Development of prediction methods for composite structure response to underwater explosions. (Protection System Design Guidelines)

(U) CONTINUE:

- (U) Development of advanced lightweight structures. (Affordable Metallic Ship Structural Systems)

(U) COMPLETE:

- (U) Improved design criteria and analysis tools for composite primary hulls. (Affordable Composite Ship Structures)
- (U) Development of advanced double hull joint detail concepts using stainless steel. (Affordable Metallic Ship Structural Systems)

(U) ($4,326) SURFACE SHIP POWER AND AUTOMATION:
(U) CONTINUE:

- (U) Development of advanced concepts in damage control/firefighting. (Integrated Damage Control Systems)

(U) COMPLETE:

- (U) Development of advanced damage control sensors to measure flow rates of air and water. (Integrated Damage Control Systems)
- (U) Demonstration of non-chemical acting alternative to HALON 1301 with zero ozone depletion potential. (Integrated Damage Control System)

(U) ($5,990) SURFACE SHIP SIGNATURE CONTROL:
(U) INITIATE:

- (U) Development of virtual EM environment modeling and visualization capability. (EM Compatibility Design Guidelines)

(U) CONTINUE:

- (U) Development of RF/IR prediction models for evolving threats. (Topside Low-Signature Concepts)
- (U) Development of machinery silencing techniques. (Underwater Low-Signature Concepts)

(U) ($2,329) SURFACE SHIP MANEUVERING & SEAKEEPING:
(U) INITIATE:

- (U) Development of analytic methods for prediction of ship maneuvers. (Hydrodynamic Analytical Methods)

(U) CONTINUE:

- (U) Conducting parametric design studies on Tip Vortex Cavitation reduction cooperative US/Netherlands project. (Hydrodynamic Analytical Methods)

(U) COMPLETE:

- (U) Development of methods to predict the motions of damaged ships and ships in deep water. (Hydrodynamic Analytical Methods)

(U) ($4,492) SUBMARINE SIGNATURE CONTROL:
(U) INITIATE:

- (U) Development of coating concepts to reduce submarine detection from active acoustic interrogation. (Hull Coatings)

(U) CONTINUE

- (U) Assess first generation experimental results and revise concept and analysis methods for hull structural concepts with intrinsic acoustic benefit. (Advanced Hull Concepts)
- (U) Demonstration of proof-of-concept for control of near-field electromagnetic signatures for shallow water. (EM Signature Reduction)

(U) COMPLETE:

- (U) Development of technology to predict far-field acoustic signature in real-time from on-board measurements and transition to NAVSEA. (Signature Condition)
- (U) Development of prototype laser Doppler vibrometer technology to characterize acoustic materials and transition to NAVSEA. (Acoustic Materials)

(U) ($4,160) SUBMARINE STRUCTURAL SYSTEMS:
(U) INITIATE:

- (U) Development of low acoustic signature stern non-pressure hull concept. (Low Signature Structures)
- (U) Development of shock design and analysis methods for water backed non-pressure hull structures. (External Systems)

(U) CONTINUE:

- (U) Construct prototype elastomeric shutterway concept. (Launcher Concepts)
- (U) Development of pressure hull concepts that incorporate features for acoustic advantage. (Hull Modifications)
- (U) Development of concepts for advanced reconfigurable sails. (Sail)
- (U) Development of hull concepts for increased shock strength. (Hull Shock)

(U) COMPLETE:

- (U) Demonstration of machinery cradle concepts and transition to Ship and Submarine HM&E Advanced Technology Program. (Machinery Truss Support System)
- (U) Verification of analysis and design tools for equipment truss support structures and transition to NAVSEA. (Machinery Truss Support System)
- (U) Demonstrate integrated shock/acoustic mounts and transition to NAVSEA. (Equipment Shock)
- (U) Verification of analysis methods to predict UNDEX for multi-compartment pressure hulls and transition to NAVSEA. (Hull Shock Strength)

(U) ($3,993) SUBMARINE POWER AND AUTOMATION:
(U) INITIATE:

- (U) Development of prototype automated system for reduced manning demand. (Automation)

(U) CONTINUE:

- (U) Technology assessment and development of alternative emergency power technologies. (Power Systems)
- (U) Verification of design tools for fluid systems. (Piping Systems)
- (U) Down select and continue development of most promising electrically powered actuator technologies for reduced cost improved reliability steering and diving systems. (Steering & Diving)

(U) COMPLETE:

- (U) Validation of analysis and design tools for quiet electric motors and transition to NAVSEA. (Electric Drive)
- (U) Transition adaptive self-energized magnetic bearing technology to NAVSEA and Ship and Submarine HM&E Advanced Technology Program. (Machinery Reliability and Electric Drive)
- (U) Demonstrate and transition environmentally safe small payload launcher. (Launcher Concepts)

(U) ($3,994) SUBMARINE MANEUVERING AND SEAKEEPING:
(U) INITIATE:

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

(U) CONTINUE:

- (U) Demonstration of jam resistant maneuvering concepts using radio controlled model tests. (Maneuvering Systems)
- (U) Evaluation of acoustic and powering performance for low cost concept. (Low Cost Propulsor Concept)
- (U) Development and validation of design and analysis for full-stern concepts from second generation experimental data. (Full-Stern/Integrated Propulsor)

(U) ($6,000) PEBB:
(U) INITIATE:

- (U) Development of advanced PEBB demonstration modules. (Advanced Concept Electrical Systems)

(U) CONTINUE:

- (U) Evaluation of third-generation demonstration modules for form, fit, and function of PEBB. (Advanced Concept Electrical Systems)

(U) COMPLETE:

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

(U) ($8,076) LOGISTICS AND ENVIRONMENTAL QUALITY TECHNOLOGY:

(U) INITIATE:

- (U) Shipboard medical waste processing technology.
- (U) Development of thermosynthesis technology for re-use of hazardous wastes.
- (U) Development of non-polluting ship lubricants.
- (U) Development of concurrent engineering techniques.
- (U) Development of dynamic impedance computer tomography for mechanical diagnostics.
- (U) Development of pier lateral response analytical model incorporating soil-structure interactions of buried bearing piles, batter piles and fender filing to assess lateral resistance.
- (U) Submarine solid waste processing and management technology development.
- (U) Submarine liquid waste treatment and management technology development.
- (U) Shipboard pollution prevention technology development.
- (U) CASE tool for embedded diagnostics of ship systems.
- (U) Development of micro-computer based technologies for the rapid manufacture of highly valuable system components.

(U) CONTINUE:

- (U) Microwave assisted paint removal.

- (U) Shipboard waste treatment system controller technology development.
- (U) Advanced non-fouling membrane technology.
- (U) Microwave plasma technology for atomic oxygen generation.
- (U) Development of analytical three-dimensional model to improve predictions of the hydrodynmic forces associated with a berthing ship.
- (U) Development of signal processing techniques of motor current signature analysis to diagnose fault conditions based on the mechanical work performed.
- (U) Development of infrared imaging system test equipment and calibration methods to support Navy infrared surveillance systems.
- (U) Development of prognostics for real-time status monitoring and troublesooting for high-power microwave tubes in combat systems.
- (U) Development of pier lateral stability.
- (U) Development of collaborative infrastructure assessment tool.
- (U) Development of structural rope mechanics.

(U) COMPLETE:

- (U) Development of enhanced methodology and definition for copper speciation and fate in sediment systems; transition to Naval Facilities Engineering Command (NAVFAC), PE 0603721N, for implementation.
- (U) Electrochemical pre/post treatment technology development of ship liquid wastes; transition to Advanced Technology Program, PE 0603712N, for shipboard demonstration.
- (U) Development of sensors and prognostics for real-time status monitoring for combat system high power microwave tubes.
- (U) Development of an array of metal oxide-based gas sensor elements capable of distinguishing different gases in a gas mixture.
- (U) Transition of air mobile, compact, lightweight Amphibious Assault Fuel Systems for ship-to-shore fuel transfer capability.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

- (U) Development of supercritical fluid technology for bilgewater treatment; transition to PE 0603712N for technology demonstration.
- (U) Development of dry dock paint application and overspray control and collection technologies; transition to PE 0603712N for integration and demonstration.
- (U) Development of surface cleaning/decontamination technologies for PCBs and other toxics; transition to NAVFAC/NAVSEA PE 0603721N for advanced development and implementation.
- (U) Development of environmentally sound substitue steam catapult lubricant; transition to NAVAIR (PMA 251) for advanced development and implementation.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	60,923	35,591	41,591	48,563
(U) Adjustments from FY97 PRESBUD:	+794	+15,808	+5,268	-1,210
(U) FY 1998/1999 PRESBUDG s Submission:	61,717	51,399	46,859	47,353

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect Jordanian F-16 financing rescission (-$70), SBIR adjustment (-$633) and changes in requirements (+$1,497). FY 1997 changes reflect Congressional Undistributed Reductions (-$2,192) and Congressional Adds for the following: PEBB (+$6,000), Vision Technology (+$1,000), Natural Language Processing (+$1,000), Surface Ship Composite Material (+$5,000), Power Node Control Centers (+$1,000) and Landing Ship/Causeway (+$4,000). FY 1998 adjustments are as follows: changes in S&T program requirements (-$1,699), Navy Working Capital Fund (NWCF) and minor adjustments (-$2,268), PE realignment from PE 0602233N (+$9,288), Inflation (-$120) and Military and Civilian Pay Rates (+$67). FY 1999 adjustments are as follows: changes in S&T program requirements (-$10,741), NWCF and minor adjustments (-$363), PE realignment from PE 0602233N (+$9,985), Inflation (-$177) and Military and Civilian Pay Rates (+$86).

(U) Schedule: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

(U) Technical: Increase to FY 1997 directly supports several Congressional Adds to include PEBB, Vision Technology, Natural Language Processing, Surface Ship Composite Material, Power Node Control Centers and Landing Ship/Causeway. Starting in fiscal year 1998 Logistics and Environmental Quality efforts are realigned into this PE.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(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 (Readiness, Training and Environmental Quality 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 (Ship and Submarine HM&E Advanced Technology)
(U) PE 0603513N (Shipboard System Component Development)
(U) PE 0603514N (Personnel/Ship 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)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602121N
PROGRAM ELEMENT TITLE: SURFACE SHIP TECHNOLOGY

(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604558N (New Design SSN Development)
(U) PE 0604561N (SSN-21 Development Program)
(U) Under the Tri-Service Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER TITLE	FY 1996 ACTUAL	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
Aircraft Technology	28,672	23,750	23,590	22,860	23,418	23,922	24,418	24,943	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 Joint Strike and Joint 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 Tri-Service 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.

(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 Joint Director of Laboratories (JDL) airframe fixed wing component 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) Aircraft Technology also addresses the Rotary Wing Vehicle (RWV). At the Project Reliance JDL rotary wing component taxonomy level, goals include 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 FY 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).

(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:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($6,250) PROPULSION:
  (U) Initiated:
  - (U) Development of moderate bypass ratio fan to meet Phase III goals.
  - (U) Design of a reduced part count Phase III advanced combustor with an integral fuel nozzle/diffuser concept which will reduce costs and weight by 20%.
  - (U) Development of a reduced parts, simplistic design engine fuel metering system that will reduce shipboard maintenance and reduce engine weight by 50 pounds.

  (U) Continued to:
  - (U) Test the Phase II forward swept Joint Technology Demonstrator fan in a rig facility. The fan will eliminate a fan stage to improve logistics of parts supply. It will increase efficiency by 4% as compared to the F414 fan.
  - (U) Fabricate high pressure turbine rotor system with a dual alloy disk. The design will provide turbine temperature capability improvement of 600F, cooling flow reduction of 35% and weight reduction of 10%.
  - (U) Rig test a full set of first stage, vaneless, counterrotating, low pressure turbine blades, yielding a reduction in weight and cooling requirements over current technology.

  (U) Completed:
  - (U) Fabrication and test of a full set of first-stage, vaneless, counterrotating low-pressure turbine blades, yielding a reduction in weight and cooling requirements over current technology.
  - (U) Rig test and final design of fan, low pressure turbine, augmentor and controls components in preparation for 1997 Integrated High Performance Turbine Engine Technology (IHPTET) Phase II demonstration.
  - (U) Testing of a turbine blade and vane in an advanced gas generator. A 600 F increase in turbine inlet temperature will be demonstrated. The fabrication utilized advanced manufacturing techniques that reduced costs by 20%. The turbine system will provide increased capability for Navy Patrol/Transport aircraft applications.
  - (U) Rig testing of a subsonic core compressor that reduces parts count by 50% and improves efficiency by 4% or 40nm range improvement (for a fighter/attack aircraft).

- (U) ($7,410) Air Vehicle:
  (U) Continued to:

- (U) Develop composite low cost integral stiffener concept with improved load carrying capability. This technology will contribute toward a 35% reduced fabrication cost, a 15% reduction in weight and a 25% increase in fatigue life.
- (U) Demonstrate Voice Recognition & Synthesis and helmet-mounted display/head tracker technology integration. Full-mission flight simulators will be used to validate the performance benefits. This effort is toward both a 10 to 1 improvement in lethality ratio and a 50% improvement in first pass target acquisition.
- (U) Demonstrate multi-function programmable display pad designs, including high definition technology flat panel displays which could lead to a 10% reduction in acquisition costs.
- (U) Demonstrate through lab testing, sensor, display, avionics architecture, and image processing integration, the Cyborg Eye concept of pilot visual/display system enhancement toward a 40% reduction in aircraft night bad weather attrition.
- (U) Develop new thermal management approaches to economically cool next generation avionics.
- (U) Develop radar cross section (RCS) benchmark measurements for use in validation of RCS analysis methods.
- (U) Demonstrate/validate repair technology on advanced composite structures. Restoration of composite electrical properties was validated.
- (U) Design a conceptual advanced thermal energy management system. Study showed that significant improvements in air vehicle survivability are achievable.
- (U) Design and test a conformal Very High Frequency/Ultra High Frequency (VHF/UHF) antenna radome.
- (U) Functionally demonstrate an Intelligent Vehicle Management System using a man-in-the-loop simulation for vehicle diagnostics, mediation, and pilot aiding in response to aircraft damage and subsystem failures.

(U) Completed:
- (U) Testing and evaluation of a damped composite aircraft centerbody structure, started in FY91, to demonstrate vibration and dynamic effects alleviation. The life time and safety margin of this structure increased. This contributes toward an objective of 25% increase in fatigue life.
- (U) Demonstration of the ability to perform post repair, non-destructive inspection of aircraft composite structures that would be suitable for use aboard aircraft carriers.
- (U) Fabrication of the Power Management & Distribution for a More Electric Aircraft (MADMEL) technology demonstrator (three-channel operation)in coordination with U.S. Air Force Wright Lab.
- (U) Design feasibility testing & documentation of prototype self-regulating cartridges for advanced escape systems to support the Human Systems Interface goal of providing safe escape to 700 knots equivalent airspeed by FY-2000.

- (U) Hardware fabrication and testing of the switched reluctance External Starter/Generator.
- (U) Hardware fabrication and testing of the Integrated Power Unit (IPU), including the magnetic bearing test rig and high speed/high temperature switched reluctance starter/generator. This supports the Propulsion and Power FY-2000 goal of reducing engine bleed air requirements by 50%.

- (U) ($8,660) DYNAMICS OF FLIGHT:
(U) Initiated:
- U) Development and demonstration of advanced outer loop flight control algorithms to substantially improve the mission effectiveness, survivability, and lethality for both current and future Naval aircraft.
- (U) Development of cost sensitivity and Life Cycle cost prediction models for system level component integration in maritime aircraft.
- (U) Design a Vectored Thrust Ducted Propeller Concept.

(U) Continued to:
- (U) Develop and evaluate control laws to assist the pilot in outer-loop control functions to reduce control related accidents.
- (U) Demonstrate an improved version of the Learning Augmented Flight Control system for pitch control of a high fidelity simulation, which addresses the objective of reducing development costs by 20%.

(U) Completed:
- (U) Application of artificial intelligence techniques for evaluating aircraft handling qualities, which contributes to the objective of reducing flight control system development costs by 20%.
- (U) Testing of advanced external weapon carriage concepts. Quantitative assessments of aerodynamic and survivability characteristics of weapon carriage concepts were obtained.
- (U) Wind tunnel evaluation of advanced air vehicle control concepts. Test data provides a unique database for use in flight control efficiency evaluations in support of the FY-2000 objective of reducing flight control development costs by 20%.
- (U) Demonstration of the On-board Expert Diagnostic System real-time, hardware-in-the-loop with a subset of flight control hardware, including diagnostic failures in the operational F/A-18 flight control computers, aileron actuators, rudder actuators, air data system, and related interfaces

- (U) ($1,102) SEABASED AIRCRAFT ADVANCED SUPPORT:
(U) Continued to:

- (U) Develop Remote Light Direction and Ranging (LIDAR) Sensor for measuring turbulent wind flow fields.

(U) Completed:
- (U) Development of a vortex-wake rotor aeromechanical analysis code to contribute to improved shipboard handling qualities.

- (U) ($5,250) OXIDE PURPLE:
  - (U) Classified.

2. (U) FY 1997 PLAN:

- (U) ($6,500) PROPULSION & POWER:
  (U) Initiate:
  - (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) Continue 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.
  - (U) Evaluate advanced electrical concepts/architectures to reduce system weight, volume and cost for future naval aircraft.

  (U) Complete:
  - (U) Design for Phase III JTDE combustor.
  - (U) Design of electronic engine control system with Wright Lab. The system design will utilize ruggedized optic connectors and combine optics and electronics on one chip to minimize size and weight.
  - (U) Fabrication, assembly and initial testing, in a 6.3 demonstrator engine, of additional 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) System level testing of the 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 IPU demonstrator to Wright Laboratory, to support the objective of increasing reliability of the electrical power system by 2.5x by FY-2000.

- (U) ($2,650) AFFORDABLE NAVY AIR VEHICLES:
(U) Initiate:
- (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 and demonstration of an exhaust impinged structural air vehicle component.

(U) Continue 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 Joint Strike Fighter (JSF) 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) Complete:
- (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 RCS measurement of the conformal VHF/UHF antenna radome.
- (U) Demonstration of composite substructure to reduce manufacturing cost.

- (U) ($8,000) AIRCRAFT COMBAT SITUATIONAL AWARENESS:
(U) Initiate:
- (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 (Congressional add of $2.2 million).

(U) Continue to:
-- (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 (Congressional add of $2 million).

- (U) ($2,532) AIR VEHICLE DYNAMIC CONTROL:
(U) Initiate:
- (U) An automated/assisted maneuvering task to investigate which types of advanced outer loop modes are feasible both from a technical and human factors point of view.
- (U) Laboratory demonstration of an advanced air data acquisition sensor.
- (U) Investigation of relaxing Navy design requirements through implementation of advanced technology developments to reduce development costs by 20%.
- (U) Investigation of control augmentation systems most appropriate to compensate for aircraft operational deficiencies in degraded environmental conditions.

(U) Continue 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.

- (U) ($363) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($8,460) PROPULSION & POWER:
  (U) Initiate:
  - (U) Design of IHPTET Phase III propulsion components that will reduce maintenance costs of Navy subsonic support aircraft by 35%.

  (U) Continue to:
  - (U) Develop JTDE 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 of Fighter/Attack category engine components in a full engine configuration to increase thrust-to-weight by 60% and reduce cost by 20%.
  - (U) Demonstration in a subsonic core advanced combustor and compressor components that reduce fuel consumption by 30%.
  - (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) Fabrication of the ISG and integration into an IHPTET engine core demonstrator.
  - (U) Fabrication of the IPU Starter/Generator and engine gas generator core.

- (U) ($3,190) AFFORDABLE NAVY AIR VEHICLES:
  (U) Initiate:
  - (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.
  - (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 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) Complete:
- (U) Design of an exhaust impinged structural air vehicle component.

(U) ($5,500) AIRCRAFT COMBAT SITUATIONAL AWARENESS:

(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) ($2,987) AIR VEHICLE DYNAMIC CONTROL:
(U) Initiate:
- (U) System architecture for the Real-Time Battle and Mid-Air Collision Damage Identification System.

(U) Continue to:
- (U) Develop parallel viscous aerodynamic methodology for improving the fidelity of aerodynamic design and cycle time.
- (U) Develop the Automated Maneuvering system using outer loop control algorithms to reduce pilot workload, maintain low observability, perform precision weapon delivery, and provide automatic recovery and altitude control.
- (U) Analyze impact of current design criteria on designs, identify areas of conservative design and survey advanced technology impact toward reducing development costs by 20%.
- (U) Refine, optimize and test control augmentation system most appropriate for compensating for aircraft operational deficiencies in degraded operational conditions.

(U) Complete:
- (U) Flight demonstration of an advanced air data acquisition sensor.
- (U) Design of the automated/assisted maneuvering system architecture and develop control algorithms.
- (U) Improved highlift system aircraft configurations and a validated 3D optimization/design method for high-lift systems.

- (U) ($3,453) OXIDE PURPLE:
  - (U) Classified.

4. (U) FY 1999 PLAN:

- (U) ($8,489) PROPULSION & POWER:
  (U) Initiate:
  - (U) Design of components that will reduce fuel consumption of Navy fighter/attack and subsonic support aircraft by 40%.
  - (U) Testing of the Internal Starter/Generator.
  - (U) Testing of the IPU Starter/Generator with gas generator.
  - (U) Develop new heat exchangers with enhanced heat transfer capabilities, increased resistance to corrosion, compatibility with the aircraft carrier environment, and reduced manufacturing and repair costs.

  (U) Continue to:
  - (U) Develop Phase III Fighter/Attack Demonstrator Engine Fan.
  - (U) Develop life/durability improvements in turbine system components.

  (U) Complete:
  - (U) Rig test of advanced corrosion resistant mechanical components to reduce operating costs.
  - (U) Rig test of the Phase III Advanced Gas Generator/Joint Technology Demonstrator Engine affordable combustor to expand flight envelope.
  - (U) Demonstrate reduced maintenance fuel flow metering system.

- (U) ($3,000) AFFORDABLE NAVY AIR VEHICLES:
  (U) Continue to:

- (U) Demonstrate unitized composite structure to reduce structural weight and manufacturing cost.

(U) Complete:
- (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) Testing of an exhaust impinged air vehicle component.

- (U) ($5,500) AIRCRAFT COMBAT SITUATIONAL AWARENESS:
(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) ($2,610) 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) Continue to:
- (U) Investigate relaxed design criteria and develop a research plan contributing to a 20% reduction in development costs.

(U) Complete:
- (U) Demonstration of the automated/assisted maneuvering system in a non-real-time simulation using a model of a pilot and a limited threat environment.
- (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) Implementation of Real Time Battle and Mid-Air Collision Damage Identification algorithms in software.
- (U) Shipboard flight test evaluation to demonstrate control augmentation system ability to compensate for aircraft operational deficiencies in degraded environmental conditions.

• (U) ($3,261) OXIDE PURPLE:
- (U) Classified.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	29,792	20,578	26,554	31,215
(U) Adjustments from FY 1997 PRESBUDG:	-1,120	+3,172	-2,964	-8,355
(U) FY 1998/1999 PRESBUDG Submission:	28,672	23,750	23,590	22,860

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect a Jordanian F-16 financing rescission (-35); an Administrative & Personnel Services reduction of (-132); SBIR Transfer reduction (-133); and execution adjustments (-820). FY 1997 adjustments reflect Congressional undistributed reductions (-1,028); and Congressional Plus-ups for Flat Panel Helmet Mounted Displays (+2,000) and Biofeedback Technology (+2,200). FY 1998 adjustments reflect rebalance of 6.2 to fund ATDs (-1,651); Navy Working Capital Fund (NWCF) and other adjustments (-1,243); and inflation reduction (-59). FY 1999 adjustments reflect a rebalance of 6.2 to fund ATDs (-7,113); and NWCF and other adjustments (-1,157); and Inflation reduction (-85).

(U) Schedule: FY 97 funding adjustments caused a delay in the start of Thermal Management efforts, as well as slowing efforts in the development of Composite Structures technologies. FY 98 & 99 funding adjustments have forced the cancellation of the Integrated Advanced Aircraft/Advanced Ship Systems technology thrust efforts until FY 02.

(U) Technical: Not Applicable.

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602122N
PROGRAM ELEMENT TITLE: Aircraft Technology

(U) RELATED RDT&E: This program adheres to Tri-Service Reliance Agreements on Air Vehicles (Fixed Wing & Rotary Wing), Integrated Platform Avionics, and Human Systems with oversight provided by the Joint Directors of Laboratories.

(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 (Readiness, Training and Environmental Quality 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)
- (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 0603245F (Advanced Flight Technology Integration)
- (U) PE 0603706N (Medical Development(Advanced))
- (U) PE 0603792N (Advanced Technology Demonstrations)

(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
C3001 Marine Corps Landing Force Technology	16,871	16,374	13,043	14,535	19,265	19,822	20,400	21,032	CONT	CONT

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: 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 to ensure the continued existence of the Marine Corps as a separate and major military service, both with distinct warfighting mission and as a flexible instrument of national policy. The National Security Act of 1947 and DoD Directive 5100.1 are the basis for conducting this Marine Corps effort.

(U) By law, the Marine Corps is tasked to develop, in conjunction with the Army and Air Force, those phases of amphibious operations that pertain to tactics, techniques, and equipment used by the landing force. It is reorganized from 8 technology thrust areas into 5 Warfighting Imperatives by the Science and Technology (S&T) Roundtable process. These Warfighting Imperatives are: Command and Control (C^2), Maneuver, Logistics, Firepower, and Training and Education.

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology PROJECT NUMBER: C3001 PROJECT TITLE: Marine Corps Landing Force Technology

(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 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 1996 ACCOMPLISHMENTS:

- (U) ($3,577) C^2: Completed systems level design for networked Over-the-Horizon (OTH) Communications system. Demonstrated intelligent automated landing plan generator. Provided complete order of battle capability for battalion level, tactical simulator and demonstrated it. Expanded field language translator system to provide briefing capability. Performed Phase I technology application for collaborative planning and decision aids. Exercised cellular communications in support of joint operations. Expanded joint countermeasures Command, Control, Communication, Computer and Intelligence (C4I) architecture to support Operational Maneuver From The Sea (OMFTS). Completed design of a Radio Reconnnaissance receiver for forward Recon Teams. Performed a comparative analysis of data compression algorithms to evaluate best allocation for digital video project.

- (U) ($7,728) Maneuver: Completed testing of the Joint Tactical Electric Vehicle and transitioned technology to Marine Corps Advanced Technical Demonstrations (ATD), PE 0603640M, Project C2223 and the joint Marine Corps, USSOCOM Light Strike Vehicle (LSV) acquisition program. Completed development and testing of Helo-Transportable

Multi-Mission Platform and Articulated Electric Drive Trailer (HTMMP/AEDT) and transitioned to joint Marine Corps, United Stated Special Operations Command (USSOCOM) LSV program. Continued field tests of corrosion resistant components and inserted new components/advanced technology on field demonstration with Combat Service Support platforms. Conducted field tests on lightweight, corrosion resistant plastic radiators on Highly Mobile Multi-Purpose Wheeled Vehicle (HMMWV) and Logistics Vehicle Systems (LVS) vehicles. Initiated and continued testing of high temperature coatings and flame-sprayed corrosion resistant coatings. Continued current, and awarded new contracts, for concept development of amphibious logistics transportation systems to support seabase-to-objective maneuver. Facilitated and supported on-going seabase, Maritime Prepositioned Forces (MPF), and future concepting between Marine Corps and Navy expeditionary warfare organizations. Procured experimental prototype tunable filter multi-spectral camera and assessed passive millimeter wave (MMW) technology shortfalls. Designed and fabricated feasibility demonstrator sensor device for mine detection in adverse weather and began laboratory tests. Solicited responses to extend operational envelope for multi-spectral mine detection and improved buried mine detection. Demonstrated visible/thermal image fusion technologies and transitioned to Coastal Battlefield Reconnaissance and Analysis (COBRA) Demonstration/Validation (DEM/VAL) program. Completed full scale testing of mechanical mine neutralization and Off-Route Smart Mine Clearance breadboard and key countermeasures concept testing. Completed evaluations of countermeasures techniques and transition activities to Army and Program Manager. Completed vehicle landmine survivability system demonstrations, transitioned program to Army, and installed kits on vehicles involved in recent military operations in Bosnia. Completed anti-helicopter predictive modeling. Corrosion and expeditionary transportation efforts will be executed under the Logistics Imperative beginning in FY 1997.

- (U) ($2,546) Logistics: Selected and awarded Broad Area Announcement (BAA) contract in support of technology road map. Expanded program to incorporate Logistics Command and Control and Logistics Transportation. Established Combat Service Special Operations Command/Tactical Logistics (CSSOC/TACLOG) Test Site. Prototyped air-liftable material handling equipment for forward areas. Began concept validation for sea-basing and ship to

shore transportation/distribution systems through modeling, to support a matrixed concept of operations. Initiated technology support efforts for Maritime Prepositioning Force operations technology. Completed Recording and Tracking system configuration integration. Selected and awarded BAA contracts in support of technology roadmap. Completed Recording and Tracking system configuration integration. Completed Expeditionary

Engineering Technologies system concepts. Completed validation of Amphibious Bulk Liquid Technology system configuration. Continued developing technology concepts for sea-basing cargo transfer technologies. Initiated technology support efforts for Maritime Prepositioning Force operations technology. Solicited BAA responses for demonstratable system components to support concepts and follow-on Marine Corps ATD efforts in PE 0603640M, Project C2223.

- (U) ($3,020) Firepower: Completed advanced testbed development. Transitioned Gated Laser Video System to Marine Corps ATD (PE 0603640M, Project C2223). Started development of sensor registration, sensor orientation, multiple sensor data fusion, and sensor communications and tactical target tracking in near perfect real-time tactical Integrated Fire Control (IFC) System. Continued to exploit emerging technology through the BAA process. Completed autoloader and transition technology to Program Manager. Developed concepts for inexpensive, autonomous and guided mortar rounds for the auto-load system. Analyzed technology deficiencies, and continued to nullify those deficiencies through the BAA process.

2. (U) FY 1997 PLAN:

- (U) ($2,152) C^2: Continue efforts in developing OTH Communications capability for landing forces. Complete prototype tactical simulator and demonstrate. Develop C4I information transfer and management architectural specification based on Marine Corps requirements and technology search. Initiate Plan Repair and Battle Damage Analysis (BDA) analysis decision aid tools. Initiate digital video prototyping task. Identify computer hardware technology and investigate ability of improving radio technology for man-portable scenarios. Develop prototype

OTH-Comms wide band relay system and demonstrate the first phase during Force 21 Exercise. Continue work in developing intelligent software to support the Commanders Critical Information Requirements (CCIR) analysis and information retrieval. Continue and complete task to provide a digital video remote reconnaisance capability over low bandwidth point-to-point radios. Develop and demonstrate methods to monitor operation execution and repair Operations Order (OPORDER) Annexes as unexpected events occur during operations. Construct a next generation prototype handheld radio frequency (RF) signal detector, classifier and localizer prototype which will be capable of wide band signal analysis. Utilizing smart algorithms, develop the capability to automatically analyze, evaluate and display battle damage in a tactical picture. Continue Information Warfare defensive phase task.

- (U) ($4,275) Maneuver: Complete award of BAA contracts for survivability. Continue technology insertion into joint Marine Corps, Defense Advanced Research Project Agency (DARPA), and USSOCOM light tactical vehicle program. Enhance hybrid electric Joint Tactical Electric Vehicle (JTEV) and test new technology. Continue joint Marine Corps/Army Joint Advanced Survivability Experiment (JASE) testing and integration. Initiate Threat Oriented Survivability Optimization Model (TOSOM) development for vehicle integration. Initiate survivability analysis for Reconnaissance Scout Vehicle (RSV) and Future Light Combat Vehicle (FLCV). Complete tests of tunable filter multispectral camera for mine detection to qualify performance, analyze remaining technology shortfalls, and solicit BAA responses to correct. Continue development of technologies to extend the standoff range of multispectral mine detection. Complete modeling and simulation (M&S) efforts directly related to mine countermeasures (MCM). Construct, test, and demonstrate sub-scale and full-scale models of mine survivable vehicle and transition. Integrate sensor suites for autonomous battlefield surveillance. Continue joint Marine Corps, Army electro-magnetic armor systems. Complete testing of tactical decal test and evaluation. Close out shaped charge alternative concepts, report, and transition technology. Planned transition of Stand-off Minefield Breacher program and Joint Amphibious MCM ATD (PE 0603640M).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology PROJECT NUMBER: C3001 PROJECT TITLE: Marine Corps Landing Force Technology

- (U)($5,348) Logistics: From technology road map of future combat service support, the emphasis is on Logistics C^2. LOG C^2 is supported by investigation into rapid request handling, an advanced prototype for CSSOC/TACLOG support, and a definition study of seabased C^2 requirements. Support Service tasks include the test and evaluation of the prototype material handling equipment. Complete preliminary concepting for Expeditionary Container Handler (ECH) and prepare for transition to ATD (PE 0603640M) in FY 1998. A washdown technology will be analyzed to support the rapid retrograde or backload of logistics and transportation assets from the forward areas to the seabase. Combat loading will be integrated as a module into MAGTF Logistics Automated Information System (LOG AIS) software, supporting load plans for combat configured loads. Conduct technology assessment to include deployable heavy lift and the integration of maintenance C^2 into LOG AIS. LOG transportation will be addressed in an initial future vehicle study for high pay-off thrust areas to include the rapid prototyping/field testing of a logistics aerial delivery support system. Emphasis will be placed on the conceptual development of the seabasing platform functionality. Complete field testing of new components and advanced corrosion technology with demonstration on Communications Support System (CSS) platforms. Complete testing of HMMWV plastic radiator and transition to Program Manager (PM). Start corrosion inhibitor coatings effort to include, investigation, analysis, and eventual laboratory testing and full scale trials. Complete preliminary concepting for Expeditionary Logistics Transporter (ELT) vehicle and prepare for transition to ATD (PE 0603640M) in FY 1998. Complete configuration integration for Amphibious Bulk Liquid technologies and Expeditionary Engineering technologies. Complete technology system concepts and begin concept validation for sea-basing cargo transfer technologies. Develop technology concepts for Maritime Prepositioning Force operations technology. Develop commanders task/asset/services correlation tool. Complete configuration integration for Amphibious Bulk Liquid technologies and Expeditionary Engineering technologies. Complete technology system concepts and begin concept validation for sea-basing cargo transfer technologies. Develop technology concepts for Maritime Prepositioning Force operations technology. Develop commanders task/asset/services correlation tool.

- (U) ($3,349) Firepower: Continue to demonstrate sensor registration, sensor orientation, multiple sensor fusion, and communication links components for real-time tactical IFC System. Develop concepts for remotely programmable adaptive sensors. Continue to exploit technology through the BAA process. Demonstrate components of lightweight, close-in Air Defense Systems. Continue to exploit emerging lightweight weapons technology through the BAA process. Identify concepts for high energy/impulse warhead concepts . Perform analysis/tradeoffs of fire-from-enclosure technologies. Develop conceptual subsystem designs of weapons accuracy improvement components.

- (U) ($900) Training and Education: Initiate program to begin to develop core competency for the Marine Corps at a recognized center of excellence for M&S with direct links to the broad field of training and education and more specifically to the operational issues associated with C^2. Begin to develop expertise in application and

  adaptation of environment features relative to the littoral battlespace. Explore new concepts using legacy and emerging Navy and Marine Corps communications assets to support at sea mission planning rehearsal and virtual training. Develop Marine specific research tools to support M&S in other Warfighting Imperative focus areas.

- (U) ($350) SBIR: Portion of the program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

4. (U) FY 1998 PLAN:

- (U) ($2,503) C^2: Demonstrate Scalable Tactical Picture and transition to ATD. Complete Plan Repair/BDA decision aids task. and transition to PE 0603640M. Demonstrate OTH Communications. Continue CCIR software prototype. Initiate scalable plan and decision aid task. Continue BDA and display task. Continue Information Warfare task and extend to offensive phase. Complete operation execution monitor and OPORDER repair task. Initiate task to

provide long range Low Probability of Interception Detection (LPI/LPD) wireless wide band local area network to support dispursed fire teams during operations. Initiate task to prototype a mobile small footprint phased array super high frequency (SHF) antenna to operate from moving platforms on land.

- (U) ($2,619) Maneuver: Complete evaluation of DARPA technology insertion into JTEV testing and publish results. Demonstrate fixed-but-multiple wavelength laser effort and Automated Target Recognition (ATR) algorithm and image synthesis tool extension to ultraviolet and near infrared (IR). Transition distributed explosive technology to PE 0604612M. Demonstrate affordable robotic mine countermeasures systems.

- (U)($4,646) Logistics: Begin development, demonstration of a deployable LOG C^2 integrated system. Complete development of the Rapid Request C2 support system. Begin demonstration of the material handling technology in conjunction with air delivery and packaging/combat load concepts. Begin demonstration of deployable heavy lift. Demonstrate washdown technology. Continue modeling and simulation efforts of MPF/Seabase/Transportation/Facilities. Complete field and atmospheric testing of thermal-spray aluminum coatings. Complete atmospheric corrosion testing of multiple alternative coatings for fasteners and connector. Complete evaluation of feasibility of accelerated corrosion testing methods for use in Marine Corps applications.

- (U) ($2,400) Firepower: Demonstrate Enhanced Target Acquisition/Geo-Location Equipment Integration. Continue BAA solicitation/award cycle. Demonstrate Acquisition & Queing Heads Up Display. Continue operation and improvement of Sensors Test Bed.

- (U) ($875) Training and Education: Continue rapid virtual database generation effort. Develop intelligent behaviors and test. Complete range instrumentation concepts analysis.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M PROJECT NUMBER: C3001
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology PROJECT TITLE: Marine Corps Landing Force Technology

5. (U) FY 1999 PLAN:

- (U) ($2,790) C^2: Develop scalable planning tool. Complete CCIR decision aid. Demonstrate offensive Information Warfare capability from Tactical Combat Operations (TCO) (Marine Corps GCCS)-develop a field level operation execution and monitoring tool for use with the Data Automated Communications Terminal (DACT). Continue the development of the wide band wireless Local Area Network (LAN) to support widely dispersed fire teams. Develop a field level operation execution and monitoring tool for use with the DACT. Initiate an effort to adapt 3 dimensional volumetric display technology into combat operation centers for ground and air operations.

- (U) ($3,660) Maneuver: Initiate technology investigation efforts that eliminate risks associated with RSV ATD programs. Develop production alternative decision matrix for determining mine survivable vehicle kits. Transition autonomous minefield reconnaissance and neutralization system to ATD. Develop technologies applicable to the Enhanced Survivability Platform ATD for integration into survivability suite of FLCV. Complete early operational assessment of tunable filter camera sensor; integrate into COBRA sensor.

- (U)($4,035) Logistics: Complete field and atmospheric test of high temperature corrosion resistant coatings and transition to PM’s. Complete corrosion performance evaluation and feasibility study of diamondlike nano-composite protective coatings.

- (U) ($3,100) Firepower: Integrate disparate sensors into compact adaptive, deep insertion tactical targeting sensor unit. Integrate meterological/environmental sensor into deep-insertion tactical sensor array. Test and integrate sighting, sight stabilization, range increasing/enhancing, and lethality enhancing technologies into existing and advanced lightweight ground weapons in support of the maneuver element. Integrate remote joint Army, Marine Corps, and Navy test and maneuver training sites into the sensor test bed facility. Test and evaluate lead-free technologies for small arms.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology PROJECT NUMBER: C3001 PROJECT TITLE: Marine Corps Landing Force Technology

- (U) ($950) Training and Education: Develop intelligent behaviors and integrate into systems. Technical concepts definition for user to simulation interfaces. Brassboard test and demonstration

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	16,917	17,093	19,049	20,809
(U) Adjustments from FY 1997 PRESBUDG:	-46	-719	-6,006	-6,274
(U) FY 1998/1999 OSD/OMB Budget Submit:	16,871	16,374	13,043	14,535

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments include (-$166) due to Jordanian F-16 financing rescission, (-$85) due to SBIR, and (+$205) due to minor adjustment. FY 1997 decrease of (-$719) due to Congressional Undistributed Reductions. FY 1998 adjustments include (-$32) for Inflation and (-$5,974) due to realignment of programs to fund high priority initiatives, CWL and Sea Dragon. FY 1999 adjustemnts include (-$54) for Inflation and (-$6,220) due to realignment of programs to fund high priority initiatives, CWL and Sea Dragon.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology PROJECT NUMBER: C3001 PROJECT TITLE: Marine Corps Landing Force Technology

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

(U) RELATED RDT&E:

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

(U) PE 0603606A (Improved Dispersed Explosives Technology
(U) PE 0603619A (Improved Dispersed Explosives Technology)
(U) PE 0603611M (Marine Corps Assault Vehicles)
(U) PE 0603635M (Marine Corps Ground Combat/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) The Army, Air Force, and Navy Technology Base Programs are monitored by Marine Corps Project Officers through their counterparts in those organizations to ensure that no unwarranted duplication exists.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

PROJECT NUMBER: C3001
PROJECT TITLE: Marine Corps Landing Force Technology

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Space & Electronic Warfare (SEW) C3 Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Space & Electronic Warfare (SEW) Technology	56,534	54,735	65,566	71,426	73,688	72,667	72,739	72,372	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) supports future command, control, communications (C^3) and surveillance systems for surface, air, and space platforms for Naval Warfare. This program develops C^3 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^3 technology and surveillance technology are related to the Joint Mission Areas of Joint Strike Warfare, Littoral Warfare, Joint Surveillance, and Space-Electronic Warfare-Intelligence (SEW/I). Specifically: Joint Strike efforts address technology issues in real-time targeting and Battle Damage Assessment (BDA). Programs include mission planning, en route C^3, 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. Joint 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. SEW/I efforts address information warfare Common Tactical Picture, battle management and connectivity. Programs include

sensors and C^3 to provide timely situation awareness of the total battlespace and indications and warning of threat operations and intentions.

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

(U) Due to the sheer volume of 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) The Navy Science & Technology program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

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

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($20,862) RADAR TECHNOLOGY:
  - (U) Field tested Radar Survivability/Counter Anti-Radiation Missile (ARM) Waveforms in a Low Probability of Intercept Radar (LPIR) testbed to assess level of immunity to anti-radiation homing seekers. This continuing multi-year effort is coordinated under Joint Service Active Systems Survivability Working Group.
  - (U) Developed a Testbed System for Compact-Multi-Mode Radar (Search And Rescue (S&R)/Moving Target Indicator (MTI)/Inverse Synthetic Apeture Radar (ISAR)) for manned and unmanned aircraft surveillance of sea and land targets in littoral environments.

- (U) Developed ISAR improvements for automatic ship classification for Fleet AN/APS-137 radar upgrade. Coordinated with Naval Air Systems Command (NAVAIR).
- (U) Developed alternate Voltage Controlled Diode Affordable Phased Array technology. Continuing program to attack the high cost of phased arrays. Technology will transition to shipboard multi-function, next generation radar. Coordinated with Program Exective Office (PEO) Theater Air Defense (TAD).
- (U) Field tested Ultra-Wideband Radar System for ship self defense against high speed low observable missiles. This effort was coordinated with PEO(TAD).
- (U)Integrated and tested Horizon Search, Track and Engagement Radar with Ship Self Defense Combat System for rapid engagement of anti-ship missiles. Coordinated with PEO(TAD).
- (U) Completed Mountain Top Phase I experiments in Space Time Adoptive Processing (STAP) for Airborne Early Warning (AEW) Radar demonstrated effective operation in dense clutter and jamming.
- (U) Laboratory Tested Two Dimensional Air Target Identification Algorithms.
- (U) Wideband AEW Radar Testbed integration to enable evaluation of concepts for next generation AEW Radar.
- (U) Developed concept for ultra wideband space fed phased array for multi-function (search, track, engage) radar.
- (U) Roof Top Tested Wideband AEW Testbed Radar and assessed performance against real targets.
- (U) Initiated efforts to Integrate Two Dimensional Air Target Identification Algorithms in AN/APG-71 Radar Signal Processor for subsequent flight tests (Joint with United States Air Force (USAF)).
- (U) Developed System Concept for Ultra High Frequency (UHF) electronically steered phased array for carrier based AEW aircraft and awarded three design study contracts.
- (U) Initiated development of lightweight composite radar rotary coupler and antenna for AN/SPS-49 surveillance radar.

• (U) ($11,774) EO/IR TECHNOLOGY:
- (U) Completed design and awarded hardware development contract for ship Infrared Search and Track (IRST) real time signal processor.

- (U) Initiated Laboratory testing of multi-dimensional detection and track algorithms for ship IRST horizon surveillance.
- (U) Conducted successful at sea demonstration of Shipboard Two Color IRST in detecting low altitude targets a the horizon.
- (U) Conducted Initial flight test of Shared Aperture (Television (TV), Forward Looking Infrared (FLIR), IRST) EO Sensor for fighter/attack aircraft surveillance and targeting. This technology is basis for E-2C Surveillance IRST development.
- (U) Completed design and awarded contract for E-2C two-color Surveillance IRST developments for Theater Ballistic Missile Defense.
- (U) Initiated testing (Joint with USAF) of multi-spectral EO Sensor for Airborne Surveillance of land targets.
- (U) Completed IR measurement and analysis of ship induced cloud wake phenomena from hi-altitude platforms to determine detectability of surface (ship) platforms transiting underneath cloud cover. (Joint Navy, Defense Advanced Research Project Agency (DARPA), National Aeronautics and Space Administration (NASA) and United Kingdom (UK)).
- (U) Completed performance testing of precision EO Interferometer at Lowell Observatory for precision imaging of orbiting and stellar objects.
- (U) Initiated validation of Integrated background/environmental model suite (software program IRTool) with North Atlantic Treaty Organization (NATO) and The Technology Cooperative Program (TTCP) nations.

• (U) ($3,071) MULTI-SENSOR TECHNOLOGY:
- (U) Completed architecture and interface designs for off-the-shelf Multi-Sensor (Multi-Mode Radar, EO, Electronic Warfare Support Measures (ESM)) Testbed System to facilitate multi-sensor data fusion development. Per Congressional direction, initiated contract efforts for development of integrated multi-sensor fusion technology. This supports Sensor Integration and Data Fusion Technology for Airborne Surveillance of land areas. This effort is coordinated with the Defense Airborne Reconnaissance Office (DARO).
- (U) Initiated concept development for adaptive resource management processor.

- (U) Conducted system study/analysis of active Radio Frequency (RF) apertures on typical Navy ship combatant to provide basis for multi-function RF aperture technology development.

- (U) ($2,248) COMMUNICATIONS NETWORKS:
  - (U) Successfully demonstrated Asynchionous Transfer Mode (ATM) traffic over the Defense Satellite Communications System (DSCS).
  - (U) Applied the submarine network simulation model to specific network protocol suites, such as the Minimum Coverage Approximation/Handoff Assigned Multiple Access (MINCAP/HAMA) and Enhanced Link 16, to establish a performance baseline for submarine participation in battlegroup networks, a capability nonexistent today.

- (U) ($9,272) COMMUNICATIONS:
  - (U) Completed at-sea measurements of the on-hull Extremely Low Frequency (ELF) submarine antenna, and field tests of the corona-model ELF antenna, refined design of submarine low-profile antennas to minimize sea-water washover effects as a means of increasing data rates, and initiated assessment of submarine Super High Frequency (SHF) phased array technologies, taking into consideration link analysis requirements, electrical and mechanical performance, and housing and deployment requirements.
  - (U) Performed analysis to extend the aircraft antenna array design to a conformal array for curved surfaces, considering both slots and dipole antenna elements; fabricated breadboards of the miniaturized airborne communications relay to provide a high data-rate UHF capability, and determined high data-rate Satellite Communication (SATCOM) requirements for Naval aircraft.
  - (U) Tested the optically controlled antenna and explored transition potential to aircraft platforms; investigated the feasibility of employing Frequency Selective Surfaces (FSS) for composite masts in order to reduce the number of antennas aboard ships, assessed alternative bandwidth efficient modulation formats for use in maritime UHF line-of-sight communications, and explored the use of existing commercial modems that incorporat bandwidth efficient modulations and adaptive signal processing techniques.

- (U) Developed an High Frequency (HF) jammer processor to aid the operator in making timely decisions concerning optimum frequencies for jamming specific targets, interference effects with own communications, propagation conditions etc., and tested/evaluated language identification algorithms developed by the USAF.

- (U) ($6,238) COMMAND SUPPORT:
  - (U) Demonstrated and transitioned Optimal Strike Routing Distributing Planning Algorithms into 6.3 Real-time Support program (PE 0603794N).
  - (U) Completed simulation demonstration of mission force/unit level planning with distributed planning algorithms.
  - (U) Completed and transitioned image/text exploitation and retrieval tools to operational command site for evaluation.
  - (U) Initiated requirements analysis for establishing a virtual collaboratory testbed utilizing existing network infrastructure to provide Navy and Joint Service a distributed collaborative environment for rapid prototyping of technologies and experiments.
  - (U) Initiated development of crisis action planning tools that will automatically generate deconfliction of crisis response across divergent areas of planning and planning centers.
  - (U) Initiated development of a virtual reality display/plan preview system that will provide strike planners a three dimensional (3D) view and interaction capability with targets on and around the battlefield.
  - (U) Initiated analysis and data representation methods for assessing data quality and identify levels of uncertainty associated with inconsistent and ambiguous data from distributed information specialist.
  - (U) Initiated development of force level execution and monitoring tools and plan repair techniques.
  - (U) Initiated development of intelligent software agents for realtime access and retrieval of data.
  - (U) Completed modification and evaluation of Commercial Off The Shelf (COTS) products for Real Time Operating systems developments as applied to Command and Control (C2) systems.
  - (U) Initiated work on defense information warfare techniques for detecting unauthorized modification of data to C2 systems.

- (U) Initiated development of multi-user collaborative workspace software using object oriented technology for use in collaborative planning.
- (U) Initiated development of secure architecture concepts using affordable secure co-processor that will improve information sharing.
- (U) Initiated development of database architecture using wrapper technology that allows access to distributed hybrid databases.

- (U) ($3,069) NAVIGATION:
  - (U) Developed improved algorithms for passive submarine terrain avoidance, investigated feasibility of quantum well gyros to avoid mechanical dithering, fabricated initial model of superconducting gyro and developed specifications for a high performance fiber-optic gyro suited for submarine applications.
  - (U) Assessment and identification of technology for strategic submarines navigation systems.

2. (U) FY 1997 PLAN:

- (U) ($20,068) RADAR TECHNOLOGY:

(U) CONTINUE:
- (U) Design and development of Ultra-Wideband phased array (Scale Model of N times N (NXN) elements) architecture and control technology to enable ultra-wideband radar operation from a single antenna.
- (U) Performance testing of horizon search, track and engagement radar integrated with ship self defense combat system in a high speed low altitude target environment.
- (U) Investigations of affordable technolgies to significantly reduce cost and complexity of phased arrays.
- (U) Integration and validation of two dimensional Air Target Identification technology in AN/APG-71 radar for all aspect target identification (ID).
- (U) Development of lightweight composite rotary coupler and antenna for AN/SPS-49 Surveillance radar.

(U) COMPLETE:
- (U) Design Studies for UHF electronically steered phased array for carrier based AEW aircraft and down select for scale model hardware development.
- (U) Field Test of Ultra-Wideband radar system against targets of varying cross section and flight regimes.
- (U) Transition automatic ship classification technology to NAVAIR for AN/APS-137 upgrade.
- (U) Wideband AEW Radar development, technology to be considered for Navy Common Support Aircraft radar.
- (U) Development and field test of compact multi-mode radar Synthetic Aperture Radar(SAR)/Moving Target Indicator (MTI)/Inverse Synthetic Aperature Radar (ISAR) for Ocean and Land Surveillance from manned aircraft and unmanned aerial vehicles (UAVs) restructure, technology development for application to Joint Synthetic Terrestrial Aperture Radar System (JSTARS) and AN/APS-137 radar.
- (U) Investigations of voltage controlled Diode implementations for phased arrays.

(U) INITIATE:
- (U) Joint Program with USAF to add Terrestrial Inverse Synthetic Aperture Mode and moving target image processing to existing SAR Joint Surveillance Target Attack Radar System (JSTARS) and AN/APS-137.
- (U) Development of breadboard hardware Very High Frequency (VHF)/UHF stepped frequency Ultra Wideband Radar Technology for concealed and buried target detection and exploitation.
- (U) Contract to Fabricate scale model UHF Electronically Steered phased array to assess performance for E-2C AEW and Theater Missile Defense (TMD) operations.
- (U) Passive Millimeter Wave radiometry for all weather, high resolution imaging for target ID and BDA operations.

- (U) ($11,535) EO/IR TECHNOLOGY:

(U) CONTINUE:
- (U) Development and software integration of real-time signal processor for Two-Color shipboard IRST.

- (U) Field testing of Multi Spectral Airborne EO Sensor for Surveillance of airspace and land targets for integrated air defense and strike missions (Joint with USAF).
- (U) Development of integrated active/passive IR Sensor for surveillance, ranging and target recognition.
- (U) Development of surveillance IRST for AEW aircraft Theater Ballistic Missile (TBM) discrimination and tracking (NAVAIR endorsement).

(U) COMPLETE:
- (U) Transition two color shipboard IRST sensor to PEO-TAD for sea demonstrations and operational utility assessment.
- (U) IR Analysis, Measurement and Modeling Program. Transition integrated IRTool 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 developments.
- (U) Shared Aperture (TV, FLIR, IRST) for fighter/attack aircraft surveillance, targeting and BDA missions.
- (U) Transition cloud ship wake technology from high altitude platforms to Intelligence users.

(U) INITIATE:
- (U) Integration of shared aperture (TV, FLIR, IRST) EO Sensor with active laser for E-2 AEW and TMD missions.
- (U) Development of Distributed Aperture Infrared Imaging/Search and Track Sensor for high resolution target etection and passive ranging.
- (U) Exploitation of EO discriminates for non-imaging, unresolved target detection and recognition.

• (U) ($2,710) MULTI-SENSOR TECHNOLOGY:

(U) CONTINUE:
- (U) Development of Compact Integrated Multi-Sensor System for UAV and manned aircraft surveillance, targeting and BDA.

- (U) Development of Data/Sensor fusion technology emphasizing integration and fusion of Radar, EO and passive ESM sensors for integrated air defense and strike surveillance missions.
- (U) Multi-function RF aperture concept development with emphasis on reducing number of topside antennas on US Navy Ships.

(U) COMPLETE:
- (U) Data/Sensor Fusion Architecture and Processor Design.

(U) INITIATE:
- (U) Procurement of COTS sensors for integrated multi-sensor system testbed.

- (U) ($1,804) COMMUNICATIONS NETWORKS:
  - (U) In conjunction with civilian standards bodies such as the Internet Engineering Task Force (IETF), develop services and mechanism for a high performance transport protocol appropriate for high speed networks.
  - (U) Develop ATM network testbed architecture for comparing performance of different ATM machines.
  - (U) Develop expeditionary warfare mobile communications networking architecture and simulation capability.
  - (U) Initiate design of the Quality-of-Service (QOS) Channel Allocation Protocol (CAP) to enable resource management and admission control.
- (U) ($9,532) COMMUNICATIONS:
  - (U) Continue development of key communications technologies for air, ship and submarines.
  - (U) Conduct second at-sea measurements of the on-hull ELF antenna for further residual noise reduction, fabricate the more promising low-profile submarine antenna for at-sea testing and demonstration, and assess the more promising submarine multiband, multifunction SHF phased array technologies for submarines.
  - (U) Complete analyses of conformal antenna arrays on curved surface and transition an automated message distribution system to naval C^3 aircraft.

- (U) Complete analysis of alternative bandwidth-efficient modulations for UHF communications and select/implement an efficient design and investigate chaotic synchronization of nonlinear circuits for improved covert communications.
- (U) Conduct at-sea experiments of high data-rate ship/air communications employing the NASA Advanced Communications Technology Satellite (ACTS).
- (U) Develop enhancements to commercial ATM adaptation protocols to meet military ATM requirements.
- (U) Develop a laboratory demonstration breadboard of a reconfigurable slot antenna array and measure performance.

• (U) ($5,530) COMMAND SUPPORT:
- (U) Continue development of force level execution and monitoring tools and plan repair techniques.
- (U) Continue development of intelligent software agents for realtime access and retrieval of data.
- (U) Continue work on crises action planning decision aid tools.
- (U) Continue work on virtual laboratory that supports interaction and prototyping of Joint Service collaborative mission planning and targeting.
- (U) Continue work on defensive information warfare techniques using pattern recognition for detecting unauthorized intrusions into C2 systems.
- (U) Develop architectural concepts, software and hardware components and evaluation tools that will improve information sharing by connecting system high enclaves of COTS components and increasing security by using high assurance components for security critical functions.
- (U) Continue work on the virtual reality display workbench for use in tactical mission planning in a multi-user environment.
- (U) Continue template development for recognition of activities, tactics and enemy intent that will provide a commander with overall Battlespace situation assessment.
- (U) Continue development of multi-user collaborative workspace software using object oriented technology for use in collaborative planning.

- (U) Continue development of distributed hybrid databases architecture that includes ability to access flat files, relational databases and object oriented databases including heterogeneous map storage and retrieval.

- (U) ($1,610) NAVIGATION:
  - (U) Conduct at-sea tests of the passive submarine terrain avoidance system that make possible Global Positioning System (GPS)-independent underwater navigation, fabricate and conduct lab tests of quantum-well lattice, and design/fabricate/test high performance fiber-optic gyros, and design high-power light source for fiber-optic gyros.

- (U) (1,946) Portion of extra extramural program reserved for Small Business Innovation Research assesment in accordance with 15 U.S.C.638.

3. (U) FY 1998 PLAN:

- (U) ($21,504) RADAR TECHNOLOGY:

(U) CONTINUE:
- (U) Characterizing and sub-system testing of Ultra-Wideband phased array (Scale Model).
- (U) Contractor development of scale model UHF electronically steered phased array for E-2C and future AEW aircraft.
- (U) Joint program with USAF to integrate multi-mode radar technology into JSTARS and Navy AN/APS-137 high resolution radar systems to enable overland and over sea surveillance.
- (U) Development and laboratory testing of Ultra Wideband (VHF/UHF) radar for concealed and buried target detection and Identification in support of Navy tactical reconnaissance and strike targeting needs. (Joint program with Army, USAF, DARPA).

- (U) Development of Millimeter Wave Radiometry High resolution, all weather imaging sensor for Navy and Marine Corps strike targeting, target ID and BDA operations.

(U) COMPLETE:
- (U) Horizon search, track and engagement radar technology and transition to PEO-TAD ship self defense program.
- (U) Two dimensional air target identification technology, prepare transition plan for AN/APG-71 and APG-73 radar applications.
- (U) Transition lightweight composite rotary coupler and antenna to PEO-TAD for AN/SPS-49 improvement program.

(U) INITIATE:
- (U) Flight testing (Helicopter) of low frequency ultra wideband radar for concealed and buried target detection and identification, Joint with Army, USAF, DARPA.
- (U) Joint program with USAF to integrate all aspect Combat Identification technology.

• (U) ($12,360) EO/IR TECHNOLOGY:

(U) CONTINUE:
- (U) Development of integrated passive/active EO Sensor for E-2C AEW and TBM Defense long range surveillance, target ID and Precision Tracking Operations.
- (U) Development of distributed Aperture Infrared Imaging/search and track sensor for all aspect high resolution surveillance, detection and passive ranging of airborne targets.
- (U) Development of Infrared 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.
- (U) Flight Testing and spectral band optimization of multi-spectral EO sensor to maximize detection of hidden targets in land backgrounds.

(U) COMPLETE:
- (U) Hardware and software integration of real time multi-dimensional COTS signal processor for ship Two-Color IRST.
- (U) Signal processor integration with previously developed Two-Color IRST sensor and transition to PEO-TAD for sea operational evaluation.
- (U) Two-Color Surveillance IRST for E-2C and install in flight test aircraft.

(U) INITIATE:
- (U) PEO-TAD at sea performance evaluation of ship Two-Color IRST in ship self defense operations.
- (U) Flight testing of Two-Color surveillance IRST on E-2C platform.
- (U) Development of Hyper Spectral Infrared sensor with greater than one-hundred sub-bands in both the mid-wave (3-5 um) and Long Wave (8-12 um) spectral bands for Naval Airborne reconnaissance, surveillance and targeting missions.

- (U) ($2,904) MULTI-SENSOR TECHNOLOGY:

(U) CONTINUE:
- (U) Development of data fusion/resource management processor to facilitate autonomous multi-sensor operation when employed on unmanned platforms.
- (U) Integration of COTS sensors (Radar, ESM, EO) for multi-sensor test bed to demonstrate emerging fusion and resource management processing technology without costly flight tests.
- (U) Multi-Function RF Aperture Development to enable multiple electromagnetic sources to operate from a single aperture.

(U) COMPLETE:
- (U) Contract efforts to develop common protocol and interfaces for Multi-Sensor Test Bed.

(U) INITIATE:
- (U) Development of Multi-Function RF Aperture demonstration model which incorporates (at a minimum) Radar, ESM/Equivalent Current Method (ECM), Communications and Navigation sensor functions in a dual shared/common aperture architecture.
- (U) Laboratory testing and characterization of an integrated multi-sensor test bed to be used for validating data fusion processing architectures and algorithms.

- (U) ($1,933) COMMUNICATIONS NETWORKS:
  - (U) Design and test prototype software for the high performance transport protocol and QOS enhancements to the Internet Protocal (IP).
  - (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.
  - (U) Develop Domain Name Server for heterogeneous mobile networks.
  - (U) Analyze the QOS Channel Allocation Protocol for throughput, delay and robustness.

- (U) ($10,214) RADIO COMMUNICATIONS:
  - (U) Continue development of key communications technologies for air, ship and submarines.
  - (U) Conduct at-sea testing of the low-profile buoyant cable submarine antenna. Determine the best deployment configuration of the most promising submarine SHF phased array antenna on the submarine platform. Transition the on-hull ELF submarine antenna to engineering development.
  - (U) Fabricate and demonstrate the structurally-embedded, reconfigurable aircraft antenna array panel on a curved surface, and compare with computed predictions.
  - (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.

- (U) Adapt commercial code division multiple access (CDMA) wireless technologies to naval applications. Employ power management and control algorithms for improved network design.
- (U) Based on at-sea experiments conducted with the NASA Advanced Communications Technology Satellite (ACTS), develop framework for reception of Global Broadcast Service (GBS) on naval ships and aircraft.

- (U) ($5,926) COMMAND SUPPORT:
  - (U) Demonstrate a prototype open system for real time object oriented database management in a distributed system.

  - (U) Demonstrate security architecture and evaluation tools in a prototype high Assurance Internet Protocal next generation (IPng) platform.
  - (U) Develop anti-data spoofing mechanisms for incorporation into detection algorithm.
  - (U) Develop colloborative planning methods that will be used to demonstrate the passing and sharing planning data across interconnected planning applications.
  - (U) Develop methods for determining the data quality transforming to software agents.
  - (U)Develop internally consistent data representation and management of object with uncertainty in context of intelligence support to operational mission execution.
  - (U) Incorporate context and time sensitive graphical images that represent a multi-user object oriented domain within a collaborative planning environment.
  - (U) Demonstrate the Virtual/Reality (V/R) workbench in a scenario that includes moving object who s impact can be observed in real time.
  - (U) Continue development of decision aiding software for mission plan repair.

- (U) ($3,945) NAVIGATION:
  - (U) Continue development of key navigation technologies for air, ship and submarines.
  - (U) Develop the Passive Submarine Terrain Avoidance technology employment in shallow water.

- (U) Analyze and test the quantum-well mirror ring laser gyro technology and compare with conventionally designed ring laser gyros.
- (U) Conduct laboratory evaluation of high performance fiber-optic gyro (FOG) for submarine applications.
- (U) Develop and test the high power fiber-optic light source for high performance FOG.
- (U) Initiate new program for integration of advanced electronics into strategic submarine navigation systems to reduce dependance on diminishing source of supply for older componentry.

- (U) ($6,780) SPACE/STRATEGIC SYSTEMS TECHNOLOGY:
  - (U) Initiate new program to develop a design code to minimize the expertise required to design a ballistic missiles.
  - (U) Initiate a new program to develop an underwater missile launch computer simulation model.

4. (U) FY 1999 PLAN:

- (U) ($22,211) RADAR TECHNOLOGY:

(U) CONTINUE:
- (U) Flight test (Helicopter) of low frequency ultra wideband (VHF/UHF) radar to assess performance in detecting, identifying and locating concealed and buried targets (Joint with Army, USAF, DARPA).
- (U) Integration of all aspect Combat ID technology to enable tactical airborne radars (APG-71, APG-73) to identify air targets at or near detection range (Joint with USAF).
- (U) Development of Ultra Wideband (.5-18 Ghz) phased array technology with emphasis on multi-function (search, track, engage) operation from a single radar.
- (U) Development of affordable phased array technologies with a goal of 50% reduction in system cost without significant performance degradation.
- (U) Joint with industry assess performance of scale model UHF electronically steered array for use on E-2C and future AEW/common support aircraft.

- (U) Performance assessment of passive millimeter wave radiometer for strike targeting and BDA missions.

(U) COMPLETE:
- (U) Joint program with USAF to develop multi-mode high resolution radar technology modes and prepare technology plan for incorporation in operational JSTARS and Navy AN/APS-137 radar s.
- (U) Complete scale model of ultra-wideband phased array and develop specifications for PEO-TAD transition planning for future multi-function shipboard radar system development.

(U) INITIATE:
- (U) Development of efficient (75%) radar transmitter development to significantly reduce prime power, cooling and aperture requirements. This development utilizes wideband gap semi-conductor advances accomplished in Program Element (PE) 0602234N.
- (U) Development of optically steered/controlled phased array technology utilizing photonic devices and components developed in PE 0602234N.
- (U) Concept and System Architecture development for airborne radar system to provide surface platforms over the horizon (>100NM) target engagement capability.

• (U) ($12,766) EO/IR TECHNOLOGY:

(U) CONTINUE:
- (U) Integration and Flight testing of passive/active EO sensor for E-2C long range low probability of intercept surveillance, target ID and precision tracking of aircraft, cruise missiles and TBM.
- (U) Distributed aperture Infrared Search and Track for all aspect higher resolution surveillance, detection and passive ranging of airborne threats.
- (U) Signal processing techniques and algorithms to recognize and exploit man made target signatures relative to natural backgrounds and countermeasures. Supports identified needs in Tactical reconnaissance and strike warfare mission areas.

- (U) Hyper-Spectral IR sensor for airborne reconnaissance, surveillance and targeting in Strike and Anti-Surface Warfare (ASW) mission areas.

(U) COMPLETE:
- (U) Joint program with USAF in airborne multi-spectral EO Sensor technology and develop options for USAF Air Combat Command future sensor developments.

(U) INITIATE:
- (U) Development of system concepts for advanced staring array technology for omni-directional, non-scanning high performance shipboard IRST for quick reaction ship self defense needs.
- (U) Eye Safe laser sensor for range finding, precision track and target ID for use in Navy air-to-air and surface-to-air engagements.

• (U) ($3,000) MULTI-SENSOR TECHNOLOGY:

(U) CONTINUE:
- (U) Multi-function RF Aperture Demonstration Model to incorporate radar, ESM/ECM Communications and navigation sensor functions in a dual shared/common aperture architecture.
- (U) Multi-sensor integration and data fusion technology development utilizing multi-sensor test bed developed in previous year.

(U) COMPLETE:
- (U) Resource management concept and architecture and development of specification for demonstration of the multi-sensor integration and data fusion processor technology development.

• (U) ($1,996) COMMUNICATIONS NETWORKS:

- (U) Test and analyze the prototype software for the high performance transport protocol and the QOS IP enhancements. Present the results to the IETF for incorporation in the next generation standards-track protocols.
- (U) Incorporate the enhanced transport and IP prototype software in the ATM network testbed and test their performance relative to existing protocols such as Transport Control Protocol (TCP) and IP. Conduct tests employing different ATM machines to determine quality of performance and interoperability.
- (U) Investigate technical issues related to ATM use, such as signaling, interoperability robustness, and ability to support QOS at the application layer.
- (U) Develop intelligent local agents for heterogeneous mobile network management.
- (U) Test the design of the QOS Channel Allocation Protocol as part of ATM battlegroup architecture.

• (U) ($10,551) 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 Command PMW-176 for submarine applications.
- (U) Configure and install the submarine SHF phased array antenna for testing.
- (U) Transition the structurally-embedded, reconfigurable aircraft antenna array to NAVAIR.
- (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 needed in the modem design and the power management algorithms.
- (U) Demonstrate the use of CDMA technologies in Navy tactical networks.
- (U) Conduct laboratory and field tests of Global Broadcase Service (GBS) reception on board Navy ships and aircraft. Demonstrate use of back-channel connectivity to the GBS broadcast service.

• (U) ($6,120) COMMAND SUPPORT:
- (U) Continue development of C2 technologies for distributed real-time, secure information systems.
- (U) Demonstrate application software with other Services participation in the virtual collaboratory

- (U) Investigate object oriented map storage and retrieval through an integrated data framework.
- (U) Continue development of information warfare techniques and integrate into prototype hardware.
- (U) Integrate, test and evaluate, crises action planning, plan monitor and repair and collaborative workspace in a distributed Joint Service test environment.

• (U) ($4,989) NAVIGATION:
- (U) Continue development of navigation technologies for air, ship and submarines.
- (U) Transition the high performance FOG to Naval Sea Systems (NAVSEA) Command for submarine applications.
- (U) Conduct laboratory testing of the squeezed-state FOG. Compare test results with comparable data from the high performance FOG.
- (U) Continue development of technologies for integration of advanced electronics into strategic submarine navigation systems to reduce dependance on diminishing source of supply for older components.

(U) ($9,793) SPACE/STRATEGIC SYSTEMS TECHNOLOGY:
- (U) Continue development of design codes for ballistic missle design.
- (U) Continue development of computer simulations and models for underwater ballistic missile launch.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Space & Electronic Warfare (SEW) C3 Technology

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	$58,186	$56,159	$62,920	$69,697
(U) Adjustments from 1997 PRESBUDG:	-1,652	-1,424	+2,646	+1,729
(U) FY 1998/1999 PRESBUDG Submission:	$56,534	$54,735	$65,566	$71,426

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect a Jordanian F-16 financing rescission (-$67); Internal Navy adjustments (+$1,526); Small Business Innovative Research assessment (-$2,180) and Execution adjustment (-$931). FY 1997 adjustments reflect Congressional undistributed reductions (-$2,424); and Congressional Plus up for Wireless/Satellite (+$1,000). FY 1998 adjustments reflect reduction to fund Advance Torpedo Technology (-$3,000); Navy Working Capital Fund (NWCF) minor adjustment (-$1,761); S&T adjustment (+$7,485); Military and Civilian pay (+$90) and inflation reduction (-$168). FY 1999 adjustments reflect S&T adjustment (+$4,336); NWCF and minor adjustments (-$2,458); Military and Civilian pay (+$116); and Inflation reduction (-$265).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Space & Electronic Warfare (SEW) C3 Technology

(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 (C3I 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 (C3) 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 0602702F (Command, Control Communications)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0603794N (C^3 Advanced Technology)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: Space & Electronic Warfare (SEW) C3 Technology

(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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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(U) COST: (Dollars in thousands)

PROJECT NUMBER &	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	TO	TOTAL
ACTUAL	ACTUAL	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	ESTIMATE	COMPLETE	PROGRAM
Readiness, Training and Environmental Quality Technologies										
	47,773	47,561	31,762	33,120	34,324	35,313	36,025	36,775	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; Support and Infrastructure; and Training. These JSAs encompass requirements for manning, operating, and maintaining fleet assets, and for providing the necessary training, facilities, and equipment 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 for logistics support of amphibious landings); 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.

(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 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 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

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

(U) This PE also seeks to strengthen the educational pipeline vital for maintaining a strong technology development capability, by supporting programs at a wide range of educational institutions, including Historically Black Colleges & Universities, and other Minority Institutions. In addition, the PE provides funding for the Navy Science Assistance Program, (NSAP) the purpose of which is to improve the ability of the Navy's science and technology community to respond rapidly to urgent fleet needs. Programs in this PE are jointly planned in the Reliance process with the Air Force and Army via panels of the Joint Directors of Laboratories, the Joint Engineers, 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 1996 ACCOMPLISHMENTS:

- (U) ($18,247) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY:
  - Initiated:
    -- (U) development of training concepts and principles unique to virtual environment based training systems.

- Continued:
  -- (U) evaluation of the effectiveness of virtual reality technology (e.g., 3-dimensional audio displays, immersive visual interfaces)in a variety of command and control functions.
  -- (U) development of generative adaptive testing techniques which permit computer generation of new test items.
- Completed:
  -- (U) evaluations of team training strategies that will minimize the adverse effects of stress on decision-making performance.
  -- (U) development and evaluation of a multi-criteria network model for optimizing assignments in the face of complex and conflicting assignment policies.

• (U) ($14,689) MEDICAL TECHNOLOGY:
- Initiated:
  -- (U) testing of liposome encapsulated hemoglobin in combination with therapeutic agents that prevent/correct reperfusion injury in hemorrhagic models.
  -- (U) evaluation of a cellular cryoprotectant that eliminates the need for washing frozen blood components.
  -- (U) evaluation of therapeutic drugs/hormones that modulate body temperature in a sub-freezing cold injury model.
  -- (U) development of amiloride formula for improved perfusion of organs for transplant.
  -- (U) testing of freeze-dried platelets in small animal hemorrhage model.
- Continued:
  -- (U) development of antibody-based enzymes for removing Rh determinant from red cells.
  -- (U) development of a therapeutic resuscitation fluid to enhance recovery of organ function in hemorrhagic shock.

-- (U) development of bacterial endo-beta-galactosidase as a more efficient enzyme for removing A determinant from red cells.
-- (U) development of oxygen delivery enhancer (crocetin) as resuscitation fluid additive.
-- (U) evaluation of immunoregulatory monoclonal antibodies as adjuvants in inflammatory diseases.

- Completed:
-- (U) transition to industry of LToral adjuvant for prevention of mucosal infections.
-- (U) transition to industry of DHEA immunoprotectant for use in surgery patients and casualties to prevent sepsis and promote wound healing.
-- (U) transition to industry of a monoclonal antibody that neutralizes an immunosuppressive factor produced by casualties.

• (U) ($13,496) LOGISTICS AND ENVIRONMENTAL QUALITY TECHNOLOGY:
- Initiated:
-- (U) proof-of-concept test and demonstration of best material handling and stowage concepts for ships.
-- (U) development of methods to exploit the combined use of future state predictors and failure progression models in mechanical diagnostics.
-- (U) development of a standard stability assessment procedure for pontoon facilities and prepare an operational guideline for open ocean use.
-- (U) development of technology for real time, in-situ identification and characterization of contaminated marine sediments.
-- (U) development of fuel additive technology for gas turbines and diesel engines to reduce NOx emissions.
- Continued:
-- (U) treatment technologies for advanced industrial wastewater treatment facilities.
-- (U) advanced fire fighter training facility wastewater and air emissions treatment technology development.
-- (U) biosensors for operations to clear littoral areas.

- Completed:
  - -- (U) design of at sea rearming capability for vertical launch capable ships.
  - -- (U) development of improved logistic strikedown capability for underway ships.
  - -- (U) exhaust treatment technology for reducing NOx emissions from small diesel engines in current Navy inventory.
  - -- (U) plasma arc technology development for shipboard solid waste treatment; transition to FY97 Advanced Technology Demonstration (ATD) start.
  - -- (U) conceptual treatment train technologies for contaminated harbor spoils.
  - -- (U) copper paint capture technology development for underwater hull maintenance vehicle.

- (U) ($1,341)NSAP:
  - -- (U) Continue support to the operational Commands in Command, Control, Communications, Computers, Intelligence Surveillance & Reconnaissance (C4ISR) for deployed assets - NSAP Global Tactical Technical Information Center (GTTIC), USS Mount Whitney C4I link, terra scan METOC data for Carrier Vessel (CV).
  - -- (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 - MK92 Gun Fire Control System (GFCS) expert diagnostician system, high reliable surface ship electrical cable connector.
  - -- (U) address Fleet/Force operational readiness issues amenable by demonstration and application of Commercial Off the Shelf (COTs) and emerging technology solutions - helmet camera system for United State Marine Corps (USMC), towed array inverse beamforming algorithms, transient acoustic processing algorithm processor, laser alidade navigational system for littoral operations, Global Positioning System (GPS) data link into 5 inch GFCS, organic surface ship gunnery target, future complexion of Joint Littoral Air Operations (OPS) technologies, computer pointer/tracker for air surveillance,

cross deck ARID HUNTER system from United State Air Force platform to carrier air F-14, and COTS system to augment surface ship radar for Non-Cooperative Target Recognition (NCTR).

2. (U) FY 1997 PLAN:

- (U) ($22,929) PERSONNEL, TRAINING AND HUMAN FACTORS TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UPS - IN-FLIGHT PHYSIOLOGICAL MONITORING TACTICAL AIRCREW AND TOTAL VEHICLE MANAGEMENT SYSTEM):
  - Initiate:
    -- (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 acceleration, high altitude, fatigue and information overload. Transition to Advanced Technology Crew Station program (PE 0603216N) in FY98.
    -- (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 FY98.
  - Continue:
    -- (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.
  - Complete:

-- (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) ($13,494) MEDICAL TECHNOLOGY (INCLUDES CONGRESSIONAL PLUS-UP - BIOLOGICAL PROTECTION FOR CASUALTY REDUCTION):
  - Initiate:
    -- (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.
    -- (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, effective, 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 detertermine 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.

- Continue:

-- (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.

-- (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) ($9,309) LOGISTICS AND ENVIRONMENTAL QUALITY TECHNOLOGY:

- Initiate:

-- (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 HM&E equipment.

- Continue:
  -- (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.
  -- (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.
- Complete:
  -- (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) ($568) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 USC 638.

- (U) ($1,261) NSAP:
  - -- (U) continue support to the operational Commands in C4ISR for deployed assets - continue refinement of NSAP GTTIC, develop Persian Gulf Infonet World Wide Web based allied state information server for Persian Gulf Area of Responsibility, support Tactical Evaluation of Viasat Advanced Data Controller for low Biological Warfare, ship-shore satcomms to support amphibious ops.
  - -- (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 - provide means to reduce Hummm Vee box frame corrosion, develop surface ship long life motor/bushing seals, develop Condition Based Maintenance technology for H-3 helos, and evaluate fiber optic lighting in hazardous spaces on CV and to reduce bulb replacement.
  - -- (U) address Fleet/Force operational readiness issues amenable by demonstration and application of COTs technology solutions - provide thesis studies to address technology based readiness issues, complete installation of AUTOEYE/CAPS on Commander Task Force 67 asset, develop COTS GPS depth collector for surface ships, provide technology for improved night periscope capabilities, complete live fire evaluation of Ship Deployable Surface Target & 2nd-Phase development of this system, conclude surface radar enhancements for NCTR project, provide submarine tactical information management system for littoral operations, support COMNAVAIRPAC initiative for next generation strike warfare assessment of technology, and investigate sports medicine protocols for reduced USMC OCS attrition.

3. (U) FY 1998 PLAN:

- (U) ($19,215) 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.
  -- (U) development of advanced headphone displays for three-dimensional presentation of sonar information to improve target localization.

- (U) ($11,257) MEDICAL TECHNOLOGY:
  - 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.
-- (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) ($1,290) 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.

4. (U) FY 1999 PLAN:

- (U) ($20,093) 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) ($11,711) 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.
    - -- (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 variosity analysis to identifying adverse impact of toxicants.

- (U) ($1,316) 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.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	47,676	40,828	43,320	47,212
(U) Adjustments from FY 1997 PRESBUDG:	+97	+6,733	-11,558	-14,092
(U) FY 1998 President s Budget Submission:	47,773	47,561	31,762	33,120

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 decrease resulted in a reductions for the Jordanian F-16 financing rescission (-55); from transfer of SBIR funds (-235); and actual execution (+387). The FY 1997 increase results from: Congressional plus-ups for In-Flight Physiological Monitoring of Tactical Aircrew (+3,300), Biological Protection for Casualty Reduction (+3,600); Total Vehicle Management System (+2,000); and from Congressional Undistributed Reductions (-2,167). FY 1998 reduction results from a realignment transferring Logistics and Environmental Quality technology from this program element to PE 0602121N (-9,288); from air and surface restructuring (-1,000); from BRAC/IV Transfer of NPRDC (-1,000); from NWCF and minor adjustments (-204); inflation adjustments (-80); and from Military and Civilian Pay Rate adjustments (+14). FY 1999 reduction results from the Logistics and Environmental Quality realignment (-9,985); funds transferred from this PE to Advanced Technology Demonstrations PE (-2,729); from BRAC/IV Transfer of NPRDC (-1,000); from NWCF and minor adjustments (-272); from inflation adjustments (-123); and from Military and Civilian Pay Rate adjustments (+17).

(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 0602232N (Space and Electronic Warfare (SEW) Technology)
(U) PE 0603706N (Medical Development (Advanced))

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(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 Training Systems, Manpower & Personnel, Human Systems Interface, Medical, CBD, Civil Engineering, and Environmental Quality. Oversight is provided by the Joint Directers of Laboratories, Training and Personnel Systems Science and Technology Evaluation Management, Armed Services Biomedical Research Evaluation and Management, and Joint Engineers.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	FY 1997 ESTIMATE	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	78,105	84,724	76,653	87,445	92,289	93,708	95,099	97,372	CONT.	0CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) provides exploratory development 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) Joint Strike: advanced thermal management materials for most platforms to reduce weight and cost.
- (U) Littoral Warfare: acoustic signature reducing materials, torpedo warhead materials, fiber optic sensors, vacuum electronics, solid state low noise amplifiers, complex systems engineering, and high performance computing.
- Joint Surveillance: real-time targeting, connectivity, counter-jamming and deception, infrared sensors, broadband adaptive transmitter/receiver modules and 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.
- (U) Maritime Support of Land Forces: 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

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

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($853) SHORE FACILITIES MATERIALS.
  - (U) Completed field trials of high temperature pavements that are six times more resistant to AV-8B exhaust temperatures and velocities which should eliminate costly procurement and engine foreign object damage repair.

- (U) ($8,048) AIRBORNE MATERIALS.
  - (U) Demonstrated growth and polishing of 1.5 mm (.060 in.) thick, 72 mm (2.84 in.) diameter diamond dome for an hypersonic (Mach 4+) missile infrared seeker applications.
  - (U) Completed development of cast gamma titanium aluminide for aircraft engine high pressure compressor blades and vanes and low pressure turbines to replace superalloys for a 40% component weight savings.
  - (U) Completed investigating low toxicity, high temperature resins for composite materials to replace PMR-15 resins in naval aircraft applications.
  - (U) Attained a 15% toughness improvement in AerMet 100 steel through process control. This will permit greater margins of safety in naval applications of this steel, e.g., F/A-18E/F landing gear and F-14 wing pivot pins.

- (U) ($8,768) SEABORNE MATERIALS.
  - (U) Continued development of anti-fouling, environmentally compliant hull coatings.
  - (U) Continued evaluation of continuous cooling transformation diagrams for 100,000 pound yield strength high strength low alloy hull steels needed to control metallurgy and hydrogen cracking of welds in hulls.
  - (U) Completed development of low strength (65,000 lb/sq-in tensile strength) low alloy steel to lower the cost of aircraft carrier construction by elimination of needs for welding preheat and post-welding heat treatment.

- (U) Completed development of advanced liner material for shipboard vertical launch systems.

- (U) ($2,339) MISSILE/SPACE MATERIALS.
  - (U) Completed fabrication, ablation screening and initial aging studies of candidate replacement heat shield materials for Md4/Mk5 Reentry Bodies to address the non-availability of current material and meet the presidential mandated life extension to 60 years.
  - (U) Completed payoff study for ceramic composite propulsion materials applicable to Theater Missile Defense systems divert and attitude control components. These materials will replace costly rhenium-based materials.

- (U) ($9,265) MULTI-MISSION MATERIALS.
  - (U) Completed concept validation of the remotely addressable, embedded sensor concept using RF energy to energize sensors in resin-matrix composite materials and transmit sensor information to external receivers eliminating the need for wire attachment to external systems and initiated phase II project to develop sensors and detectors.
  - (U) Completed development of high temperature superconductor wire for motor magnet windings and test in a superconducting motor and demonstrated operation in a superconducting homopolar motor. High temperature superconductors will permit motor application at liquid nitrogen rather than liquid helium temperatures (77 K (-196^{o} C) vs. 20 K (-253^{o} C)).
  - (U) Completed a study to apply laser countermeasure materials developed in the Laser Hardening program in the Next Generation Stinger.
  - (U) Established a cooperative research agreement and patent license for the application of tubule-based, biomolecularly derived controlled release materials anti-fouling and mildew-control coatings.

- (U) ($7,187) RF SOLID STATE DEVICE AND CONTROL COMPONENTS.
  - (U) Continued development of InGaAs/InP heterostructure power High Electron Mobility Transistors (HEMTs) (including power and power combining components) for use in Wide-band active aperture phased array component development.
  - (U) Continued development of silicon carbide static induction transistor devices and structures that exhibit 10 Watts(W) of continuous power and air-bridged static induction transistors that exhibit 160 watts of continuous power for Navy systems applications such as AEGIS.

- (U) Initiated development of high power (20KW) ultra high frequency (UHF) circulators for shipboard communications applications, especially for integrating multiple systems within a common aperture.
- (U) Continued development of 18-40 GHz Monolithic Microwave Integrated Circuit (MMIC) Driver for Millimeter Wave (MMW) Power Module for use in decoys and extending frequency range of the SLQ-32.
- (U) Completed demonstration of fixed frequency superdirective array for improved direction finding for small diameter anti-radiation missile seeker applications.
- (U) Continued development of high dynamic range, wide band Low Noise Amplifier (LNA) with very high second and third order intermodulation intercepts.

• (U) ($12,907) VACUUM ELECTRONICS.
- (U) Continued extension of Microwave Power Module (MPM) concept to higher frequencies with the development of MMW (20-40 GHz, 50-W) power modules.
- (U) Completed development of MPM capable of producing in excess of 125 watts CW (within C-band) at extremely high efficiencies for use in an airborne antenna conformal to an E-2C.
- (U) Completed and distributed beta test version of the Millimeter Wave Advanced Computational Environment (MMACE) 2-dimensional Research and Engineering Framework (REF) with a preliminary design tool set selected for the design of a helix traveling wave tube (TWT).
- (U) Continued development of high power density Microwave (MW) window technology using man-made diamond. This technology is central to needed performance improvements in several Navy systems
- (U) Initiated the development of a high-power W-band gyro-klystron supporting defense interests in space object identification, ballistic missile defense, long range command guidance and non-cooperative target identification.

• (U) ($6,560) ELECTRO-OPTICS (E/O) TECHNOLOGY.
- (U) Continued development of fiber optic beamformer for phased array radar systems with emphasis on fast wavelength tuning of source, large dynamic range, and field testing of system, especially as related to the Advanced Technology Development (ATD) on shipboard Electronic Counter Measures (ECM) transmitter for ship defense.
- (U) Continued mid-Infrared fiber development to reduce impurity loss to <.5 dB/m, total loss <1.0 dB/m, and, increase mechanical strength to >75 ksi to support Electronic Warfare and hazardous waste detection applications.

- (U) Completed development of 128 x 128 adaptive Infrared Focal Plane Array (IRFPA) with on-chip electronics to enhance the dynamic range to 120 dB and to implement offset nonuniformity correction and initiated development of 256 x 256 adaptive IRFPA also with high dynamic range on-chip electronics to implement on-chip nonuniformity correction and preliminary filtering functions.
- (U) Completed development of color-discriminating infrared (IR) detectors and initiated development of 128x128 color discriminating IRFPA.
- (U) Continued development of GaInSb/InAs superlattice based detectors as an alternative to HgCdTe-based detectors for higher temperature operation at longer wavelengths.
- (U) Completed development of 64x64 dual-band IRFPA and initiated development of 256x256 dual band IRFPA.

• (U) ($6,307) MICROELECTRONICS.
- (U) Continued development of three dimensional (3D) circuits on Silicon-on-Insulator (SOI) with emphasis on Reduced Instruction Set (RISC) processor.
- (U) Continued development of analog front-end of 16 bit, 125 megasample/sec analog-digital converter for Anti Submarine Warfare (ASW) applications.
- (U) Continued development of 100x100 synapse, 100 neuron analog self-learning artificial neural network. GHz.
- (U) Continued development of analog Very Large Scale Integrated (VLSI) circuits for co-site interference cancellation applications.

• (U) ($1,886) ELECTRONIC AND E/O MATERIALS.
- (U) Continued development of wide bandgap III-V semiconductors such as GaN and AlN which will involve a combination of materials growth, device structure fabrication, and characterization to produce blue and ultra violet (UV) lasers and high power, high temperature operation of RF devices.
- (U) Completed development of techniques for growth of unstrained InGaAs/InAlAs heterostructures on GaAs substrates by means of compositionally graded layers acting as dislocation filters. The devices will be used for secure communications with applications to military and civilian users.
- (U) Completed contractual activity to demonstrate narrow band (less than 1 percent) high temperature superconducting bandpass filters capable of handling more than ten watts of incident MW power and initiate

program to fabricate and characterize high temperature superconducting thin films optimized for high power MW components.
- (U) Initiated single-precursor growth of cubic silicon carbide substrates. The goal is to provide a method for producing low defect density substrates used in Navy high power RF electronics.

- (U) ($3,166) HIGH PERFORMANCE COMPUTING (HPC).
  - (U) Completed sea trial (TB-29) with laboratory hardened submarine towed array algorithms using Commercial-Off-the-Shelf (COTS) hardware.
  - (U) Demonstrated the capability of Processing Graph Method Tool (PGMT) to place Multiple Instruction Multiple Data (MIMD) parallel computers using static scheduling under Precision Guided Munitions (PGM).
  - (U) Initiated the design of a Digital Library for the Warrior using parallel computers and demonstrate parallel image/video servers. Installed and worked with early research products from the Defense Advanced Research Projects Agency (DARPA)/National Science Foundation (NSF)/National Aeronautics and Space Agency (NASA) Digital Library program.

- (U) ($2,700) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION.
  - (U) Demonstrated the application of machine learning techniques for developing more reliable robotic software.
  - (U) Redesigned multi-mode interfaces using new interaction techniques and conducted evaluation experiments.
  - (U) Applied speech understanding lessons learned from Eucalyptus to a model for speech control in virtual environments to enhance operator effectiveness.
  - (U) Demonstrated range-based sensing and control in mobile robots, suited to surveillance and other missions.
  - (U) Assessed alternative approaches to the management of large and dynamic case-based memories, integrate model-and case-based reasoning; explore novel uses of cases viewed as active agents using a strict object-oriented model; these are key issues to making this approach effective in time constrained environments.

- (U) ($4,727) ENGINEERING OF COMPLEX SYSTEMS (ECS).
  - (U) Released DESTINATION prototype, a software tool for automated specification and exploration of complex processor-intensive systems, including advanced capabilities to perform system level design capture, design optimization, and structuring and restructuring in a coherent, seamless manner. Hierarchical capabilities will

allow manipulation of various levels of system design, component, and environment representations. Included are proven tailorable objective functions based on different measures-of-effectiveness criteria to ensure that system requirements are affordable for the system s projected life. Transition to Surface Combatant Surface Combat 21st Century (SC21) program.
- (U) Delivered prototype translator of CMS-2 (including embedded assembly language) to Ada. Completed and demonstrated test on actual Navy CMS-2 code. Highest success is with uncomplicated algorithms free from input/output.
- (U) Developed Software Infostructure through formalization of a Common Object Request Broker Architecture (CORBA) reusable component strategy. Develop and demonstrate World-Wide-Web (WWW) and Java-based interfaces to Infostructure tools to assure portability while addressing potential security issues.

- (U) ($3,392) ADVANCED DISTRIBUTED MANUFACTURING DEMONSTRATION
  - (U) Continued development of measures of effectiveness for distributed manufacturing and virtual management of distributed manufacturing, exploration of new manufacturing technologies for Navy application in distributed networks, application of virtual and distributed management to software development and software reuse in cooperation with government needs, documentation of military-related successful virtual management models for Virtual Management Workshop (Congressional add of $3.5 million).

2. (U) FY 1997 PLAN:

- (U) ($3,000) SHORE FACILITIES MATERIALS.
  - (U) Initiate program to engineer lumber composed of wood products, polymers, carbon fibers and adhesives for long life, environmentally benign, and low cost shore applications such as fender pilings (Congressional add of $2.5 million).
  - (U) Complete establishment of 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) ($9,602) AIRBORNE MATERIALS

- (U) Initiate a project on the plasma quench process to produce low cost titanium powder for aircraft components (Congressional earmark of $2 million).
- (U) Initiate program to qualify new composite materials for use in naval aircraft primary and secondary structures.
- (U) Complete material and fabrication concept for a switchable (electrically conductive to non-conductive) missile radome to shield internal antennas from RF energy.
- (U) Transition 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) Complete demonstration of 1500^{0} F nickel superalloy disk and orthorhombic titanium capable of functioning with the higher cooling air temperatures of the Phase II Integrated High Performance Turbine Engine Technology demonstration engines.
- (U) Complete development of an 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) ($11,730) SEABORNE MATERIALS.
- (U) Initiate program to use intelligent processing methods for advanced complex materials to reduce cost.
- (U) Complete 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) Complete field testing of biofouling and other fouling resistant gray-water filter membranes for ship application.

• (U) ($3,430) MISSILE/SPACE MATERIALS.
- (U) Complete Phase II of the Robust Processing Program in which high thermal conductivity carbon fibers are incorporated in metal thermal planes for a 50% increase in heat removal from electronic modules accompanied by a 30% decrease in thermal plane weight.
- (U) Complete mechanical, thermal, ablation, and moisture (aging) characterization of replacement heat shield materials.

• (U) ($5,246) MULTI-MISSION MATERIALS.

- (U) Complete engine durability testing of stabilized zirconia thermal barrier coatings in marine turbine engines to provide at least 50% greater resistance to vanadate attack from lower grade oils than current zirconia coatings.
- (U) Establish the capability to remotely address embedded sensors in conductive carbon-fiber composites using RF energy.
- (U) Complete the development of non-linear laser protective materials based on phthalocyanine and continue materials development for both eye and sensor protection from agile (tunable) lasers.
- (U) Establish material processes for new high strain sensor actuators.

• (U) ($3,328) RF SOLID STATE DEVICE AND CONTROL COMPONENTS
- (U) Complete 18-40 GHz MMIC Driver for MMW Power Module for use in decoys and extending frequency range of SLQ-32.
- (U) Initiate development of InP/InGaAs heterojunction bipolar transistors for application to pulsed Ka-band phased arrays.
- (U) Initiate development of 100 kW (peak) W-band duplexer for Navy s 94 GHz radar program.

• (U) ($14,564) VACUUM ELECTRONICS.
- (U) Complete extension of MPM concept to higher frequency by development of MMW (18-40GHz, 50-W) power modules for Electronic warfare (EW) applications.
- (U) Initiate development of selected elements of an advanced MMACE design tool set for implementation in consort with the 2 and 3-dimensional REF.
- (U) Complete development of high power density MW window technology using man-made diamond. This technology is central to needed performance improvements in several Navy systems.
- (U) Continue development of high-power W-band gyro-klystron for Naval Research Laboratory W-band radar.

• (U) ($4,368) E/O TECHNOLOGY.
- (U) Continue development of 256 x 256 adaptive IRFPA with high dynamic range on-chip electronics to implement on-chip nonuniformity correction.
- (U) Continue demonstration of fiber optic beamformer for phased array radar with emphasis on a two-dimensional (4x4) array and rapidly tunable sources.

- (U) Continue 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 initiate development of IR fibers that transmit in the 8-12um region for Infrared Countermeasurers (IRCM) applications.
- (U) Complete development of single color GaInSb/InAs superlattice detectors and initiate development of two-color superlattice detectors as an alternative to HgCdTe-based detectors for higher temperature operation at longer wavelengths.
- (U) Continue development of 128 x 128 color discriminating IRFPA.
- (U) Continue development of 256x256 dual band IRFPA.

• (U) ($5,500) MICROELECTRONICS.
- (U) Demonstrate and manufacture planar Metal Oxide Semiconductor (MOS) Controlled Thyristers (MCTs) that operate at 1400 volts, 300A/cm^2 and 100 KHz switching speed for incorporation into Power Electronic Building Blocks (PEBBs).
- (U) Complete demonstration of collocated interference cancellation circuitry for communication systems.
- (U) Initiate development of sub 500nm - 250nm p-channel silicon germanium devices with T-gate structures in 50nm thick thin-film silicon-on-sapphire for improved transistor performance up to 50 Ghz.
- (U) Complete demonstration of analog front-end of 16 bit, 125 megasample/sec analog-digital converter for ASW applications.

• (U) ($2,123) ELECTRONIC AND E/O MATERIALS.
- (U) Complete development of growth techniques for single color IR detector materials and initiate development of growth techniques for two-color detectors.
- (U) Initiate nanometer-scale direct proximal probe patterning for fine-line (<0.05um) processing of metals and semiconductors to achieve the capability to realize sub-micrometer scale RF and microelectronic devices.

• (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 allocation 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 microelectonic 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 Systmes Command (NAVAIR), SC-21, CVX, Program Exective Office (PEO) Theater Air Defense (TAD), PEO Surface Combatant Aegis Program (SC/AP) Common Support Aircraft (CSA) and Assisstant Secretary of the Navy (ASN) Research,Development Acquisition (RDA). Specific efforts within this thrust include:
- (U) Demonstrate a MW frequency, CW, high linearity GEISHA amplifier with 7-10 watts output.
- (U) Continue development of UHF high power circulator for application to Multi- Functional Electomagnetic Radiating System (MERS) ATD.
- (U) Continue and expand high power SiC transistor structure development to encompass high linearity and high efficiency for fleet surveillance and protection applications.
- (U) Complete development of high dynamic range wide band Low Noise Amplifier (LNA) with very high second and third order intermodulation intercepts and explore potential use of LNAs in Joint Advanced Strike Technology (JAST) demonstration aircraft.
- (U) Demonstrate 16 bit, 20 MHz low temperature superconducting analog to digital (A/D) converter.
- (U) Demonstrate an RF beamforming network capable of RF frequency independent beam steering over – 60 degrees from boresight using photonic technology to control RF transmission of an antenna array. Develop the necessary photonic components: integrated lasers and modulators, tunable lasers, dispersive fibers and tunable spectral filters.
- (U Demonstrate the feasibility of using optical switches to activate nested wideband spiral antennas and thereby demonstrate RF beam steering. The initial optical switch will be based on a photo-voltaic field effect transistor (FET) structure activated by an optical fiber. Maintain 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) ($2,390) HPC
  - (U) Demonstrate a software parallelization tool based on the Processing Graph Method (PGM) for mapping signal processing data flow diagrams into arbitrary sets of processors automatically with appropriate scheduling to meet real time deadlines. Provide instrumentation to missile software testbed.

- (U) Demonstrate effective, customized digital library for information delivery to the warrior from multiple sources (spin-off from DARPA/NSF program). Develop and demonstrate Java-based digital mapping system.
- (U) Demonstrate 3D virtual reality workbench for battlefield situation assessment. Deliver first prototype to the Marine Corps for use in their Sea Dragon experiment. Add interface to accept data from the Joint Maritime Information System (JMCIS) and the Global Command and Control System (GCCS).

• (U) ($2,558) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION.
- (U) Demonstrate new capabilities for meteorological forecasting using machine learning.
- (U) Demonstrate guidance of mobile robot tasks by utilizing a 3D range scanner, and advance the computational efficiency of machine vision through innovative use of data from tripod operators.
- (U) Distribute an advanced Case Based Reasoning Shell which is useful for building decision aids with advanced capabilities in domains such as weather forecasting and situation assessment and planning.
- (U) Evaluate and extend multi-modal robotic interface and related tools.

• (U) ($4,692) ECS
- (U) Apply Destination and other ECS tools to the development of a sub-system of the AEGIS system using forward and reverse system composition methodology and prototype automation aids for specification and analysis of performance of at least three alternative designs. This will provide a fully integrated, automated environment to support affordable and evolutionary system design methodology for large complex computer-based systems.
- (U) Develop interoperable software environment under joint US-France project. Further develop affordable reusable component methodology using CORBA, Java, and other industry standards. Implement distributed interfaces using Web technology. Test commercial/government components to get best functional capability for Command and Control (C2) and combat system development.
- (U) Initiate development of new wavelet coding algorithms with packet parity protection that is compatible with any packet switching network including Link 16 messages.

• (U) ($4,000) ADVANCED DISTRIBUTED MANUFACTURING DEMONSTRATION
- (U) Extend the Virtual Company model to include modules for Prototype Development and for Full Production Manufacturing for Navy applications. Enhance the recently implemented Quality Assurance/Quality Control

(QA/QC) modules. Develop a Best Practices and Capabilities module. Apply the Virtual Company model to Navy requirements in the areas of software development and software reuse. The Machine Shop Company implementation of the model will be made available to private companies in order to expand industrial base capability to meet Navy needs (Congressional add of $4 million).

- ($193) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 1998 PLAN:

- (U) ($948) SHORE FACILITIES MATERIALS.
  - (U) Complete development of corrosion resistant dual phase ferritic materials and flame-sprayed catalyzed titanium cathodic protection concept for extension of service life of waterfront structures.
  - (U) Expand projects on 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) ($7,112) AIRBORNE MATERIALS.
  - (U) Continue development of single crystal/powder metal insertable bladed disk system for 1200° F compressors and 1450° F turbines.
  - (U) Complete development of very low volatile organic (200 gram/liter) waterborne self-priming topcoat for aircraft.
  - (U) Complete development of cyanate ester adhesives for rapid curing aircraft repairs.
  - (U) Initiate development of a distributed sensor system for condition-based maintenance monitoring of aircraft corrosion and health of corrosion preventive coatings.

- (U) ($9,655) SEABORNE MATERIALS.
  - (U) Complete pilot development of part-on-call spray forming of non-axisymetric parts, including titanium based components and complete investigation of self-canning of powder components via selective laser sintering of the surface.

- (U) Complete sea water testing of materials replacement candidates for seawater valves and nondestructive testing techniques to evaluate the health of valves in service.
- (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) Initiate a hot-corrosion study of the best spray-formed materials for shipboard incinerator application.

- (U) ($1,941) MISSILE/SPACE MATERIALS.
  - (U) Continue heat shield replacement materials development emphasizing lower cost fabrication techniques.
  - (U) Continue development of ceramic materials for nozzle application with emphasis on lower cost fabrication and tailored coatings for specific applications using various fuels.

- (U) ($6,454) MULTI-MISSION MATERIALS.
  - (U) Initiate a study of the vulnerabilities to lasers of the new uncooled IR detector arrays and establish plans for laser hardening approaches and materials to protect them.
  - (U) Complete transition of tubule-based materials to controlled release coatings.
  - (U) Continue development of high temperature composites based on fluorinated and non-fluorinated phthalonitrile polymers for high temperature application to multiple platforms.
  - (U) Initiate an evaluation of 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) Initiate development of nanometer wear-resistant coatings for valve stems, labyrynth seals, and rotating parts.

- ($3,380) RF SOLID STATE DEVICES AND CONTROL COMPONENTS
  - (U) Continue development of 100 kW W-band duplexer for Navy s 94 GHz radar program.
  - (U) Initiate development of highly compact, high Q, tunable filters and oscillators for transmit/receive (T/R) module applications.
  - (U) Continue development of InP/InGaAs heterojunction bipolar transistors for application to pulsed Ka-band phased arrays.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

- (U) ($14,572) VACUUM ELECTRONICS
  - (U) Complete development of selected elements of an advanced Microwave & Millimeter Wave Advanced Computational Environment (MMACE) design tool set for implementation in consort with the 3D Research and Engineering Framework (REF)
  - (U) Complete the development of selected elements of an advanced MMACE design tool set for helix Travel Wave Tubes (TWTs) for implementation in 3D REF.
  - (U) Complete the development of a high-power, moderate bandwidth gyro-klystron for the Navy 94-GHz radar program.
  - (U) Initiate the development of a high-duty, wideband gyro-twystron to meet the requirements of MMW radar applications.

- (U) ($4,377) E/O TECHNOLOGY.
  - (U) Demonstrate multifunctional operation of fiber optic beamformer with one and two dimensional array.
  - (U) Continue development of mid IR fibers to reduce impurity loss < 0.05 dB/m and total loss< 0.1 dB/m with emphasis on kilometer lengths of cabled fibers; demonstrate IR fibers for 8-12 μm region with loss less than 1 dB/m.
  - (U) Complete development of 256 x 256 dual band IRFPA and initiate development of a 512 x 512 dual band IRFPA to provide wider field of view for missile seeker and Forward Looking Infrared (FLIR) applications.
  - (U) Initiate development of a three band IRFPA to enhance performance against countermeasures and stealthy targets.
  - (U) Continue development of 256 x 256 adaptive IRFPA with high dynamic range on-chip electronics to implement on-chip nonuniformity correction.
  - (U) Continue development of 128 x 128 color discriminating IRFPA.

- (U) ($5,592) MICROELECTRONICS.
  - (U) Complete development of 16 bit, 125 megasample/sec analog-digital converter for application to wide bandwidth digital ASW receiver to meet Navy multi-channel acoustic system requirements
  - (U) Complete development of low power, low voltage sub 500nm - 250nm silicon germanium devices with T-gate structures in 50nm thick thin-film silicon-on-sapphire. These structures will allow the development of 4 bit, 10 gigasample/sec and 10 bit, 2.5 gigasample/sec analog-digital converters.
  - (U) Initiate development of low power, low voltage Complementary Metal Oxide Semiconductor (CMOS) sub-250nm-100nm SiGe devices with T-gate structures in 50nm to 30nm thick Thin-film Silicon-on-Sapphire (TFSOS) to achieve

f_t, f_{max} in the range of 70-100 Ghz. These structures will allow the development of 20 bit, 20 mega samples per second (MSPS) room temperature and 16-bit, 1 giga sample per second (GSPS) A/D converters.
- (U) Demonstrate 4-bit, 10 (GSPS) A/D based on 100 nm minimum feature size CMOS TFSOS for EW applications.
- (U) Continue development of analog VLSI continuous wavelet transform circuit for RF emitter identification.

- (U) ($2,128) ELECTRONIC AND E/O MATERIALS.
  - (U) Initiate in situ diagnostics to optimize Molecular Beam Epitaxy (MBE) and Orgono-Metallic Vapor Phase Epitoxy (OMVPE) growth of semiconductor alloys and heterostructures. This task will enable control of growth and processing for high reliability.
  - (U) Continue the investigation of the high power behavior of High Temperature Superconducting (HTS) MW devices and identify those material parameters that limit performance.
  - (U) Continue nanometer-scale direct proximal probe patterning for fine-line (<0.05um) processing of metal resonant tunneling diode structures to realize nanometer scale microelectronic devices.

- (U) ($9,500) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY
  - (U) Complete development of UHF circulator and provide to MERS ATD.
  - (U) Demonstrate highly linear broadband power amplification from 100 MHz to 10 GHz with GEISHA.
  - (U) Initiate contractural development of Twystrode to reduce size of MPM for radar and EW applications.
  - (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 – 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) Demonstrate an optimized optical switch that consumes less optical power, switches faster and can accommodate more voltage. Assemble a 3 X 6 array of spiral antennas, each with optical reconfigurable RF phase shifting networks. Evaluate the radiation distribution pattern with emphasis on optimizing the relation between spiral separation and grating lobe formation.

- (U) ($2,155) HPC
  - (U) Begin transition of software parallelization tool based on the PGM to the Advanced Submarine Technology Office for completion and Program Objective Memorandum (POM) maintenance support.
  - (U) Demonstrate webbed-access using DARPA sponsored work in distributed Digital Libraries to support multimedia (e.g., video) in Navy Command, Control, Communication, and Information (C4I) - Friend or Foe application.

- (U) ($2,889) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION
  - (U) Demonstrate learning of control for multiple autonomous devices in cooperative complex mapping and surveillance.
  - (U) Demonstrate software support of validation and verification methodologies and tools integrated with tools for building case-based decision aids.
  - (U) Demonstrate high-level human-computer collaboration in assessment of force-level threats. Identify effects of human multi-sensor input to cognitive enhancement of situations for rapid and accurate decision making.
  - (U) Continue 3D virtual reality workbench and add multiple view access. Initiate work on distributed prototype and designs for miniaturized versions. Enhance Marine Corps Sea Dragon Version; consider for deployment at sea for the Battalion Landing Team.

- (U) ($5,950) ECS
  - (U) Finalize approach to incorporate human performance models in ECS tools for total system design and evaluation. This will provide a basis for automated tools for human systems integration in the design of complex systems and provide approaches to embed monitors in systems to identify changing human use and roles over time to flag opportunities for manpower reduction; SC21 is a key recipient.
  - (U) Deliver a system evaluation and assessment repository consisting of system metrics knowledge base and non-invasive and minimally invasive system measurement techniques against system measures of effectiveness requirements.
  - (U) Develop multi-criteria optimization strategies for life-cycle cost engineering of large, complex systems. This will provide an automated means for evaluation and rationale capture in a simultaneous manner across a

range of factors such as performance, reliability, safety, security, producability, and costs for alternate implementations.
- (U) Continue demonstration collaboratively with France and develop unified distributed object architecture and repository; coordinate with Defense Information Systme Agency (DISA), Defense Information Infrastruture (DII) and DARPA Collaboratory efforts.
- (U) Test and apply Signal Processing Rapid Prototyping testbed to Navy missile applications needing real-time image processing in small devices.
- (U) Continue development of new wavelet algorithms. Develop robust feature compatible image transmission algorithms for tactical data links.

4. (U) FY 1999 PLAN:

- (U) ($1,059) SHORE FACILITIES MATERIALS.
  - (U) Complete durability focused materials characterization and parametric studies of composite systems for waterfront upgrades of reinforced concrete structures.
  - (U) Continue development of composite materials for fenders, camels, piles, and other applications.

- (U) ($8,452) AIRBORNE MATERIALS
  - (U) Complete evaluation of beryllium-aluminum alloys for aircraft application.
  - (U) Continue development of wrought orthorhombic titanium alloys for compressor and low pressure turbine components.
  - (U) Identify novel elastomeric fuel cell materials for longer operational life in higher temperature application appropriate to advanced fighter aircraft.
  - (U)Complete erosion characterization of diamond infrared domes.

- (U) ($11,434) SEABORNE MATERIALS.
  - (U) Complete hot corrosion testing of incinerator materials.
  - (U) Conduct field tests of nondestructive, field-portable coatings evaluation system to determine the health of ship paint systems.
  - (U) Continue evaluation of polyaniline-based anticorrosive coatings for shipboard application.

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

- (U) ($2,288) MISSILE/SPACE MATERIALS.
  - (U) Complete materials development for reentry vehicle heatshields.
  - (U) Expand the development of ceramic materials for protection of propulsion components and other high temperature impingement applications.

- (U) ($6,970) MULTI-MISSION MATERIALS.
  - (U) Complete development of a low cost laser protective cell that can be incorporated in optical systems for the Marine Corps.
  - (U) Complete development of system and controlling software for a reliable ultrasonic tomography system that alleviates the problem of refraction.
  - (U) Transition controlled release system to commercial and naval coatings application for anti-fouling and anti-fungal/mildew applications.

- (U) ($5,790) RF SOLID STATE DEVICE AND CONTROL COMPONENTS
  - (U) Initiate wideband receiver component effort in support of the Joint Strike Fighter.
  - (U) Complete development of 100 kW W-band duplexer for Navy s 94 GHz radar program.
  - (U) Continue development of highly compact, high Q, tunable filters and oscillators for T/R module applications.
  - (U) Complete development of InP/InGaAs heterojunction bipolar transistors for application to pulsed Ka-band phased arrays.

- (U) ($14,850) VACUUM ELECTRONICS
  - (U) Complete the development of a high-power, moderate bandwidth gyro-klystron for the Navy 94-GHz radar program.
  - (U) Initiate development of 100 Watt, 5 GHz bandwidth, folded-waveguide TWT for W-band communications applications
  - (U) Initiate development of pole-piece beam focusing technique to explore a magic sphere design using rare earth magnetic materials.
  - (U) Continue the development of a high-duty, wideband gyro-twystron to support radar and EW applications at millime wavelengths.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

- (U) ($5,754) E/O TECHNOLOGY
  - (U) Continue multifunction array using fiber optic beamformer.
  - (U) Complete development of 256 x 256 adaptive IRFPA
  - (U) Complete development of a 128 x 128 color discriminating IRFPA networks.

- (U) ($5,663) MICROELECTRONICS
  - (U) Complete development of CMOS low voltage, low power sub 250-100nm SiGe with T-gate structure in 50-30nm TFSOS for implementation of 16 bit, 1 GSPS and 10 bit, 2.5 GSPS analog-to-digital converters.
  - (U) Complete development of very low power (<0.5 mw) high resolution (16 bits, 2 to 5 kilo sanples per second (KSPS) A/D converter for sonar applications.

- (U) ($2,468) ELECTRONIC AND E/O MATERIALS
  applications.
  - (U) Complete multiple color detector growth techniques and transfer the techniques to industry and device technology programs.
  - (U) Complete investigation of high power handling behavior of HTS MW devices and transition results to vendor community.
  - (U) Continue nanometer-scale direct proximal probe patterning for fine-line (<0.05um) processing of metal resonant tunneling diode structures to realize nanometer scale microelectronic devices.

- (U) ($10,000) ADVANCED MULTIFUNCTIONAL RF SYSTEM SUPPORT TECHNOLOGY
  - (U) Demonstrate 40 watt CW ultra broadband (100 Mhz to 10 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 the steerability of a structurally embedded 3 x 6 or larger wideband antenna dynamically controlled over multi-octaves of frequency with VSWR less than 2:1 for next generation wide area surveillance systems.
  - (U) Continue the development of dimensionally reduced MPMs for electronically scanned arrays.
  - (U) Continue the development of field emitter array (FEA) based power amplifiers as a more compact and efficient vacuum power booster for the next-generation MPM.

- (U) Demonstrate true time delay control of optical beamforming networks with new architectures.
- (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 – 60 degrees from boresight on transmit and receive with an optical control structure that uses photonic technology components that preserve a 500 Mhz instantaneous RF bandwidth for each beam.
- (U) Demonstrate and characterize the performance of thin, conformal arrays of wideband spiral antennas operating over 8 octaves of bandwidth with a VSWR of less than 2.2 over the operating bandwidth, and a radiation pattern free of grating lobes.

- (U) ($1,985) HPC
  - (U) Test and Apply Signal Processing Rapid Prototyping test to Navy application. Explore capability to apply to C4I centric systems.
  - (U) Apply distributed Digital Library Technology to Navy C4I application.

- (U) ($3,432) ARTIFICIAL INTELLIGENCE AND HUMAN COMPUTER INTERACTION.
  - (U) Demonstrate learning of control for intelligent agents with opponents.
  - (U) Integrate case-based reasoning with alternative problem-solving strategies for advanced toolsets.
  - (U) Demonstrate advanced hybrid of reactive and reflective planning for robotic navigation and manipulation.
  - (U) Demonstrate security measures that can defeat intrusion within Joint Warfare Strategy Technology (JWST) criteria and incorporate alternative action strategies upon detection of intrusion.
  - (U) Demonstrate 2-D visualization from multiple views at distributed sites to meet Marine Corps Sea Dragon needs.

- (U) ($7,300) ECS
  - (U) Demonstrate an integrated System Engineering Environment including design capture repository, design structuring and optimization, and system assessment repository. This will provide a capability to flow and evolve the complete system design record across all phases of development, production, and life-cycle support and insert in SC21 testbed. Demonstrate secure use of COTS software components and safeguard against detection of intent through analysis of network traffic.

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

- (U) Develop human-centered system design processes and methods to capture and specify the essential role of human operators and decision-makers in enabling the desired emergent behavior of complex systems.
- (U) Provide an initial demonstration of multi-criteria optimization strategies for life-cycle cost accounting of a key ship system element (e.g., SC21 weapon system).
- (U) Demonstrate unified distributed reusable Web-based object software development architecture and repository on a C4I and combat system application.
- (U) Complete development and transition of wavelet algorithms.
- (U) Demonstrate formal methods approach to Navy safety -critical operation that captures requirements and automatically generates suitable test suites for the final system.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY1999
(U) FY 1997 President's Budget:	$75,933	$75,886	$85,791	$95,641
(U) Adjustments from 1997 PRESBUDG:	$+2,172	$+8,838	$-9,138	$-8,196
(U) FY 1998/1999 PRESBUDG Submission	$78,105	$84,724	$76,653	$87,445

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustment reflects a Jordanian F-16 financing rescission (-$88); Small Business Innovative Research assessment(-$147); execution adjustment (+$2,407). FY 1997 adjustment reflects Congressional plus-ups for Thermoplastic Engineered Lumber (+$2,500), New Processes for Navy Aircraft Skins (+$3,000), Advanced Materials Intelligent Processing Center (+$3,000), Virtual Company Framework (+$4,000); Congressional undistributeds (-$3,662). FY 1998 adjustment reflects PEBB realignment (-$6,000); Navy Working Capital Fund (NWCF) and minor adjustments (-$13,384); S&T adjustments (+$10,334); Military and Civilian pay (+$110); and Inflation reduction (-$198). FY 1999 adjustments reflect PEBB realignment (-$10,000); NWCF and minor adjustments (-$978); S&T adjustment (+$2,965); Military and Civilian pay (+$142); and Inflation reduction (-$325).

(U) Schedule: Specific areas within the following thrust areas will be delayed: Airborne Materials, Shore Materials, Multimission Materials, and Microelectronics. Specific areas which will be delayed include research in

the area of integration of electrically switchable radome materials into airborne systems, engineered lumber for pilings, and transitioning high efficiency power converters to military systems.

(U) Technical: Airborne Materials, Shore Materials Microelectronics, and High Performance Computing thrust areas will be delayed increasing the technical and transition risk for front frame technology for aircraft engines, especially F414 in the F/A-18E/F; increase the technical risk for transitioning of engineered lumber for pilings, increase the tecnical risk for transitioning laser protective materials, increase the technical risk and development time of power converters that can be used for all-electric drive systems; draw down the focus area of HPC in order to increase Engineering of Complex system focused work so as to meet requirements of SC-21, NSSN, and other emerging platforms.

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 Weapons Technology)
- (U) PE 0602121N (Surface Ship & Submarine HM&E 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 DTAP and DTO Agreements on Advanced Materials, Electronic Devices and Computer Technology with oversight provided by the Joint Directors of Laboratories and Joint Engineers. This PE is integrated with the Navy's

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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. FUNDING PROFILE: Not applicable.

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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: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Electronic Warfare Technology	17,133	21,535	22,810	24,707	25,878	26,332	26,896	27,503	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, Joint Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Maritime Support of Land Forces, Readiness and Training). 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 Tri-Service 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 Joint Director of Laboratories (JDL) 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.

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BUDGET ACTIVITY: 2

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

(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. Prograr 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), lou 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 1996 ACCOMPLISHMENTS: The FY 1996 program included increased emphasis on technology addressing increased survivability for surface ships and tactical aircraft against the advancing infrared (IR) threat. Efforts to increase shipboard sensor and weapons response to satisfy the reduced timelines associated with operations in littoral regions

continued. Programs in the areas of combat identification, precision strike and information dominance received added support to assist in the successful accomplishment of the Navy's JMA strategy.

- (U) ($2,821) THREAT WARNING - The objective was to develop small and inexpensive radio frequency (RF) receivers and demodulation techniques to recognize and characterize complex modern-modulation waveforms and to exploit both active and passive Electro-Optic (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) Advanced processing technologies (including algorithms associated with emitter characterization) were integrated with object-oriented software tools to produce automated receiver systems with a capability to perform non-cooperative platform/emitter recognition.
  - (U) A direct infrared frequency (IF) sampling architecture has been developed and an Application Specific Integrated Circuit (ASIC) designed which takes the output of a high-speed Analog-to-Digital Converter (ADC) and reformats it for rapid processing by a single processing chip allowing for extremely small Specific Emitter Identification (SEI) extraction and processing hardware for use in a miniature SEI system for tactical aircraft, Unmanned Aerial Vechicles (UAVs), and portable systems.

  - (U) Completed an optimum concept and design to compensate for ship's roll and pitch and to reduce the effects of multi-path for Electronic Stabilization of shipboard receive antennas providing a more precise Direction Finding measurement.
  - (U) Completed integration of latest extraction and processing techniques to achieve a complete automatic system for precision signal characterization, SEI and automatic radar/electronic support measure (ESM) track correlation.
  - (U) Field tested a prototype small arms counterfire direction finding 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.

- (U) ($8,243) 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, Joint Strike, Sealift/Protection, Strategic Deterrence, and Space and Electronic Warfare (SEW) Intelligence. The entire radar RF 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 IR/EO guided weapons by the development of new IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
  - (U) Designed a prototype off-axis laser detection system and demonstrated successful single-shot ejection of IR payload from a modified MK19-3 grenade launcher for the integrated onboard/offboard countermeasures (CM) solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
  - (U) Successfully developed and tested a laser-based false target technique intended to defeat man-in-the-loop imaging seekers. Also tested a robust jam code, to defeat imaging Anti-Ship Cruise Missile (ASCM) seekers, and to enhance capability of the Advanced Integrated Electronic Systme (AIEWS) system against advanced IR guided anti-ship threats.
  - (U) Completed effectiveness testing of the Phase I Multi-Cloud decoy against IR guided anti-ship threats. Developed and tested a large signature add-on target to increase the radiant intensity of the keeper target by a factor of six and the lifetime of the decoy by 50%.
  - (U) Deployment tested six (6) rocket-thrusted Kinematic Special Material Decoys (KSMD) that dispense special material IR payloads for tactical aircraft self-protection against threats that employ motion as well as spectral discriminants. Test results warranted a significant design review that resulted in a new design of smaller units using composite materials.
  - (U) Developed antenna isolation improvement technology, that was necessary for the EAGER ATD to meet performance requirements, at less than one-third the cost of previous isolation improvement efforts.
  - (U) Completed testing of brassboard 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) Completed initial system concept design of Small Ship Jammer for physically small surface patrol crafts that have no active onboard EW self-protection capability (e.g., special forces PC-1 and MK V SOC) and that are currently involved in fleet littoral warfare operations.
- (U) Developed and tested infrared counter counter measure (IRCCM) algorithms and inserted detailed Focal Plane Array (FPA) model into a digital seeker simulation as part of a tri-service planned and funded program to assess the susceptibility of imaging seeker components for the development of countermeasures against advanced imaging IR missiles.

• (U) ($6,069) 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. Efforts also focus on advanced surveillance techniques and jamming and deception of C2 systems and data links. In order to provide dependable combat identification and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information, work continues in developing strike, surveillance, electronic countermeasures (ECM) and other mission support aircrat capabilities to improve situational awareness.
  - (U) Conducted laboratory tests with an upgraded EA-6B Prowler Universal Exciter for the development of countermeasures against modern cellular radio communication systems as part of a tri-service effort.
  - (U) Developed data server technology for 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. Built a preprocessor to a real-time software bridge between the ESM ATD and EW Simulator.
  - (U) Defined computational approaches and system/subsystem accuracy requirements, and identified necessary IR sub-models for providing an IR ship target and scene modeling for the Cruise Missiles EW simulation to address the shortcomings of previous IR ship predictive codes.

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

2. (U) FY 1997 PLAN: FY 1997 increased funding reflects a $3,000K Office of the Secretary of Defense (OSD) directed infrared counter measure (IRCM) technology. Work continues 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/UAV designs for small radar cross section (RCS) platforms will be initiated.

- (U) ($3,911) 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) Completed 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 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 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) Develop preliminary double delta direction finding algorithm and demonstrate 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.
  - (U) Characterize feature vector effectiveness and initiate 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) Initiate development 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) ($9,799) 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, Joint 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) Analyze susceptibility of foreign and surrogate threats to develop and characterize jamming techniques, in the laboratory and at militarily significant ranges, to assess overall 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) Conduct Optokinetic Nystagmus experiments on man-in-the-loop IR imaging seekers, assess capabilities of new foreign imagers, and assess IRCM techniques against imaging seekers, to enhance capability of the AIEWS system against advanced IR guided anti-ship threats.
  - (U) Redesign 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) Fabricate and test 20 redesigned KSMD units to assure they will properly eject under various wind conditions and then, fabricate 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) Improve antenna isolation model to represent antennas mounted on curved surfaces for any decoy platform and investigate interference cancellation techniques to achieve higher decoy effective radiated power (ERP) through improved antenna isolation.
  - (U) Integrate 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.
  - (U) Complete fabrication and lab testing of 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 are currently involved in fleet littoral warfare operations.
- (U) Update imaging missile model algorithms and perform susceptibility measurements 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 countermeasures against advanced imaging IR missiles.

- (U) ($7,752) 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 identification (ID) and to determine the intent of enemy forces by passive means while disrupting their capability to obtain and disseminate tactical information.
  - (U) Begin detailed design for development of flight technology 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) Complete analysis and document results of laboratory tests conducted with an upgraded EA-6B Universal Exciter, and plan and execute follow-on tri-service field tests for the development of countermeasures against modern cellular radio communication systems.
  - (U) Extend 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 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) Develop 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) Identify necessary modifications to the Little Monopulse Information Signal Processing Element (LMISPE) system and develop a tri-service plan to develop a system capable of fingerprinting modern cellular radio communication systems from airborne platforms.

- (U) ($73) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (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.

- (U) ($4,300) 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) Initiate development of a 12-bit 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) Initiate development 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) ($10,310) 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, Joint 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 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) Complete Multi-cloud decoy effort by adding and testing a floating component which will increase the lifetime of the device thus enhancing ship self-defense against IR guided anti-ship threats.
  - (U) Complete radiometric testing 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 ERP through improved antenna isolation.
  - (U) Complete 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) Complete 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) ($8,200) 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) Conclude tri-service field tests evaluating countermeasures against modern cellular radio communication systems and transition countermeasure techniques into the EA-6B jamming system.
  - (U) Promote 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.

- (U) Complete and validate 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.

4. (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) ($4,200) 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) Complete system 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) ($11,700) 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, Joint Strike, Sealift/Protection, Strategic Deterrence, and SEW Intelligence. The entire radar RF frequency band from HF to MMW is covered under this project. It also includes the protection of U.S. Naval platforms against IR/EO guided weapons by the development of new IR materials for decoys and new deployment concepts and the development of technologies for laser based jammers.
  - (U) Conduct preliminary designs of onboard laser guided weapons detection/protection systems and field test prototype developmental systems for the integrated onboard/offboard CM solution to laser-guided threats that will challenge Navy and Marine surface vessels operating in littoral areas.
  - (U) Determine most efficient jam codes against steering array sensors and transition selected robust seductive waveforms to enhance capability of the AIEWS system against advanced IR guided anti-ship threats.
  - (U) Complete captive seeker testing of thrusted KSMD to evaluate 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 RAM-coated curved surfaces for any decoy platform and finalize isolation improvement techniques and document analysis methods to achieve higher decoy 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) ($8,807) 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) Complete development 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.
  - (U) Complete and 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.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	17,778	22,454	24,089	25,251

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602270N
PROGRAM ELEMENT TITLE: Electronic Warfare Technology

(U) Adjustments from FY 1997 PRESBUDG:	-645	-919	-1,279	-544
(U) FY 1998/1999 PRESBUD Submission	17,133	21,535	22,810	24,707

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 reduction reflects: Jordanian rescission (-21); and execution adjustment (-624). FY 1997 adjustment reflects Congressional undistributed reductions (-919). FY 1998 adjustment reflects Naval Working Capital Fund (NWCF) adjustment (-1,218); and Inflation reduction (-61). The FY 1999 adjustment reflects NWCF adjustment (-452); and Inflation reduction (-92).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

C. (U) OTHER PROGRAM FUNDING SUMMARY:

(U) RELATED RDT&E PROGRAMS:
This PE adheres to Tri-Service Reliance Agreements on EW with oversight and coordination provided by the JDL 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 (Electronic Combat Technology)
- (U) PE 0602270A (Electronic Warfare Technology)
- (U) PE 0603270A (Electronic Warfare Technology)
- (U) PE 0605604A (Survivability and Lethality Analysis)

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(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 (Space and Electronic Warfare (SEW) Technology)
(U) PE 0602111N (Air and Surface Weapons Technology)
(U) PE 0603270N (Advanced Electronic Warfare Technology)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604270N (EW Development)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602314N
PROGRAM ELEMENT TITLE: Undersea Warfare Surveillance Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
Undersea Warfare Surveillance Technology	52,057	47,967	51,033	57,875	59,224	60,364	61,640	63,087	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All of the Navy s applied research in undersea target detection, classification, localization, and tracking is funded through this Program Element (PE). In countering the troubling proliferation of quiet diesel submarines to third world countries and Russia s continued heavy investment in submarine technology, work within this PE provides an enabling capability for power projection and force sustainability. Associated research directly supports the Department of Defense Joint Warfighting Science and Technology Plan and the Defense Technology Area Plans. Within the Navy the effort supports the following Navy Joint Mission Areas (JMAs): Forward Engagement/Deterrence; Joint Littoral Warfare; Intelligence, Surveillance, and Reconnaissance; and Maritime Support. The approach protects the country s capital investment in submarine, surface ship and air Antisubmarine Warfare (ASW) assets both by developing commercial off-the-shelf upgrade options for today s ASW suites and by exploring those high risk/high payoff technologies that promise affordable, break-through operational capabilities in five to fifteen years.

(U) Forward Engagement/Deterrence includes research and technology issues associated with reliable undersea target detection and tracking to enable on-command application of precision offensive military force. Programs include undersea sensors and arrays to provide robust shallow water surveillance and reconnaissance, and to detect undersea threats to the surface battleforce.

(U) Joint Littoral Warfare includes research and technology issues associated with dominating the undersea battlespace to enable timely execution of joint/combined operations and to ensure joint force sustainability. Programs include advanced sensors and arrays for both improved ASW surveillance and enhanced battleforce self defense, ASW data fusion for better tactical control, and low frequency active sonar and [classified material deleted] deployable surveillance systems for [classified material deleted] indication and warning.

(U) Intelligence, Surveillance and Reconnaissance includes research and technology issues associated with maintaining a timely tactical picture of the undersea battlespace to enable allied force power projection and sea control. Programs include

development of acoustic and non-acoustic sensors, [classified material deleted] arrays, low frequency sonobuoys and fusion of multi-sensor data into a reliable tactical picture.

(U) Maritime Support includes research and technology issues associated with reliable undersea target detection and tracking, enabling joint battleforce sustainability. Programs include the entire spectrum of technology development undertaken in support of other JMAs.

(U) These efforts support the naval portion of the Joint Warfare Strategy as expressed in "Forward...From the Sea". Programs in this PE are primarily service (Navy) unique.

(U) Applied research funded by this PE in many cases transitions to advanced development projects in undersea warfare advanced technology (PE 0603747N).

(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 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 an advanced development effort.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($43,382) ACOUSTIC SENSOR TECHNOLOGY:
  (U) Initiated: (Includes Congressional adds of $.5 million for AA lithium carbon monofluoride batteries and $.5 million for safe, rechargeable batteries for SEAL Deliver vehicles)
  -- (U) Development of a multistatic ASW effort aimed at developing common acoustic sources and signal processing to benefit submarine, surface ship, surveillance, and air ASW platforms.
  -- (U) Development of critical technology for low cost autonomous deployable surveillance systems which use commercial cellular phone satellite network technology for data transmission.

-- (U) Development of optical depth and heading sensors to support low cost all-optical array designs both for towed and deployable applications.
-- (U) Development of signal discrimination techniques similar to those used in biologic echolocation for undersea warfare active sonar system applications.
-- (U) Development of improved Lead Magnesium (PMN) material, focusing on an improved coupling coefficient for more efficient operation over a wide acoustic bandwidth.

(U) Conducted:
-- (C) Sea trial to evaluate tactical surface ship [classified material deleted] multidimensional towed array.
-- (U) Cooperative low- and mid-frequency shallow water active classification sea test with NATO s SACLANTCEN to further develop active classification algorithms and benchmark active sonar developments.
-- (U) Initial demonstration of a developmental parametric sonar to investigate the feasibility of employing this technology for helicopter-borne ASW and for mine avoidance applications.

(U) Demonstrated:
-- (U) Improved active sonar detection performance utilizing a new slotted cylinder projector, high density power electronics, and lithium thermal batteries for application to air-deployed sonobuoys.
-- (U) Technology of a fiber-optic cabled deployable acoustic array of increased bandwidth, sensor count and type, and reduced cost per channel.
-- (U) A state-of-the-art active sonar acoustic classifier capable of combining echo structure clues with clues based on plausible target tracks.
-- (U) Performance improvements of conventional and adaptive passive beamforming employing a tactical multi-dimensional towed array in a shallow water exercise conducted in the Mediterranean.

-- (U) Completed:
-- (U) Development of active and passive sonar integration concepts for processing and display of multistatic operations.
-- (U) A simulation model for the acoustic performance characteristics of a deployable, expendable, single-line vertical array.

(U) Transitioned:
-- (U) Algorithms to PE 0603504N (Submarine Tactical Passive Program) which provide the capability to adaptively process [classified material deleted] signals across receiver array beams for accurate passive sonar detection and classification of a quiet submarine.

- (U) ($6,151) NON-ACOUSTIC SENSOR TECHNOLOGY:

(U) Initiated:
-- (C) A two-year concept/feasibility study to determine the viability of detecting [classified material deleted] associated with submerged submarines.
(U) Developed:
-- (U) Concept system design (antenna, waveforms, and processor) will be a candidate for an upgrade to P3 and S3 maritime patrol aircraft for a next-generation periscope detection radar. The technology will be a candidate for the next-generation maritime patrol aircraft.
Completed:
-- (U) Concept definition of an accurate, rapid beam-steering laser for application to a shipborne Electro-Optic (EO) periscope detection system. (Originally conceived by the US Army.)
(U) Conducted:
-- (U) Field tests of linear, flexible, distributed non-acoustic array incorporating [classified material deleted] sensors (enabling technology for a shallow water search capability rapidly deployable from a surface ship). This technology will be a candidate for an upgrade to the Advanced Deployable Surveillance System (ADS).

- (U) ($2,524) DATA FUSION TECHNOLOGY:
(U) Initiated:
-- (U) Concept definition and system architecture design for data fusion of distributed sensor field information associated with a deployable autonomous system.
(U) Demonstrated:
-- (U) A real time processor and display which fuses signals from complementary active acoustic waveforms, for surface ship and submarine applications. (The objective is to provide a robust detection and classification capability for both high- and low-speed targets).
(U) Transitioned:
-- (U) Active waveform data fusion algorithm to Surface Ship ASW Combat Systems Office, Program Managers Office (PMS 411) Echo Tracker Classifier.

2. (U) FY 1997 PLAN:

- (U) ($39,792) ACOUSTIC SENSOR TECHNOLOGY:
(U) Initiate: (Includes Congressional add of $.5 million for continued development of AA lithium carbon monofluoride batteries.)

-- (U) Computer simulations to demonstrate the feasibility of exploiting unique classification clues made available by coherently processing active sonar data collected by two widely spaced, relatively moving sensors. The goal is to significantly increase the search rate of a surface combatant and its associated Light Airborne Multi Purpose (LAMPS) helicopter while simultaneously providing precise target position information.
-- (U) Development of an improved micro-machined directional hydrophone sensor utilizing better fabrication techniques to reduce noise and power consumption and improve stability.
-- (U) Development of submarine [classified material deleted] detection algorithms aimed at greatly reducing the false alarm rate, which is currently evaluated as unacceptable by the fleet. The approach employs techniques for simultaneous detection and classification, and at the same time target localization in range and depth.
-- (U) An analysis of bi-and multi-static ASW data to determine the physical mechanisms by which the harsh shallow water environment degrades active acoustic system performance. This effort will lead to environmentally adaptive system designs.
-- (U) Development of a glider capable of deploying an underwater surveillance array, to be air-launched from a Maritime Patrol Aircraft that is operating at a safe stand-off range.

(U) Conduct:

-- (U) In water test to evaluate improved towed array optical sensors. This test will benefit two developments: the all optical towed array and the advanced fiber-optic acoustic sensor for submarine conformal hull arrays.
-- (U) At-sea testing and data collection to support development of common off-board acoustic sources and signal processing techniques for multistatic ASW to benefit submarine, surface ship, surveillance, and air ASW platforms.

(U) Demonstrate:

-- (U) Lower cost, lighter weight submarine hull array sensor technology. This technology is critical in dramatically reducing the cost of submarine hull mounted arrays.

(U) Develop:

-- (U) Enhanced helicopter/surface ship acoustic interoperability for improved detection/classification performance. This effort couples improved active acoustic signal processing algorithms for both surface ships and ASW helicopters to the same development baseline.
-- (U) Improved acoustic transducers using energy-dense materials, innovative form factors, and hybrid PMN/Terfenol devices. This is enabling technology for lightweight, high power, broad bandwidth, active acoustic sources needed to improve detection ranges when operating against small submarines in a shallow water environment.

-- (U) Innovative technologies for sonar receive arrays, including fiber-optic ultra-low power piezo-electric and micro-machined acoustic sensors. This is an affordability initiative applicable to all warfare communities.

(U) Complete:
(U) Real-time capability to autonomously process [classified material deleted] signals from acoustic sensor arrays for automatic target association and operator alerting. This is enabling technology in the development of an uncabled rapidly deployable surveillance array which is designed to be more survivable than current cabled arrays.
-- (U) An algorithm development that combines the outputs of a shallow water acoustic channel scattering model with improved active sonar classification techniques to simultaneously determine range and signal highlights of active acoustic echoes. This effort will lead to an improved capability to minimize false contacts while reducing false dismissals.
-- (U) An algorithm which adapts to the local shallow water reverberation environment to enhance the detection performance of traditional matched filters, commonly used in active ASW processing systems.
(U) Transition:
-- (U) Algorithms for [classified material deleted] active classification and false alarm rejection to the Improved Extended Echo Ranging system, PE 0603254N.

- (U) ($4,964) NON-ACOUSTIC SENSOR TECHNOLOGY:

(U) Complete:
-- (C) Final report on analysis of field tests examining the detectability of submarines by airborne sensors searching for [classified material deleted] submarines.
-- (U) Delivery and laboratory testing of the rapid wide-angle beam steering laser project (initiated in FY 1996) for the Shipborne EO Periscope Detection system.
-- (U) Initial sea test of the next-generation periscope detection radar.
(U) Complete:
-- (U) A concept study to determine the feasibility of detecting [classified material deleted] associated with submerged submarines.

- (U) ($2,626) DATA FUSION TECHNOLOGY:

(U) Demonstrate:
-- (U) Clutter reduction techniques for improved search effectiveness by fusing surface ship radar data with acoustic data.

-- (U) Correlation, tracking and classification fusion capabilities of a field-level prototype deployable autonomous distributed system in a testbed environment.

- (U) ($585) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 1998 PLAN:

- (U) ($42,929) ACOUSTIC SENSOR TECHNOLOGY:

(U) Initiate:

-- (U) An innovative passive signal processing effort capable of integrating classification and localization processes for [classified material deleted] signals emitted by submarines. This effort is aimed at reducing false alarms to an acceptable rate. The primary transition for this effort will be to the Advanced Processing Build Program in PE 0603504N.

(U) Develop:

-- (U) A signal processing algorithm to select the appropriate advanced active waveform for improved detection and classification of stationary or slowly-moving submarines, based on in-situ environmental information and the tactical scenario. This effort is applicable to all mid-frequency tactical sonar systems.

-- (U) Multistatic environmentally adaptive active acoustic signal processing techniques incorporating improved multi-static propagation models.

(U) Conduct:

(U) An over-the-side sea test of a high-power, low frequency off-board acoustic source for multistatic ASW.

(U) An at-sea experiment to evaluate the capability to exploit unique classification clues provided by coherently processing active sonar data collected by two widely spaced, relatively moving sensors. This technology promises up to a four-fold increase in search rate and area, while also providing precise target position information for rapid weapon placement.

(U) Continue:

-- (U) Development of active sonar classification techniques which exploit target-physics-based features using the measured space-time target response from a state-of-the-art scale model of a [classified material deleted] submarine.

-- (U) Development of innovative active acoustic transducer design concepts proposed by industry. These efforts are aimed at reducing production and life-cycle cost, increasing acoustic source levels, and reducing associated array weight.
-- (U) Development of improved acoustic receive arrays using fiber-optic, ultra-low power and micro-machined sensor technologies.

(U) Demonstrate:
-- (U) Critical sensor technologies required to autonomously detect and classify submarines with a small passive acoustic array deployed on the ocean floor. The sensor is packaged in a 10 inch diameter, 36 inch long cylinder suitable for deployment from surface ships, submarines and Maritime Patrol Aircraft.
-- (U) Performance of innovative fiber-optic submarine hull array sensors in an at-sea test. This is a key milestone in developing an affordable, lighter weight submarine wide aperture or conformal hull array.
(U) Complete:
-- (U) Demonstration of an optical, Bragg grating-based TB-16 towed array including system/cost assessment, engineering sensors, and mid-frequency sensor designs.

- (U) ($5,010) NON-ACOUSTIC SENSOR TECHNOLOGY:
(U) Complete:
-- (U) Development of an Extremely Low Frequency (ELF) sensor model, platform noise reduction algorithms, ELF/Ultra Low Frequency (ULF) geomagnetic noise reference sensor study report and noise reduction flights all associated with the design of a new generation Magnetic Anomaly Detection (MAD) system.
-- (U) Concept evaluation for a shipborne EO periscope detection system including an assessment of the initial test plan, the feasibility of component integration, and counter-measure/ counter-counter-measure performance.
(U) Develop:
-- (U) The initial design of a coherent processor and electronically steered phased array antenna for the next generation airborne periscope detection radar.
(U) Demonstrate:
-- (U) The performance of low power, electric and magnetic field sensors integrated with acoustic sensors in an initial prototype node of a Deployable Autonomous Distributed System.

- (U) ($3,094) DATA FUSION TECHNOLOGY:
(U) Demonstrate:

-- (U) The impact of fusing active and passive sonar information and non-acoustic (radar) information to improve surface ship ASW performance, as measured by reduced detection time and threshold, reduced false alarm rate, and improved classification, while simultaneously reducing sonar manning.
-- (U) Initial capability for fusion of information (acoustic and non-acoustic sensors) from multiple nodes in a virtual emulation of a Deployable Autonomous Distributed System.

4. (U) FY 1999 PLAN:

- (U) ($49,514) ACOUSTIC SENSOR TECHNOLOGY:
(U) Initiate:
-- (U) Development of autonomous deployable receivers suitable for use in a distributed sensor field, interlinked by acoustic communications, and employing radio frequency communications for data transfer to shore.
(U) Continue:
-- (U) Development of the most promising active acoustic transducer concepts from industry for improving source levels, increasing bandwidth and reducing associated array weight and cost.
(U) Demonstrate:
-- (U) A first-generation multi-static ASW system incorporating off-board acoustic sources and on-board signal processing techniques. This is enabling technology for systems which are common across submarines, surface ships, surveillance, and air ASW platforms.
-- (U) Acoustic velocity sensor performance on an SSN, in conjunction with a hull coating test. Both efforts are associated with a follow-on to the Wide Aperture Array, and are expected to decrease conformal array system cost to one-third and system weight to one-fifth compared with the present AN/BQG-5.
-- (U) Performance improvements of an active acoustic signal processor designed to make use of target-physics-based features for active sonar classification in a shallow water at-sea test.
-- (U) An order of magnitude reduction in the cost of constructing towed arrays using innovative optical sensing technology and telemetry technology.
-- (U) A significant decrease in false alarm rates over the current baseline established by the Low Frequency Active/Surveillance Towed Array Sonar System (SURTASS/LFA) by utilizing environmental adaptation, echo structure clues, adaptive beamforming, and advanced Doppler detection.
-- (U) A capability for utilizing tactical sensors to measure and adapt in-situ to the harsh littoral environment, thereby optimizing detection ranges and classification capabilities of passive and active sonar systems.

-- (U) An innovative passive signal processing effort capable of integrating detection, classification and localization processes for transient signals emitted by submarines.
(U) Conduct:
-- (U) Flight tests of a glider capable of deploying an underwater surveillance array, air-launched from a Maritime Patrol Aircraft that is operating at a safe stand-off range.
-- (U) Signal processing algorithms which provide an estimate of range and depth of quiet threats in shallow water using tactical [classified material deleted] towed arrays. The primary transition of this work is to PE 0603504N, Advanced Processing Build Block.
(U) Transition:
-- (U) Signal processing algorithms to the Active Adjunct Processor program for the SQQ-89 surface ship sonar system, and to the Airborne Low Frequency Sonar helicopter sonar system. This effort, which will significantly decrease operator false alarm rates, incorporates common signal processing algorithms to enable Bi-static and interoperable operations between the two platforms.
-- (U) Signal processing algorithms which exploit [classified material deleted] acoustic signals to simultaneously detect and classify quiet threat submarines, and algorithms which use these signals to estimate target range and depth. This work will transition to the Advanced Processing Build program in PE 0603504N.

- (U) ($5,407) NON-ACOUSTIC SENSOR TECHNOLOGY:
(U) Complete:
-- (U) Point design for the next generation periscope detection radar. This effort is enabling technology that will lead to an extension of the periscope detection envelope by a factor of [classified material deleted] in altitude and [classified material deleted] in range relative to the current AN/APS-137 radar system).
-- (U) ELF sensor installation and field support, ELF sensor algorithm development in support of the next generation MAD system.
-- (U) Development and laboratory evaluation of a miniature, low cost, low power, magnetometer together with electromagnetic feature extraction and tracking algorithms all for use in a deployable autonomous distributed system.
(U) Conduct:
-- (U) Geomagnetic noise reduction flights essential to support the development of the next generation MAD system.
-- (U) At-sea experiments, data collection reduction, and analysis, and evaluation of the concept plan for a technical break-through shipborne EO periscope detection system.

(U) ($2,954) DATA FUSION TECHNOLOGY:
(U) Demonstrate the ability of the Deployable Autonomous Distributed System to detect, classify, and track a threat target, using data fusion techniques to develop a fire control quality track suitable for weapon employment.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	55,226	49,580	54,440	59,105
(U) Adjustments from FY 1997 PRESBUDG:	-3,169	-1,613	-3,407	-1,230
(U) FY 1998/1999 PRESBUDG Submit:	52,057	47,967	51,033	57,875

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments include (-$2,591) for SBIR assessment,(-$64) for Jordanian F-16 financing rescission and (-$514) update to reflect actual execution. FY 1997 adjustments include (-$2,113) for Congressional Undistributed Reductions, (+$500) due to Congressional plus-up for AA lithium batteries. FY 1998 adjustments include (-$4,381) due to NWCF and minor adjustments, (-$2,000) due to transfer to 0603508N for PEBB, (+$3,035)for Science and Technology restoral, (-$130) for Inflation and (+$69) for Military and Civilian Pay Rates. FY 1999 adjustments include (-$214) for Inflation, (+$89) for Military and Civilian Pay and (-$1,105) due to NWCF and minor adjustments.

(U) Schedule: Reduction in FY 1998 and FY 1999 will result in:
(U) A descoping of a signal processing effort aimed at a 100-fold reduction in false alarm rate for the LFA/SURTASS and a delay in transitioning this technology from FY 1998 to FY 1999.
(U) Eliminating a FY 1998 Shallow Water Active Classification sea test which would demonstrate a prototype classifier for surface ship active sonar. The test would also collect data in a strategically significant littoral area that would have been used to continued active sonar signal processing algorithm development.
(U) Considerable resources within this program element have been reallocated to support technical efforts aimed at demonstrating a multistatic ASW capability using high-power, low frequency, off-board acoustic sources

with associated on-board signal processing in FY 1999. As a result, a number of lower priority efforts reported in previous R-2 submissions have been reduced in scope, delayed, or canceled.

(U) Technical: Not applicable.

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

(U) RELATED ACTIVITIES:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0603747N (Undersea Warfare Advanced Technology)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0603254N(Anti-Submarine Warfare Systems Development)
(U) PE 0603504N (Advanced Submarine Combat Systems Development)
(U) PE 0604212N (Anti-Submarine Warfare and Other Helicopter Development)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602314N
PROGRAM ELEMENT TITLE: Undersea Warfare Surveillance Technology

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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 1996 ACTUAL	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
Mine Countermeasures, Mining and Special Warfare Technology	43,553	44,602	42,737	44,575	45,920	46,920	47,919	48,985	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 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, self-protection, minehunting, neutralization/breaching and clearance; the Mining component emphasizes offensive mining capabilities. The 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.

(U) Mine Technology: The need for improved mine technologies has diminished 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 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 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 1996 ACCOMPLISHMENTS:

- (U) ($21,037) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Conducted VSW sea tests of low frequency (LF) and high frequency (HF) Synthetic Aperture Sonar (SAS) and assessed beamforming and motion compensation technology performance. Assessed effectiveness of the TVSS, with advanced beamforming, for wide-area mine detection/classification in shallow water.
  - (U) Electro-Optic Sensors: Completed sea tests of a Laser Line Scan (LLS) prototype to identify sea mines in littoral waters. Investigated spectral imaging and analysis techniques for enhanced performance object classification and identification.
  - (U) Electro-Magnetic Sensors: Completed thin-film superconducting gradiometer down-selection process and began fabrication of a field-deployable prototype sensor.

- (U) Image Processing and Classification Algorithms: Demonstrated acoustic image processing algorithms for more automated mine classification in conjunction with the SAS sea test. Evaluated effectiveness of using resonance signal processing algorithms (using acoustic backscatter returns from mines) for long range mine classification without imaging. Refined airborne laser based image processing algorithms for detection of anti-invasion minefields in high clutter surf/BZ environments, achieving further reduction in false alarm rates. Developed and evaluated algorithms which exploit multi-source data fusion methods to baseline the physics for submerged mine detection using remote imaging radar. Developed an artificial neural network target classifier for emulating a marine mammal's mine detection and classification capabilities.

• (U) ($13,268) MINE/OBSTACLE NEUTRALIZATION:
  - (U) SW Mine Neutralization: Investigated technology issues associated with targeting and fire control for the Rapid Airborne Mine Clearance System concept. Performed analysis of integrated target acquisition, fire control, gun, and anti-mine projectile performance. Conducted technical analysis regarding feasibility and effectiveness of creating focused underwater shock waves to implement standoff mine destruction. Investigated hydrodynamic issues and approaches for pressure influence mine sweep concepts.
  - (U) SZ Mine Neutralization: Conducted mine vulnerability testing of tilt rod mines to establish kill criteria and developed analytical models to simulate effectiveness of systems against buried mines in wet sand. Conducted critical component and initial full scale, high velocity testing of Thunder Road concept, providing an alternative approach to delivery of distributed explosives which does not require a naval surface craft operating near the SZ.
  - (U) Obstacle Breaching: Conducted tests of various penetrating warheads against concrete obstacles and established baseline damage rules. Developed damage rules for shock damage of steel and wood obstacles in SW. Performed initial concept investigations of proposed technologies including small autonomous crawling vehicles, precise bomb delivery, and bridging technologies.

• (U) ($1,448) MINING:
  - (U) Mine Sensors: Completed first phase of technology demonstration of acoustic and electro-magnetic sensors for Littoral Sea Mine (LSM) application. Initiated integrated acoustic, magnetic, electric and pressure LSM sensors data analysis. Tested advanced gradient influence sensor to determine the ability to detect targets in SW high wave noise environments.
  - (U) Mine Support Technology: Developed high reliability underwater message transmission techniques for Remote Control (RECO) applications. Transitioned advanced neural network classification and mine control firing algorithms using fuzed influence sensor data to Mine Improvements program. Continued development of advanced LSM classification and fire control algorithms for detecting/localizing all surface targets, including fast patrol boats.

• (U) ($7,800) SPECIAL WARFARE/EOD:
  - (U) Mission Mobility Technology: Tested and demonstrated a 1/3-scale NSW high speed boat shock mitigation system; developed first-generation 2-Dimension strip theory planing boat dynamics model. Transitioned a solid state CO2 and oxygen sensor technology to the Program Management Support-EOD program. Conducted laboratory experimentation of

porous/nonporous hollow fiber membranes for possible use for scrubbing CO2 from the breathing loop of closed circuit Underwater Breathing Apparatus. Explored power source/fuel technologies for low signature diver propulsion vehicle application. Conducted modeling/testing/evaluation of phase change materials for use in diver thermal protection.

- (U) Mission Support Technology: Evaluated feasibility of a portable multispectral reconnaissance imager for target (land mines, tanks, etc.) identification using an uncooled optical parametric amplifier laser. Conducted laboratory testing of prototype ultrashort range-gated UV laser/camera. Conducted a technology assessment of underwater adhesives and non-metallic attaching technologies.
- (U) Clearance of UXO: Demonstrated capability of four different concepts for small taskable robotic systems that will detect and gather UXO and also provide a capability to place charges for mine countermeasures.
- (U) Response to WMD Incidents: Demonstrated adaptive shielding technique to mask EOD technician from anti-intrusion sensors.

2. (U) FY 1997 PLAN:

- (U) ($20,177) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Complete sea testing of the Side-Looking Sonar (SLS). Demonstrate coordinated signal processing of both the SAS and electro-optic imaging sensor integrated into a small underwater towed vehicle. Based on analysis of at-sea tests, optimize the LF and HF SAS design for improved performance in shallow water.
  - (U) Electro-Optic Sensors: Optimize electro-optic sensors based on analysis of at-sea performance. Conduct sea tests of next generation spectral imaging systems for power-efficient mine detection and identification.
  - (U) Electro-Magnetic Sensors: Complete fabrication of field deployable superconducting gradiometer for the detection of buried mines. Conduct dock-side operability testing in small diameter underwater vehicle prior to at-sea tests.
  - (U) Image Processing and Classification Algorithms: Conduct 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. Demonstrate airborne image processing algorithms for detection of anti-invasion minefields in high clutter environments. Demonstrate capability to use multi-source data fusion algorithms to identify locations of obstacles and mines. Evaluate and demonstrate 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) ($12,713) MINE/OBSTACLE NEUTRALIZATION:
  - (U) SW Mine Neutralization: Conduct laboratory experiments to evaluate potential effectiveness of new mine destruction concept using focused underwater shock waves.
  - (U) SZ Mine Neutralization: Validate multi-phase c oupled code model for simulation of explosive shock propagation through wet sand and use results to update SZ mine neutralization analytical model. Update database of mine neutralization criteria (pressure, impulse, energy) for threat mines through testing and analysis. Complete full-scale testing of

Thunder Road for deploying distributed explosive arrays. Conduct concept assessment of precision clearance and large bomb proposals.

- (U) Obstacle Breaching: Develop model of damage sustained by finite con crete obstacles when hit or penetrated by high velocity penetrating ordnance. Conduct testing to validate predicted performance enhancement of simultaneous and sequential detonation of bombs for obstacle clearance. Perform initial concept investigations of proposed technologies for enabling instride obstacle breaching.

- (U) ($2,750) MINING:
  - (U) Intelligent Mine Network: Develop and evaluate concepts for integrating mobile sea mines into fields of autonomous sensor nodes communicating via covert acoustic modems. These fields will be designated Deployable Autonomous Distributed Systems (DADS) and will leverage technology developed for littoral underwater surveillance. Weapon concepts for DADS will build on prior developments in the Submarine Launched Mobile Mine (SLMM) and the fixed LSM.
  - (U) Mine Sensors: Complete analyses of data and publish final report from the first phase of LSM technology feasibility demonstration. Complete measurement of target advanced gradient signatures, complete theory and performance model development, and arrive at feasibility decision for continuing advanced gradient technology. Initiate work on sensors and signal processing for the DADS weapons concept.
  - (U) Minefield Command and Control: Assess at sea reliable communications concepts between a ship and mine, providing Identify Friend or Foe (IFF) and RECO capabilities. Assess 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) ($8,210) SPECIAL WARFARE/EOD:
  - (U) Mission Mobility Technology: Complete and transition high speed boat shock mitigation system. Prototype and transition CO2 membrane scrubber technology. Develop drive mechanism and propeller for low signature diver propulsion vehicle.
  - (U) Mission Support Technology: Integrate and demonstrate prototype UV imaging system for mine identification. Prototype and evaluate ensemble containing phase change materials for passive diver thermal protection. Design and characterize optical parametric amplification laser for multispectral imaging.
  - (U) Clearance of UXO: Conduct development of 2 kilowatt laser diode stack for the neutralization of surface unexploded ordnance. Initiate 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. Complete experiments with time domain electro-magnetic induction and SQUID gradiometer techniques for detecting and classifying buried UXO. Apply model based neural network processing to the buried UXO sensor data to reduce false alarms and increase detection rate.
  - (U) Response to WMD Incidents: Demonstrate a high velocity linear shaped charge for the disablement of the explosive firing train of a WMD.

- (U) ($752) Portion of extramural program applied to Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($21,137) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Integrate TVSS, SLS, and SAS sensor modules into remote underwater sensor platform for Joint Countermine ACTD demonstration of sea mine detection, classification, and identification. Fabricate broadband sonar transmitter for SAS application to enhance Detection/Classification Probabilities and area search rate.
  - (U) Electro-Optic Sensors: Complete sensor performance prediction model for optical mine detection system that includes the spectral characteristics of mine-like targets.
  - (U) Electro-Magnetic Sensors: Continue effort in Low Temperature Critical(Tc) superconducting gradiometer physics to investigate motion-induced noise and radio frequency immunity and to improve sensor performance. Further develop High Tc fabrication technology to a level of maturity comparable to the 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. Demonstrate, as part of the Joint Countermine ACTD, capabilities and improvements to mine detection and classification through use of semi-automated multi-sensor fusion and processing.

- (U) ($9,985) MINE/OBSTACLE NEUTRALIZATION:
  - (U) SW Mine Neutralization: Develop design options to implement focused underwater shock wave generator for standoff mine neutralization. Transition development and testing of anti-mine projectile for the Rapid Airborne Mine Clearance System concept to an Advanced Technology Transition Project. Conduct testing and analysis of target acquisition, fire control, gun, and anti-mine projectile subsystem components, to predict integrated system performance.
  - (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) MINING:
  - (U) Intelligent Mine Network: Develop DADS mobile shallow water mine (DADS-weapon) concept. Develop covert deployment concept based upon SLMM. Develop concepts for “restart” of deployed mobile mine for target attack, communications with DADS during target attack mode, and terminal guidance.
  - (U) Mine Sensors: Develop guidance sensors and signal processing for DADS mobile shallow water mines.

- (U) Mine Field 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) ($8,755) 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.
  - (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.

4. (U) FY 1999 PLAN:

- (U) ($20,489) MINE/OBSTACLE DETECTION:
  - (U) Acoustic Sensors: Demonstrate and evaluate the combined effectiveness of the TVSS, SLS, and SAS systems for detection, classification, and identification of sea mines, as a part of the Joint Countermine ACTD. Incorporate and conduct at-sea performance trials of the newly fabricated broadband SAS transmitter.
  - (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: Develop High Tc superconducting gradiometer for field demonstration by mid-1999.
  - (U) Image Processing and Classification Algorithms: Assess effectiveness of multi-sensor data fusion techniques used for Joint Countermine ACTD and initiate development of improvements indicated by the assessment. Initiate broadband acoustic signal processing techniques for SAS application to provide improved beamforming, increased target image resolution, and extended sonar range. Initiate adaptive processing techniques sensitive to maintaining high detection/classification probabilities under adverse environmental conditions.

- (U) ($12,300) MINE/OBSTACLE NEUTRALIZATION:

- (U) SW Mine Neutralization: Select generator design option and establish full-scale test for demonstration of focused underwater shock wave mine neutralization.
- (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 lig ht/medium obstacles in water and air. Investigate innovative concepts for clearance or burial of SZ obstacles.

• (U) ($2,975) MINING:
- (U) Intelligent Mine Network: Develop hardware/software to demonstrate feasibility of DADS-weapon concept.
- (U) Mine Sensors: Test guidance sensors and signal processing for DADS-weapon in the laboratory.
- (U) Mine Field 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) ($8,811) 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 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	46,894	40,534	42,885	48,988
(U) Adjustments from FY 1997 PRESBUDG:	-3,341	+4,068	-148	-4,413

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(U) FY 1998/1999 President's Budget Submission:	43,553	44,602	42,737	44,575

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 change resulted in a reductions for the Jordanian F-16 financing rescission (-54); from Transfer of SBIR funds (-2,055); and actual execution (-1,232). The FY 1997 increase resulted from Congressional plus-up for Lithium Battery Technology (+6,000); and from Congressional Undistributed Reductions (-1,932). The FY 1998 decrease are due to NWCF and minor adjustments (-40); and from inflation adjustment (-108). The FY 1999 reductions resulted in NWCF and minor adjustments (-247); and transferred from this PE to Advanced Technology Demonstrations P.E. (-4,000) to fund higher Navy priorities; and from inflation adjustment (-166).

(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 (Readiness, Training and Environmental Quality Tech)
(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(U) COST (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
N/A Oceanographic and Atmospheric Technology	57,260	73,416	48,211	58,037	60,946	52,734	53,560	54,737	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) provides the fundamental programmatic instrument by which basic environmental research is transformed into technology developments that provide new or enhanced warfare capabilities. This PE also provides environmental technologies that form the general environmental 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 environment, (2) environmental 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 environmental support for 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:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

(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 environmental influences on mine countermeasure (MCM) systems.

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

(U) These efforts support the Joint Warfare Strategy "Forward...From the Sea." This program adheres to Tri-Service Reliance Agreements on Environmental Sciences with oversight provided by the Joint Directors of Laboratories. 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 under the Reliance program in the Environmental Sciences categories of Lower Atmospheric Sciences and Ocean Sciences.

(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 1996 ACCOMPLISHMENTS:

- (U)($13,929) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:

- (U) Validated a mid-frequency (1-10 kHz) state-of-the-art, bistatic active acoustic performance model for continental shelf and slope regions as a contribution to undersea acoustic surveillance.
- (U) Transitioned a mid-frequency reverberation-suppression technique (Principal Components Inverse Method) to the Space and Naval Warfare Systems Command; this enables mathematical characterization of the acoustic components of the reverberation in near real-time.
- (U) Used measurements to assess ocean bottom influences on transient and broadband detection capabilities in SW regions; this directly supports efforts in detecting transients emitted by quiet targets.
- (U) Performed numerical testing and field testing of stochastic acoustic formalisms aimed at enabling complex SW environments to be treated without a complete deterministic description.
- (U) Conducted field measurements to provide a basis for linking acoustic variability with ocean variability.
- (U) Developed full-spectrum source models for surf, shrimp, fish and earthquake contributions and developed full-spectrum noise clutter statistics to advance the detection capabilities of full-spectrum processing.
- (U) Incorporated ocean focusing techniques using measured environmental data into signal processing algorithms to eliminate directional noise and other sources of interference to provide a robust tracking capability in the littoral environment.
- (U) Developed a detector/classifier which exploits the nonlinear character of broadband signals by simultaneously using nonlinear and chaotic methods to improve detection performance and increase detection/classification ranges, especially for the "quiet" submarine in littoral regions.
- (U) Conducted a joint oceanographic-acoustic field experiment to determine the significance of the variability of coastal oceans for undersea acoustic surveillance.
- (U) Revised the SW environmental false target model to include bottom features to advance torpedo guidance & control (G&C) in SW; validated a bistatic bottom scattering strength model.

• (U) ($26,083) ENVIRONMENTAL INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY:
  - (U) Transitioned bottom sediment scattering and penetration models and associated data bases to the MCM community to improve the capability to predict environmental effects on MCM acoustic systems.

- (U) Demonstrated the use of remotely-sensed optical properties in predicting the performance of MCM optical systems; conducted optical characterization of a second coastal ocean site for support of optical MCM systems.
- (U) Completed documentation of MCM Tactical Environmental Data System (MTEDS) and its transition to the MCM community; this system will enable the on-scene commander to have critical environmental data available for tactical improvements.
- (U) Continued development of hydrodynamical models that describe the migration, scour, and burial of mines in the surf zone (SZ).
- (U) Developed a rapid, three-dimensional seismoacoustic scattering model in support of statistical algorithms to characterize littoral sediments for prediction of both geoacoustic and shock wave interaction with sediments.
- (U) Performed preliminary tests and modification of bubble and acoustic scattering measurement systems in SW to enable determination of the effect of bubbles on acoustic and optical MCM systems.
- (U) Analyzed experimental data on high-frequency acoustic spatial/temporal coherence to determine the major environmental influences on high-resolution MCM sonar systems, such as real and synthetic aperture sonar systems.
- (U) Used the tactical oceanography simulation laboratory to provide environmental fields for amphibious warfare and special operations warfare simulations at Cherry Point, North Carolina.
- (U) Developed expendable, low-cost tide sensor technology and initiate development of sensor fusion procedures for littoral warfare applications.
- (U) Continued development of selected environmental sensor technologies that contribute to a remote semi-autonomous underwater oceanographic measurement capability.
- (U) Initiated development of a Portable Hyperspectral Imaging Low-Light Spectrometer (PHILLS) for use in the coastal zone to enable remote sensing of environmental characteristics and features of the coastal ocean.

• (U)($12,428) OCEAN AND ATMOSPHERIC PREDICTION:

- (U) Evaluated data assimilation techniques for the North Atlantic basin for inclusion in a large-scale ocean forecast system to be implemented by the year 2000.
- (U) Delivered an ocean forecast system for operational testing and subsequent use aboard Navy ships.
- (U) Demonstrated three-dimensional visualization methods applicable to real-time situations in shipboard environments as a means of improving the utility of ocean forecasts.
- (U) Demonstrated an ocean forecast model for the Yellow Sea - an area of operational interest.
- (U) Delivered a global ocean high-resolution eddy-resolving model for testing and operational evaluation; this represents a key step toward the goal of achieving a global ocean prediction system.
- (U) Developed new initialization methods for all atmospheric prediction models to enhance continuous assimilation of unconventional data.
- (U) Converted atmospheric prediction models to massively parallel processing machines to take advantage of their potential for greatly increased computational speed.
- (U) Continued atmospheric modeling of aerosols and improved non-hydrostatic model parameterization.
- (U) Further developed artificial intelligence and neural network techniques to extract atmospheric parameters of tactical importance from remotely-sensed data.
- (U) Initiated effort to determine utility of tactical radar systems for real-time, localized weather description as a means of contributing to ship self-defense and strike warfare.
- (U) Conducted development and integration of the Polar Ozone and Aerosol Measurement (POAM) sensor, which is scheduled for launch aboard a French satellite in the fall of 1997; POAM data will have significance for communications, theater defense, and surveillance.

• (U) ($4,820) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS:
- (U) Transitioned the full vertical extent version of the radio physical optics model that incorporates terrain effects; this model will enable better performance assessments in complex ocean-land coastal regions.
- (U) Completed demonstration of the determination of atmospheric moisture profiles using Global Positioning Satellite signals of opportunity; this is an important advance in the ability to easily determine

atmospheric moisture, which influences the performance of all weapon and sensor systems using EM propagation.

- (U) Delivered algorithm to estimate height of surface trapping layer above the ocean surface from remotely-sensed data; this provides a breakthrough in the ability to estimate a critical environmental characteristic that affects the detection of sea-skimming missiles.
- (U) Conduct a major coastal field experiment off the US west coast (Electro Optical Propagation and Aerosol Characterization Experiment - EOPACE) to characterize EO transmission and coastal aerosol distributions.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2

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

3. (U) FY 1997 PLAN:

- (U) ($16,919) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS (INCLUDES CONGRESSIONAL PLUS-UP OCEAN CLIMATE RESEARCH):
  - (U) Transition 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) Develop and validate an environmentally-based method for clutter control in SW to advance the capabilities of underwater active acoustic detection techniques.
  - (U) Evaluate 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) Conduct a field test of predictions based on stochastic propagation formalisms to determine whether the stochastic approach can adequately represent acoustic conditions in harsh SW environments.
  - (U) Perform 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) Demonstrate 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) Derive semi-empirical relationships linking acoustic variability with ocean variability.
  - (U) Extend the SW scattering function model used in torpedo G&C to muddy bottoms; update the time, frequency and spatial coherence models using trial data.
  - (U) Utilize underwater acoustic techniques to determine the ocean climate in a large ocean basin.

- (U) ($24,391) ENVIRONMENTAL INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY (INCLUDES CONGRESSIONAL PLUS-UP SENSING SYSTEMS AND UNMANNED UNDERWATER VEHICLES (UUVs)):
  - (U) Begin development of a semi-empirical formulation to predict lateral variability of high-frequency acoustic scattering in coastal areas and prepare to conduct further towed-body measurements to assess the spatial variability of high-frequency acoustic properties relevant to MCM operations in coastal areas.
  - (U) Use remote-sensing techniques to extend optical characterizations for MCM systems to high interest areas outside the continental US; evaluate surface effects on optical MCM system performance.
  - (U) Conduct experiment to demonstrate the environmentally enhanced performance of magnetic MCM systems.
  - (U) Make an identification of the fluid flow parameters critical to the surf/swash zone mine/sediment interaction and develop an initial empirical model for the interaction.
  - (U) Complete the preliminary development of a three-phase constitutive model for sands to advance the environmental base on which explosive techniques of mine clearance will depend.
  - (U) Analyze data from the previous measurements to determine the influence of bubbles on acoustical and optical MCM systems.
  - (U) Transition tactical decision support functions to produce worldwide surf statistics, real-time surf data and amphibious vehicle operability data.
  - (U) Provide an upgraded coherence model to the MCM development community for insertion into the synthetic aperture sonar system performance prediction model.
  - (U) Continue use of simulations to determine environmental sensitivities of systems and sensors that support mine warfare and amphibious warfare.
  - (U) Implement moored, low-cost mini-Acoustic Doppler Current Profiler technology to enable an affordable means of monitoring current structures in littoral regions.
  - (U) Complete development of the PHILLS sensor and initiate characterization of the sensor capabilities in the coastal ocean.
  - (U) Complete a littoral warfare environmental simulation capability including high-resolution circulation, wave, tidal and acoustic models in the tactical oceanographic simulation laboratory and support coastal simulations for joint undersea warfare.
  - (U) Continue development of environmental sensor technologies that contribute to remote semi-autonomous

and autonomous ocean measurement; develop plans for further mapping of ocean structure.

- (U) ($13,154) OCEAN AND ATMOSPHERIC PREDICTION: (INCLUDES CONGRESSIONAL PLUS-UP POAM)
  - (U) Deliver 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) Demonstrate a coastal tide prediction model capable of assimilating water level data and ocean current measurements; tide prediction is an essential environmental capability for successful littoral operations.
  - (U) Demonstrate 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) Continue 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) Demonstrate new ensemble forecasting methods for atmospheric prediction as a means of yielding not only a forecast but a likely range of possibilities.
  - (U) Provide standards for incorporation of atmospheric parameters in Navy simulators.
  - (U) Develop synthetic atmospheric environments for use in Navy training, systems testing, and tactical simulations.
  - (U) Continue effort aimed at utilization of tactical radar systems for real-time, localized weather description and as providing input to on-scene mesoscale prediction models.
  - (U) Continue efforts aimed at integration of the POAM sensor for launch aboard a french satellite.

- (U) ($4,900) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS (INCLUDES EARMARK CONGRESSIONAL PLUS-UP PM-10):
  - (U) Extend the Navy aerosol model into the ocean surface layer (below 10m) which plays a critical role in the detection of sea-skimming missiles; continue further development of aerosol distribution capabilities including efforts aimed at particulate matter less than 10 microns in diameter (PM-10).
  - (U) Develop a model of cloud edge effects to reduce false alarm rates in infra-red detection systems.

- (U) Deliver an airborne hybrid radio propagation model to improve EM propagation prediction for airborne platforms.
- (U) Continue the EOPACE field experiment at an east coast location, include an aerosol data system.

- (U) ($13,000) NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM (NOPP) (CONGRESSIONAL PLUS-UP):
  - (U) Establish 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) Solicit proposals through a Broad Area Announcement for partnership programs involving federal agencies, academia, industry, and other members of the oceanographic scientific community.
  - (U) Establish 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) Establish 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) Establish broad-based partnership efforts in areas such as: effects of algal blooms; mechanisms of cross-shelf transport; transport, fate, and effects of arctic ocean and coastal atmospheric contaminants; effects of sound and marine mammals.

- (U) ($1,052) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance with 15 U.S.C. 638.

4. (U) FY 1998 PLAN:

- (U) ($10,679) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:

- (U) Continue to advance the capabilities of active acoustic techniques for undersea surveillance in SW 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 SW on tactical frequency acoustic propagation, surface duct leakage, and vertical/horizontal coherence in SW.
- (U) Develop techniques for acoustic/nonacoustic fusion performance prediction for nonstationary noise fields in SW 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 environmentally enhanced, volumetric, acoustic surveillance arrays for locating and tracking quiet threats in SW environments.
- (U) Initiate the development of geo-acoustical inversion algorithms to improve the performance of environmentally enhanced signal processing algorithms for undersea surveillance.
- (U) Participate in international program to conduct high-frequency acoustic measurements in SW off Australia; the aim is to characterize effects of the environment on detection, classification and localization of small, quiet submarines.

• (U) ($17,525) ENVIRONMENTAL INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY:
- (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) Conduct field experiment to test environmental 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 environmental data for performance prediction.
- (U) Begin task of describing distribution as well as bulk per-cent 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
- (U) Develop a predictive model of mine migration/burial within the SZ based upon the previous year s field study. Initiation of a study of morphological stability assessing the stationarity of sandbar structures; this work will facilitate prediction of the probability of burial for large (stationary) anti-landing mines in 3-6 feet of water. Additionally, this work is useful for the assessment of the meaningfulness of previously obtained bathymetry, based on the predicted stationarity of the sandbar.
- (U) Continue assessments of techniques for optical characterization of environments to serve MCM, especially in terms of variety of environments.
- (U) Analyze data and report results of FY 97 experiment on SW, high-frequency acoustics bubble effects, especially as they impact MCM systems.
- (U) Apply interim bubble/acoustics models to FY 97 SW 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 SW 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 environmental descriptions.
- (U) Make investment strategy suggestions relating to accuracies and space/time resolutions of ocean descriptions based on Korean and Persian Gulf environments.
- (U) Develop fully-coupled nonlinear wave/tide model with data assimilation and incorporate into system performance models.

- (U) ($10,388) 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 tactical radar to detect clear air turbulent features in the marine atmosphere using advanced processing techniques for coded waveforms.
- (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.

• (U) ($4,619) ATMOSPHERIC INFLUENCES ON EM/EO SYSTEMS:
- (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) ($5,000) NOPP:

- (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 basis 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) Continue broad-based partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences and education.

4. (U) FY 1999 PLAN:

- (U) ($11,225) ENVIRONMENTAL ISSUES IN UNDERSEA SURVEILLANCE AND WEAPONS:
  - (U) Demonstrate environmental adaptation techniques for in-situ, near-real-time reverberation assessmen and clutter control, optimizing sonar operation in complex, SW 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 SW 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 environmental such as straits and gulfs.
  - (U) Complete validation of high frequency underwater acoustic noise models and conduct experimental of the false-alarm/classification-error performance of newly developed noise exploitation algorithms.
  - (U) Demonstrate performance improvements of environmentally enhanced signal processing algorithms using geo-acoustical inversion techniques.
  - (U) Perform detailed analyses of high-frequency acoustic data obtained in several SW locales with the purpose of creating a unified basis for undersea weapon performance prediction in SW.

- (U) ($20,433) ENVIRONMENTAL INFLUENCES ON MCM SYSTEMS, INCLUDING LITTORAL OCEANOGRAPHY:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Oceanographic and Atmospheric Technology

- (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 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) 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 environmental data 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 environments.
- (U) Evaluate the Predictive Visibility Model in terms of performance in various environments and determine the feasibility of improvements to the model to provide the environmental basis for optical MCM systems.
- (U) Conduct final and comprehensive experiment on influence of bubbles in SW 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 SW 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 environment to provide an upper bound for the statistical characterization of bottom clutter which will be utilized in the clutter model.

- (U) Adapt physics-based mission/tactics analysis model for use in higher level analyses, like war games, training, trade-off studies, investment decisions, etc.

- (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 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) ($4,707) 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.

- (U) Transition improved EM propagation effects decision aids incorporating terrain, surface clutter, airborne platforms, etc, thus expanding the capability to assess environmental effects on radar systems.

- (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 broad-based partnership efforts in oceanography to optimize resources, intellectual talent, and facilities in ocean sciences and education.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	56,576	44,559	47,254	53,011
(U) Adjustments from FY 1997 PRESBUDG:	+684	+28,857	+957	+5,026
(U) FY 1998/1999 President s Budget Submission:	57,260	73,416	48,211	58,037

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 changes resulted in a reductions for the Jordanian F-16 financing rescission (-65); from Transfer of SBIR funds (-293); and actual execution (+1,042). The FY 1997 increase resulted from Congressional plus-ups for Sensing Systems/UUVs (+10,000); NOPP (+13,000); Polar Ozone Atmospheric Monitor (+4,000); Ocean Climate Research (+5,000); and from Congressional Undistributed Reductions (-3,143). FY 1998 increase consists of

realignment of funding (-2,000); NWCF and minor adjustments (-3,687); Defense Science and Technology adjustment (+1,685); from NOPP (+5,000); from inflation adjustments (-126); and from Military and Civilian Pay Rate adjustments (+85). FY 1999 increase consists of transferred from this P.E. to Advanced Technology Demonstrations P.E. (-4,000) to fund higher Navy priorities; from NWCF and minor adjustments (-868); from NOPP (+10,000); from inflation adjustments (-216); and from Military and Civilian Pay Rate adjustments (+110).

(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 Weapon 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

BUDGET ACTIVITY: 2 | PROGRAM ELEMENT: 0602633N | DATE: February 1997
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE WEAPON TECHNOLOGY

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
UNDERSEA WARFARE WEAPONS TECHNOLOGY	32,021	36,821	35,736	38,304	39,170	39,960	40,817	41,799	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program focuses on undersea warfare in support of future Joint Warfighting Capabilities endorsed by the Joint Chiefs of Staff, namely: (1) developing a range of tactical Anti-Submarine Warfare (ASW) capabilities that could be employed at the lower end of the full range of military operations with minimum risk of casualties or collateral damage to friendly forces, and (2) developing a robust world-wide capability for neutralizing undersea threats in decisive conflict, also with minimal casualties or collateral damage. Projects support the development of technologies associated with undersea target neutralization, force unit survival and undersea tactical control relating to the Joint Mission Areas (JMAs) of: Joint Littoral Warfare, Joint Strike, and Forward Presence/Deterrence. Specifically:

(U) Joint Littoral Warfare is concerned with dominating the undersea battlespace to enable timely execution of joint/combined operations and to ensure joint force sustainability. Programs address improved shallow-water operation, tactical control, torpedoes, torpedo countermeasures and hard-kill devices for surface battleforce and submarine self defense.

(U) Joint Strike concerns the application of precision offensive military force. Programs address new explosives for enhanced target damage effectiveness, and sensors and countermeasures to detect and neutralize undersea threats to the surface battleforce.

(U) Forward Presence/Deterrence concerns preserving our nuclear deterrent capability and developing an enhanced conventional warfare ballistic missile capability. Programs address improved SSBN self defense weapons.

(U) Success in neutralizing undersea threats to both submarines and surface ships not only requires successful detection, classification, localization and tracking but also must culminate in an effective weapon which removes the threat and denies

use of the battlespace to the enemy.

(U) These efforts support the naval portion of the Joint Warfare Strategy as expressed in "Forward...From the Sea." While this program's components are primarily service (Navy) unique, explosives and warheads programs are jointly planned and monitored with the Army and Air Force under the Reliance process through the Joint Directors of Laboratories Technical Panel on Conventional Air/Surface Weaponry.

(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 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.

B. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1.(U) FY 1996 ACCOMPLISHMENTS:

- (U) ($8,200) GUIDANCE & CONTROL (G&C):
  --(U) Conducted in-water test of shallow water countermeasure algorithms and [classified material deleted].
  --(U) Performed at-sea test of an [classified material deleted].
  --(U) Began development of robust, high fidelity simulation models that reduce dependence on expensive in-water testing for weapons development and validation.
  --(U) Demonstrated coherent intersensor processing using [classified material deleted] signal processing combined with [classified material deleted] processing to improve post-launch classification and localization.
  --(U) Demonstrated [classified material deleted] to detect and classify false and real targets.
  --(U) Transitioned [classified material deleted] to the Shallow Water Advanced Technology Demonstration (ATD).
  --(U) Completed shallow water experiment [classified material deleted].

- (U) ($6,400) PROPULSION:
  --(U) Conducted laboratory tests of HYDROX energy and energy conversion subsystems.
  --(U) Completed high pressure liquid perchlorate pump development for an environmentally-benign torpedo propellant replacement for Otto Fuel II.
  --(U) Demonstrated ignition and stable combustion of aluminum with both air and steam in a vortex combustor.
  --(U) Conducted laboratory tests of a complete, long-endurance (100 hour), wick Combustor, Rankine-Engine power source for unmanned undersea vehicle (UUV) applications.
  --(U) Evaluated and tested new metal-oxide cathode materials for an undersea vehicle rechargeable battery.
  --(U) Improved cell performance and safety features of 100 Ah rechargeable lithium/cobalt oxide undersea vehicle propulsion battery module.
  --(U) Completed the development of the Electrolyte Management System for the high power/energy density aluminum semi-fuel cell.
  --(U) Completed candidate fuel combustion testing and conducted engine tests using environmentally-benign fuel, and transition to Weapon Advanced Development.

- (U) ($4,548) UUV & SILENCING:
  --(U) Completed at sea vehicle stability testing above 4 knots of the low speed nonlinear "sliding mode" autopilot controller that provides stable vehicle operation in energetic ocean environments for advanced mine countermeasure and surveillance sensors.
  --(U) Conducted first at sea performance test of fault tolerant mission controller to enhance vehicle reliability and increase mission success rate.
  --(U) Demonstrated at sea on an UUV the precision velocity aided inertial navigation system and achieved an accuracy of 0.18% of distance traveled.
  --(U) Demonstrated affordable advanced undersea acoustic communications in the shallow water multipath ocean environment from a UUV. Data transmission rates exceeded 4 kilo-bits per second at 2.3 kilo-meters with an 8 knot Doppler. Transitioned the signal processing algorithms to the Tactical Advanced Communications ATD (6.3) program.
  --(U) Completed testing of the lightweight, quiet, composite hull for a 21 inch diameter vehicle.
  --(U) Demonstrated the automated launch and recovery of a tethered UUV from an SSN 688 submarine.
  --(U) Initiated advanced capabilities (ADCAP) gas exhaust quieting analysis, and concept and technology assessment.

- (U) ($7,295) COUNTERWEAPON AND COUNTERMEASURES:
  --(U) Incorporated [classified material deleted] in 6.25 inch diameter test vehicles and conduct at-sea testing [classified material deleted].
  --(U) Conducted land-based and at-sea evaluation of [classified material deleted].
  --(U) Completed real-time countermeasure design and development system and installed in test-bed.
  --(U) Initiated transfer of technology designs, drawings, and data into the submarine torpedo defense (SMTD) system (PMS 415).
  --(U) Completed classification algorithms and continuing development of localization algorithms for the multi-beam torpedo rapid automatic classification system (MTRACS) to enable full use of combined submarine towed and spherical array data for torpedo detection, classification and localization.
  --(U) Conducted laboratory demonstrations of real-time capable algorithms for parameter extraction, decision logic, and signal generation for smart acoustic countermeasures.
  --(U) Initiated boardband signal processing technologies for SSTD to be used in classifiers.

- (U) ($1,815) COMBAT CONTROL:
  --(U) Completed development of platform torpedo-defense tactical decision aids for [classified material deleted] employment.
  --(U) Completed development of a set of decision aids which reduce false alarms in the tactical scene through the use of advanced multiple-hypothesis pruning techniques.
  --(U) Completed development of a tactical decision aid that displays the theoretical lower bound of target tracker performance and assists in planning ship maneuvers and sensor deployments to support target tracking and transition to the Joint Tactical Control Advanced Development Program's Advanced Development Model.
  --(U) Developed and demonstrated intelligent data integration technique for weapon tracking adaptable to low data rate processing.

- (U) ($3,763) WARHEADS AND EXPLOSIVES:
  --(U) Transitioned advanced (bubble) damage mechanism for ASW to the Naval Sea Systems Command (NAVSEA) Submarine Design & System Engineering Program.
  --(U) Continued development and transition to the Program Executive Officer (Undersea Warfare) (PEO/USW) Torpedo Program a first generation computational capability to predict submarine vulnerability.

--(U) Demonstrated advanced underwater bubble explosive with 56% greater bubble energy than PBX-103 for heavyweight torpedoes.
--(U) Developed notional design for micro-electromechanical system (MEMS) safe & arm for application to all mine and underwater weaponry.
--(U) Demonstrated torpedo vulnerability assessment model for submarine self defense.

2.(U) FY 1997 PLAN:

- (U) ($ 8,100) G&C:
--(U) Conduct shallow water demonstration of the [classified material deleted] to detect, classify and discriminate targets in a shallow water environment. Transition this technology to the Shallow Water ATD.
--(U) Transition the real-time architecture for [classified material deleted] to the MK 48 ADCAP Torpedo.
--(U) Initiate an effort to include [classified material deleted].
--(U) Continue development of [classified material deleted].
--(U) Integrate the wideband array with the G&C system and conduct in-water technology demonstration of the shallow water target detection and classification algorithms, new sensor processing and data fusion, and environmentally adaptive signal processing.
--(U) Continue Simulation Based Design modeling effort and include signal processing and intelligent controller functions.
--(U) Initiate [classified material deleted] G&C technology using [classified material deleted].

- (U) ($6,300) PROPULSION:
--(U) Continue development of the 21 inch diameter HYDROX undersea thermal power source.
--(U) Complete laboratory tests of the wick-Rankine long-endurance thermal power plant, and initiate development of wick-stirling system.
--(U) Continue development of aluminum semi-fuel cells evaluating candidate liquid catholytes.
--(U) Fabricate 100 Ah lithium/cobalt oxide batteries for an undersea vehicle propulsion system demonstration.
--(U) Evaluate rechargeable battery technologies for low-cost propulsion systems for undersea vehicles.

- (U) ($4,800) UUVS & SILENCING:
--(U) Conduct at sea demonstration of efficient, quiet Thrust Vectored Pumpjet propulsor on a 21 inch diameter

UUV testbed.
--(U) Conduct at sea adaptive control performance test, from 4 to 8 knots, of the low speed nonlinear "sliding mode" autopilot controller which compensates for changes in ocean environments and vehicle dynamics in order to maintain stability and precise trajectories in energetic ocean environments.
--(U) Perform at sea performance test of the fault detection and compensation mission controller in order to increase vehicle reliability and mission success rate.
--(U) Initiate an analysis and develop a computer model of an affordable full volume UUV submarine launch and recovery system that has a minimum impact on submarine modifications and operations.
--(U) Demonstrate at sea on a UUV an in-stride satellite position fix using Global Positioning System (GPS), in order to bound the errors of the precision velocity aided inertial navigation system which is needed to perform mine reconnaissance and vehicle recovery.
--(U) Demonstrate at sea affordable half duplex undersea acoustic communications between launch platform and UUV, for offboard signal processing, target classification and identification, and UUV monitoring and control.
--(U) Perform signature testing in order to characterize the sources of electro-magnetic radiation, in order to enhance sensor performance, increase platform and submarine stealth and reduce target vulnerability.
--(U) Identify affordable, practical methodologies for quieting MK48 ADCAP Torpedo gas exhaust.

- (U) ($2,500) Semi-autonomous Underwater Vehicle (Congressional Add):
  --(U) Develop a control methodology for performing complex tasks using a remote robotic arm in an undersea environment. Experimentally validate system through at-sea testing.

- (U) ($593) Small Business Innovation Research (SBIR):
  --(U) Portion of extramural program reserved for SBIR assessment in accordance with 15 U.S.C. 638.

- (U) ($8,678) COUNTERWEAPON AND COUNTERMEASURES:
  --(U) Continue modeling and simulation development and evaluation of [classified material deleted].
  --(U) Initiate [classified material deleted] technologies for SSTD.
  --(U) Complete development of localization algorithms and conduct at-sea test of MTRACS.
  --(U) Conduct testing of smart, adaptive algorithms to demonstrate an effective acoustic torpedo countermeasure capability in countermeasure in-water testbed.
  --(U) Continue development of broadband feature classifiers for SSTD and initiate noise normalization methods.

--(U) Conduct in-water data gathering experiment to measure complete bubble size density profile in a surface ship wake to better understand the wake environment.
--(U) Design and evaluate enhanced Stored Chemical Electric Propulsion (SCEPS) and thruster for 6.25 inch diamenter quick reaction offensive/defensive weapon. (Congressional Add $2 million)

- (U) ($2,050) COMBAT CONTROL:
  --(U) Demonstrate combined simulated annealing and knowledge-based system for improved targeting.
  --(U) Implement and test intelligent data integration demonstration system for tactical scene generation.
  --(U) Transition the extended ADCAP weapons order generation to provide torpedo presets for an evading target.
  --(U) Transition platform torpedo-defense tactical decision aids for acoustic countermeasure employment to the Joint Tactical Control Advanced Development Program's Advanced Development Model.

- (U) ($3,800) WARHEADS AND EXPLOSIVES:
  --(U) Initiate modeling effort for detailed explosive damage effects.
  --(U) Initiate the development of new composite explosive formulations to achieve at least 20% enhanced shock over PBX-103 for Lightweight Hybrid Torpedo and submarine defense.
  --(U) Transition methodology for assessing torpedo defense systems to SSTD Joint Program Office.
  --(U) Continue development of hybrid MEMs-based safe and arm device for all undersea weapons.

3.(U) FY 1998 PLAN:

- (U) ($ 9,195) G&C:
  --(U) Complete [classified material deleted] and detection technologies for false and real targets in shallow water.
  --(U) Complete [classified material deleted] for enhanced homing performance in shallow water.
  --(U) Demonstrate [classified material deleted] configuration for classification enhancement.
  --(U) Evaluate active sonar test of Bidynamic Processing for improved shallow water performance.
  --(U) Complete broadband transducer design for broadband G&C efforts.
  --(U) Conduct Prototype Intelligent Controller (PIC) environmental exploitation experiment.
  --(U) Transition [classified material deleted] technologies to the MK48 ADCAP torpedo.

- (U) ($7,000) PROPULSION:
  --(U) Evaluate cell performance of high performance, low-cost rechargeable battery for undersea vehicle applications.
  --(U) Fabricate 21-inch HYDROX high energy/power density thermal system.
  --(U) Complete combustor and thruster testing for a pilot scale aluminum-seawater vortex combustor.
  --(U) Continue Stirling engine development for use with wick combustor as a long endurance energy source.
  --(U) Continue development of most promising liquid catholyte aluminum semi-fuel cell.

- (U) ($4,140) UUVS:
  --(U) Initiate design of a compact, integrated Motor/Rotor propulsor for a 21 inch diameter UUV for increased payload and energy.
  --(U) Perform at sea stability test of the low speed nonlinear "sliding mode" autopilot controller, from hover to 4 knots, in order to validate the enhanced performance of sensors and precise trajectory control.
  --(U) Perform at sea test of the fault tolerant mission controller to increase the reliability of the navigation and propulsion systems.
  --(U) Develop a launch and recovery computer hydrodynamic model for the design, development and conceptual testing of new affordable full volume submarine launch and recovery systems, which have minimum impact upon the submarine and are compatible with NSSN.
  --(U) Perform at sea performance test of low cost, covert, precision geophysical gravity field navigation system for stealth, energy savings and affordability.
  --(U) Perform at sea performance test of advanced equalization algorithms which characterize the acoustic transmission channel, for the affordable high rate undersea acoustic communications shallow water system.
  --(U) Develop a computer model, for test purposes, of the electric and magnetic signatures of the UUV for simulation based design of low signature vehicles and subsystems for increased stealth of vehicle and submarine, and reduced vulnerability to targets.

- (U) ($7,445) COUNTERWEAPON AND COUNTERMEASURES:
  --(U) Continue development of technologies for physical understanding of surface ship wake characteristics.
  --(U) Demonstrate SSTD fuzing technologies for counterweapon.
  --(U) Demonstrate the smart, adaptive countermeasure (SACM) in real-time hardware-in-the-loop land-based tests and in-water tests.

--(U) Initiate development of interference rejection algorithms for robust torpedo DCL.
--(U)Transition [classified material deleted] diameter vehicles to the Anti-Torpedo Torpedo ATD for surface ship and submarine applications (PE 0603792N).

- (U) ($2,600) COMBAT CONTROL:
  --(U) Develop uncertainty algorithms for active/passive multisensor data integration.
  --(U) Extend algorithms incorporating landmass constraints to multiple contact tracking.
  --(U) Integrate post-launch torpedo guidance algorithms into the Vehicle Management testbed.
  --(U) Transition multi-sensor torpedo classifier aid to Tactical Control Program.
  --(U) Demonstrate Automated Planning and Evaluation System for SSTD.

- (U) ($4,300) WARHEADS AND EXPLOSIVES:
  --(U) Demonstrate and transition to PEO/USW Torpedo Program predictive capability for underwater explosive damage to double-hulled submarines.
  --(U) Demonstrate "hybrid" MEMS safe & arming device utilizing commercial off-the-shelf (COTS) MEMS based sensors and conventional actuators for torpedo applications.
  --(U) Initiate development of high energy composite explosive based upon boron fuel using fluorinated oxidizers and polymeric binder systems for undersea weaponry applications.

- (U) ($1,056) SILENCING:
  -- (U) Design, develop and fabricate MK48 ADCAP torpedo quiet exhaust system.

5.(U) FY 1999 PLAN:

- (U) ($ 9,700) G&C:
  --(U) Evaluate hybrid classification architecture with in-water data base.
  --(U) Demonstrate [classified material deleted] using the PIC.
  --(U) Conduct multi-sensor data fusion test.
  --(U) Complete and evaluate [classified material deleted] for improved G&C in shallow water.
  --(U) Test and evaluate [classified material deleted] and [classified material deleted] technology for shallow water application.

- (U) ($7,500) PROPULSION:
  --(U) Full size electrode development of high performance, low-cost rechargeable battery for undersea vehicle applications.
  --(U) Conduct laboratory testing of the 21 inch HYDROX high energy/power density thermal system.
  --(U) Complete brassboard development of aluminum-seawater vortex combustor propulsion and transition to Weapon Advanced Development.
  --(U) Complete Stirling engine development for use with wick combustor and UUV energy source.
  --(U) Evaluation of most promising aluminum semi-fuel cell which meets LMRS energy requirements.

- (U) ($4,200) UUVS:
  --(U) Fabricate compact integrated Motor/Rotor propulsor for a 21 inch diameter UUV for increased volume (payload).
  --(U) Conduct at sea performance test, from hover to 4 knots, of adaptive low speed nonlinear "sliding mode" autopilot controller, for optimizing stability and trajectory control when changes in ocean environments and vehicle dynamics occur and transition to potential Longterm Mine Reconaissonce System (LMRS) improvements.
  --(U) Develop a full scale model, for design and test purposes, of the affordable maximum volume covert submarine UUV launch and recovery subsystem, which minimizes the impact on the submarine modifications and operations.
  --(U) Develop a computer model for the design of an affordable precision gravity based navigation system for stealth and energy savings.
  --(U) Develop and demonstrate at sea a full duplex undersea acoustic communications system for mine reconnaissance and surveillance missions using UUV.

- (U) ($1,178) SILENCING:
  --(U) Conduct in water performance test of passive and active control electric and magnetic signature reduction methods for maintaining submarine and vehicle stealth and reducing target vulnerability.
  --(U) At sea test and transition of MK48 ADCAP Torpedo quiet exhaust system.

- (U) ($7,880) COUNTERWEAPON AND COUNTERMEASURES:
  --(U) Transition SSTD technologies to PMS 427 and PMS 406 for inclusion in Lightweight Hybrid torpedo.
  --(U) Demonstrate homing and fuzing performance of counterweapon in the bubbly wake.

--(U) Demonstrate air dropped scenario performace with 6.25 inch counterweapon.
--(U) Transition Smart, Adaptive, Countermeasure Technologies to PMS 415.

- (U) ($2,946) COMBAT CONTROL:
  --(U) Test tracking algorithms with landmass constraints with recorded sea test data.
  --(U) Integrate Automated Planning and Evaluation System for torpedo defense into Tactical Control Program.
  --(U) Incorporate own platform noise characteristics into ownship survivability measures.
  --(U) Integrate weapon performance prediction algorithms into Vehicle Management System testbed.

- (U) ($4,900) WARHEADS AND EXPLOSIVES:
  --(U) Transition validated second generation hydrocode with parallelized architecture resulting in order of magnitude reduction in solution time.
  --(U) Develop new high shock underwater explosive formulations based upon novel boron fuel and fluorinated oxidizers concept.
  --(U) Transition robust in-wake fuzing concept to Lightweight Hybrid Torpedo.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

BUDGET ACTIVITY: 2 | PROGRAM ELEMENT: 0602633N | DATE: February 1997
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE WEAPON TECHNOLOGY

B.(U) PROGRAM CHANGE SUMMARY

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	33,158	33,891	36,345	39,061
(U) Adjustments from FY 1997 PRESBUDG:	-1,137	+2,930	-609	-757
*-FY 1998/1999 PRESBUDG Submit:	32,021	36,821	35,736	38,304

(U) CHANGE SUMMARY EXPLANATION:

(U) FUNDING: FY 1996 adjustments reflect an Administrative and Personnel Rescission (-147K), Jordanian F-16 financing rescission (-38K) and actual execution adjustments (-952K). FY 1997 adjustments reflect two Congressional adds for Semi-Autonomous Underwater Vehicle (+2,500K) and Quick Reaction Offensive/Defensive Weapon (+2,000K) and include reductions for Congressional Undistributed Reductions (-1,570K). Funding adjustments for FY 1998 reflect Navy Working Capital Fund (NWCF) and minor adjustments (-609K). FY 1999 adjustments reflect NWCF and minor adjustments (-757K).

(U) SCHEDULE: Not applicable.

(U) TECHNICAL: Beginning in FY 1996, the THERMAL PROPULSION, ELECTRIC PROPULSION AND G&C Tasks are reorganized to PROPULSION, G&C AND UUVS & SILENCING in order to more closely group the efforts along technology lines. The PROPULSION task now supports high rate (torpedo) and moderate rate (UUV) and target propulsion technology efforts; the G&C task now supports torpedo and UUV G&C technology efforts; and the UUVS & SILENCING task now supports UUV and weapons platform technology efforts.
(U) Beginning in FY 1998, the UUVs & SILENCING task will be separated into two tasks. The UUVs task will continue to address all UUV technology including platform specific quieting, while the SILENCING task will focus on torpedo silencing technology.

(U) RELATED ACTIVITIES:
(U) PE 0101224N (SSBN Security and Survivability Program)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

BUDGET ACTIVITY: 2 | PROGRAM ELEMENT: 0602633N | DATE: February 1997
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE WEAPON TECHNOLOGY

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602111N (Air and Surface Weapons Technology)
(U) PE 0602121N (Surface Ship and Submarine HM&E Technology)
(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
(U) PE 0602435N (Ocean and Atmospheric Technology)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603747N (Undersea Warfare Advanced Technology)
(U) PE 0603792N (Advanced Technology Transition)

(U) This program adheres to Tri-Service Reliance Agreements on Conventional Air/Surface Weaponry--in particular, in the areas of G&C and of explosives--with oversight provided by the Joint Directors of Laboratories.
Work is fully coordinated with efforts in accordance with the ongoing Reliance joint planning process with the following PEs:
(U) PE 0602602F (Conventional Munitions)
(U) PE 0602624A (Weapons and Munitions Technology)
(U) PE 0603226E (Experimental Evaluation of Major Inovative Technology (EEMIT))
(U) PE 0603601F (Conventional Weapons Technology)
(U) PE 0603609F (Insensitive Munitions Advanced Development)

(U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R0446 Maritime Avionics Subsystems and Technology (MAST)	9,464	3,672	0	0	0	0	0	0	0	23,044
R0447 Weapons Advanced Technology	7,649	21,841	23,838	24,154	29,925	30,616	31,304	32,022	CONT.	CONT.
R2264 Air Systems Affordability	0	3,198	3,617	5,652	5,464	5,485	5,536	5,591	CONT.	CONT.
R2282 CINC (Tech for Rapid Response)	8,466	0	0	0	0	0	0	0	0	8,466
R2327 Integrated High Payoff Rocket Propulsion Technology (IHPRPT)	0	959	0	0	0	0	0	0	0	959
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	6,262	7,079	7,638	7,735	7,871	7,995	8,165	8,352	CONT.	CONT.
W2185 Advanced Anti-Radiation Guided Missile (AARGM)	33,097	0	0	0	0	0	0	0	0	57,712
TOTAL	64,938	36,749	35,093	37,541	43,260	44,096	45,005	45,965	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 Joint Strike, Joint Littoral Warfare, and Joint Intelligence Surveillance and Reconnaissance. Projects in this PE are jointly planned in the Reliance process with the Air Force and Army through panels of the Joint Directors of Laboratories.

(U) Joint Strike technology issues relevant to this PE include surgical lethality, platform survivability and 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. Joint Intelligence Surveillance and Reconnaissance technology issues relevant to this PE include platform mission endurance and survivability. Six projects are contained in the PE:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) Maritime Avionics Subsystems an Technology (MAST): A FY 95 short term new start, multi-faceted program maturing integrated modular avionics concepts and coordinated endeavors towards common avionics. Focused on scaleable, open, fault tolerant and common avionics architecture along with multifunction sensors and subsystems. Program thrusts addressed either Navy-specific applications or technological areas where the Tri-Services have agreed on a Navy lead.

(U) Weapons Advanced Technology: Demonstrates emerging sub-system/component level weapons concepts identified in PE 0602111N which promise affordable and significant performance improvements to both existing and next generation Naval air and surface launched weapons.

(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) Rapid Response Technologies: A FY 1996, Congressionally directed increase geared to making emerging technologies more readily available to the fleet.

(U) AARGM: A Congressionally mandated program that will demonstrate advanced missile/seeker technologies to support the delivered accuracy of future stand-off weapons.

(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, 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R0447 Weapons Advanced Technology	7,649	21,841	23,838	24,154	29,925	30,616	31,304	32,022	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project has been renamed and expanded. The project was originally named Electromagnetic Radiation Source Elimination (ERASE). This renamed project includes the elements contained in the original ERASE program while providing additional risk reducing demonstrations of emerging weapon guidance and control, ordnance, propulsion and airframe sub-system/component level technologies identified in Applied Research which promise affordable performance improvements to existing and next generation Navy air and surface launched weapons. The elements of this project address the Joint Mission Area (JMA) requirements for increased capabilities in the surgical lethality of weaponry (Strike JMA), increased ship self-defense capabilities (Littoral Warfare JMA) and increased accuracy and range for Naval gunfire support (Strike and Littoral JMAs). Included in this project is a focused thrust for both emitter location and defense suppression missile technologies, the requirements for which are documented in the Navy's Strike Warfare Master Plan and Conventional Munitions Plan.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($2,746) Advanced Anti-Raditaion Missile (ARM) Guidance Demonstration (AAGD):
  (U) Initiated:
  - (U) Study of low frequency antenna concepts.
  - (U) Development of aimpoint selection and sensor fusion processor specifications.

- (U) Development of flight test plan.
- (U) Anti-Radiation Homing (ARH) receiver Software Code Generation and Fabrication.

(U) Continue:
- (U) Integration of ARH and terminal sensor.
- (U) Bench and Anechoic Chamber Testing of Integrated Radio Frequency (RF) Receiver and Conformal Antenna.
- (U) Design of ARH wideband active phased array.
- (U) Integration of digital signal processor with ARH receiver.

(U) Complete:
- (U) ARH receiver fabrication and testing.
- (U) Procurement and fabrication of ARH processor.
- (U) Terminal sensor processing design.
- (U) ARH processor ADA software development.
- (U) Software design for terminal sensor processing.
- (U) Active array trade study and limited demonstration.

- (U) ($3,892) Cruise Missile Real Time Retargeting Demonstration:

(U) This new task represented the Navy portion of a Joint Air Force/Navy effort to develop a flight weight brassboard real-time guidance and control system using a laser detection and ranging seeker under development by the Air Force and a mission planning system based on technologies developed under Program Element (PE) 0602111N, Air and Surface Weapons, to demonstrate the following capabilities for future cruise missiles: immediate launch on coordinates capability, inflight decision making, on-board target identification, precise aimpoint selection, battle damage indication and in-flight coordinated attack and targeting flexibility against fixed, relocated or mobile targets.

(U) Initiated:
- (U) Development of a data base of laser detection and ranging images.
- (U) Flight testing laser detection and ranging devices over typical cruise missile flight profiles.
- (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) Development of mission planning procedures and software for strike planning, targeting and neural network training.

- (U) ($1,011) Surgical Strike Adaptive Video and Data Communications System:

(U) This new task developed and demonstrated advanced video compression and RF modulation/coding technology for a podless digital weapon control data link system for use in joint strike operations. This advanced weapon data link system, which is backward compatible with the current Aircraft Armament Flight Control (AWW)-13 system, greatly improves critical warfighting capabilities such as anti-jamming, target aimpoint selection, battle damage indication (BDI), control aircraft tactical maneuver flexibility, and real time retargeting. The podless system configuration significantly reduces aircraft Radar Cross Section (RCS) resulting in improved platform survivability for those missions where speed and stealth are critical. For those missions where maximum weapons load is critical, the podless system will free up an additional weapons station. Affordability is emphasized by maximizing the use of existing avionics systems and by using commercial design and production standards.

(U) Initiated:

- (U) Definition of preliminary system level performance requirements.
- (U) Definition of system level mechanical/electrical interface requirements.
- (U) Performance prediction analysis of weapon control data link system.
- (U) Technology/design tradeoff studies of antenna concepts, communication channels, RF architectures, RF modulation techniques, error control coding techniques, communication network techniques, and video compression techniques.
- (U) Assessment of video compression algorithms.

2. (U) FY 1997 PLAN:

- (U) ($1,641) AAGD:

  (U) Initiate:
  - (U) Analysis of integrated RF receiver and conformal antenna bench and anechoic chamber test data.

  (U) Continue:
  - (U) Integration of ARH and terminal sensor.

  (U) Complete:
  - (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) ($3,930) Cruise Missile Real Time Retargeting Demonstration:

  (U) Initiate:
  - (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) Continue:
- (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.
- (U) Flight testing of laser detection and ranging devices using the flight profile of potential transition weapons candidates. Build 1 Laser Detection and Ranging Devices (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) ($2,444) 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) 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) Continue:
  - (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) ($4,641) Concentric Canister Launcher (CCL):
(U) This task is a transition/continuation of a project selected through the Advance Technology Demonstration process, started in PE 0603792N in FY 1996, transitioned to this PE for continued long

term development and demonstration. This task will demonstrate a universal munitions launcher for Tomahawk, SM-2 Block IV, and Evolved Sea Sparrow Missile (ESSM). The technologies to be demonstrated involve missile fly out from a full scale launcher tube; validation, verification, computational design tools; and will demonstrate a distributed launch control system capable of simultaneous and coordinated launch of multiple missile types. This program will address reduced Life Cycle Costs through reducing manning, automated construction, and by utilizing a modular design.
(U) Initiate:
- (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 (NATACMS).
- (U) Design and build full scale steel NATACMS launcher.

(U) Complete:
- (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) ($3,421) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:
(U) This task is a transition/continuation of a project selected through the Advanced Technology Demonstration (ATD) process, started in PE 0603792N in FY 1996, transitioned to this PE in FY 1997 for continued long term development and demonstration. 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) Initiate:
- (U) System integration.
- (U) Test platform integration.
- (U) Subsystem lab and environmental testing.

(U) Continue:
- (U) Subsystem laboratory testing.

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

(U) Complete:

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

- (U) ($1,764) Shared Aperture:

(U) This task is a new task originally planned for PE 0603238N, "Precision Strike and Air Defense Advanced Technology", but was moved to this PE during the PR-97 review process. This task will demonstrate 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) Initiate:

(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.

3. (U) FY 1998 PLAN:

- (U)($2,905) AAGD:

(U) Initiate:

- (U) Chamber and Field Testing of the Integrated ARH Sensor, Terminal Sensor and Automatic Target Recognition (ATR) Processor

(U) Continue:

- (U) Preparation for Flight Testing
- (U) Perform the necessary Hardware and Software design modifications

(U) Complete:

- (U) Delivery of ATR Digital Processor and associated Algorithms
- (U) Complete initial integration of the ARH Sensor, Terminal Sensor and ATR Processor

- (U) ($4,060) Cruise Missile Real Time Retargeting Demonstration:

(U) Initiate:

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

(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.

(U) Complete:
- (U) Upgrade Low Cost Anti-Armor Submunition (LOCAAS) seeker with integrated Global Positioning System (GPS)/Inertial Measurement Unit (IMU) and resolvers to quantify image motion errors and take sequential frames of target aim points. Complete flight test, data collection and analysis.
- (U) Build 1 solid state LADAR delivered Jun 97. Build 2 is an affordable LADAR designed to accommodate the needs of Tomahawk, Standoff Land Attack Missile (SLAM) Pre-Planned Product Improvement (P3I), Joint Stand Off Weapon (JSOW) P3I, and Joint Air to Surface Standoff Missile (JASSM), and maximize commonality with Army and Air Force LADAR designs.
- (U) Demonstration of Build 1 LADAR in the HITL lab which includes the adaptive strike planning and fixed target automatic target recognition software, Tomahawk mission computer simulation, Navy Sattelite simulation, satellite data link simulation, and Tomahawk 6 Degrees of Freedom (DOF) and T-39 aircraft simulation.

- (U) ($4,949) 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) Integrate RF, modem, network control processor, and central processor modules into terminals.
- (U) Environmental/laboratory testing of terminals.

(U) Continue:
- (U) Refinement of system level performance requirements.
- (U) Performance prediction analysis of weapon control data link system.

(U) Complete:
- (U) Antenna design.
- (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) ($4,645) 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 will address reduced Life Cycle Costs through reducing manning, automated construction, and by utilizing a modular design.
  (U) Initiate:
  - (U) SM-2 Block IV Cannister Design and Fabrication.
  - (U) Hatch design and fabrication.
  - (U) Prototype launch system hardware fabrication.
  (U) Complete:
  - (U) Tomahawk full scale flyout and restrained firing tests.
  - (U) All up distributed control system demonstration
  - (U) Tomahawk CFD model validation.

- (U) ($4,400) Concurrently Engineered (CE) Ball-Joint Gimbal for Joint Strike Weapon:
  (U) Initiate:
  - (U) CE seeker demonstration.
  - (U) Flight test pod design integration.
  - (U) Ground, rooftop, HITL. Fabrication and flight clearance tests.
  (U)Continue:
  - (U) CE seeker integration and test.
  (U) Complete:
  (U) Integrated CE seeker development and environmental demonstration.

- (U) ($2,879) Shared Aperture:
  (U) This task enables the development and demonstration of wideband multifunction RF systems with shared apertures and electronics to perform the functions currently performed by multiple RF systems, in particular radar, communications and electronic warfare systems.
  (U) Initiate:
  - (U) Construction of test prototype.
  (U) Continue:

- (U) Final design for open archtitecture 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.

4. (U) FY 1999 PLAN:

- (U) ($3,237) AAGD:
  (U) Continue:
  - (U) Chamber and Field Testing of the Integrated ARH Sensor, Terminal Sensor and Automatic Target Recognition (ATR) Processor.
  - (U) Preparation for Flight Testing.
  - (U) Perform the necessary Hardware and Software design modifications.

- (U) ($4,730) 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 HITL lab.
  (U) Continue:
  - (U) Flight testing of the Build 1 solid state LADAR on the T-39 aircraft.

  (U) Completed:
  - (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 HITL lab.
  - (U) Build 2 of the solid state LADAR delivered.

- (U) ($4,060) 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) Complete:

- (U) Laboratory integration testing of terminals.

- (U) ($4,814) CCL:

(U) Complete:

- (U) CCL System Specification.
- (U) CCL System Life Cycle Cost model.
- (U) Transition Plan.
- (U) Standard Missile-2 Block IV flyout and restrained firing.
- (U) Hatch operability test.
- (U) Prototype launch system demonstration.

- (U) ($3,956) 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) ($3,357) 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N PROJECT NUMBER: R0447
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT TITLE: Weapons Advanced Technology

B. (U) PROGRAM CHANGE SUMMARY

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	9,252	18,602	27,890	29,428
(U) Adjustments from FY 1997 PRESBUDG:	-1,603	+3,239	-4,052	-5,274
(U) FY 1998/1999 PRESDUBG Submission:	7,649	21,841	23,838	24,154

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect Jordanian F-16 financing rescssion (-$9); and changes in requirements (-$1,594). FY 1997 adjustments reflect Congressional undistributed reductions (-$761) and a minor reprogramming to forward fund FY 1998 requirements. FY 1998 adjustments reflect Navy Working Capital Fund (NWCF) and minor changes in requirements (-$354); reduction to reflect FY 1997 funded acceleration (-$4,000); and Defense Science & Technology adjustments (+$302). FY 1999 adjustments reflect a NWCF and minor adjustments (-$164); and reduction to reflect change in requirements (-$5,110).

(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 (Surface/Aerospace Surveillance and Weapons Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602234N (Materials, Electronics, and Computer Technology)
- (U) PE 0602602F (Conventional Munitions)
- (U) PE 0603238N (Precision Strike and Air Defense Technology Demonstrations)
- (U) PE 0603609N (Conventional Munitions)
- (U) PE 0603601F (Advanced Weapons)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N PROJECT NUMBER: R0447
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT TITLE: Weapons Advanced Technology

(U) PE 0207133F (F-16 Squadrons)
(U) PE 0203730A (Chaparral Missile)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

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

(U) COSTS: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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	0	3,198	3,617	5,652	5,464	5,485	5,536	5,591	CONT.	CONT.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS: This Fiscal Year 1997 new start 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 1996 ACCOMPLISHMENTS: Not applicable.

2. (U) FY 1997 PLAN:

- (U) ($3,198) 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/Joint Direct Attack Munition (JDAM) and Tomahawk Block IV missiles.
  (U) Initiate:
  - (U) Fabrication and testing of PSN IMU.
  - (U) Wafer fabrication.

- (U) Software development and verification.

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

3. (U) FY 1998 PLAN:

• (U) ($3,617) PSN:
(U) Continue:
- (U) Fabrication and testing of PSN IMU
(U) Complete:
- (U) Wafer fabrication.

4. (U) FY 1999 PLAN:

• (U) ($5,652) PSN:
(U) Initiate:
- (U) Test preparation and integration.
(U) Complete:
- (U) Fabrication and testing of PSN IMU.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY1998	FY1999
(U) FY 1997 President's Budget:	0	3,333	4,344	5,758
(U) Adjustments from FY 1997 PRESBUDG	0	-135	-727	-106
(U) FY 1998/1999 PRESBUDG Submission:	0	3,198	3,617	5,652

(U) CHANGE SUMMARY EXPLANATION:

FY 1997 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603217N PROJECT NUMBER: R2264
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology PROJECT TITLE: Air Systems Affordability

(U) Funding: FY 1997 adjustments reflect Congressional undistributed reductions (-$135). FY 1998 adjustments reflect a Navy Working Capital Fund (NWCF) and minor rate adjustments (-$2,801) and a restoral of Science & Technology funds (+$2,074). FY 1999 adjustments reflect NWCF and minor rate adjustments (+$106).

(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 (Surface/Aerospace Surveillance and Weapons Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0602602F (Conventional Munitions)
(U) PE 0603238N (Precision Strike and Air Defense Technology Demonstrations)
(U) PE 0603609N (Conventional Munitions)
(U) PE 0603601F (Advanced Weapons)
(U) PE 0207133F (F-16 Squadrons)
(U) PE 0203730A (Chaparral Missile)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Perf.Engine Tech (IHPTET)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
W2014 Integrated High Performance Turbine Engine Technology (IHPTET)	6,262	7,079	7,638	7,735	7,871	7,995	8,165	8,352	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. 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 Joint Mission Area (JMA)), increased platform mission endurance (Joint Surveillance 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)):
(U) Phase I - 1993: +30% thrust/weight (Fn/Wt), +100 ^{0}F combustor inlet temperature (CIT), +300 ^{0}F turbine inlet temperature (TIT), -20% fuel burn.
(U) Phase II - 1997: +60% Fn/Wt, +200 ^{0}F CIT, +600 ^{0}F TIT, -20% acquisition cost, -20% maintenance cost, -30% fuel burn.
(U) Phase III - 2003: +100% Fn/Wt, +400^{0}F CIT, +900^{0}F TIT, -35% acquisition cost, -35% maintenance cost, -40% fuel burn.
(U) Turboprop/shaft (Joint Turbine Advanced Gas Generator (JTAGG)):

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Perf.Engine Tech (IHPTET)

(U) Phase I - 1993: +40% shaft horsepower/weight (SHP/Wt), -20% specific fuel consumption (SFC), +300^{O}F TIT.
(U) Phase II - 1997: +80% SHP/Wt, -30% SFC, +600 ^{O}F TIT, -20% acquisition cost, -20% maintenance cost.
(U) Phase III - 2003: +120% SHP/Wt, -40% SFC, +1000 ^{O}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 ^{O}F CIT, +500 ^{O}F TIT, -30% Cost.
(U) Phase II - 1997: +70% Fn/Wt, -30% SFC, +1200 ^{O}F CIT, +900 ^{O}F TIT, -45% Cost.
(U) Phase III - 2003: +100% Fn/Wa. -40% SFC, +1400^{O}F CIT, +1400 ^{O}F TIT, -60% Cost.

(U) Each engine company utilizes 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 1996 ACCOMPLISHMENTS:
   - (U) ($6,262) Continued:
     - (U) Phase II JTDE: Detailed design and initiated fabrication.
     - (U) Phase II JTAGG: Detailed design and initiated component development tests and fabrication of engine system.
     - (U) Phase II JETEC: Fabricated and initiated demonstrator testing of the XTL-86/1 supersonic engine to characterize compression system performance. Initiated fabrication of the XTL-16/1 supersonic engine demonstrator. Continue the characterization of MA754 sheet forming, bending and joining to develop database for construction of combustor and turbine blades.
   - (U) ($100) Completed:
     - (U) Phase I JTAGG: Demonstration in excess of goal performance for SFC (-22%). Exceeded goal performance for SHP/Wt (+65%), completed additional testing to demonstrate enabling Phase II technologies under contractor cost share funding. This demonstration includes the first CMC combustor component in a turbine engine and is a first look at this Phase III technology.

2. (U) FY 1997 PLAN:
   - (U)($6,925) Continue:
     - (U) Phase II JTDE: Design, fabrication and assembly of demonstrator engines.
     - (U) Phase II JTAGG: Design, component development, fabrication and initial demonstrator engine test.

- (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.

• (U) ($154) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

• (U) ($500) Initiate:
- (U) Phase III JTDE: Source selection and contract award.
- (U) Phase III JTAGG: Source selection and contract award.
- (U) Phase III JETEC: Source selection and contract award.

• (U) ($7,138) Continue:
- (U) Phase II JTDE: Completion of assembly and instrumentation of demonstrator engines and demonstration of Phase II goals.
- (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. Phase III subsonic propfan demonstrator fabrication and assembly.

4. (U) FY 1999 PLAN:

• (U) ($7,735) Continue:
- (U) Phase III JTDE: Design of Phase III demonstrator engines.
- (U) Phase III JTAGG: Design, component development and fabrication for demonstrator engine and initiate preparation for demonstrator engine testing.
- (U) Phase III JETEC: Design, component development and integration of a hypersonic expendable gas turbine engine.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	7,427	7,380	7,681	7,808
(U) Adjustments from FY 1997 PRESBUDG	-1,165	-301	-43	-73
(U) FY 1998/1999 PRESBUDG Submission:	6,262	7,079	7,638	7,735

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February, 1997

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603217N
PROGRAM ELEMENT TITLE: Air Systems and Weapons Advanced Technology
PROJECT NUMBER: W2014
PROJECT TITLE: Integrated High Perf.Engine Tech (IHPTET)

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect a Jordanian F-16 financing rescission (-9); SBIR Transfer reduction (-156) and a reduction in requirements to fund the higher priority Navy requirements on the FY 1996 DoD Omnibus Reduction (-1,000). FY 1997 adjustments reflect Congressional undistributed reductions (-301). FY 1998 adjustments reflect a Navy Working Capital Fund (NWCF) and minor rate adjustments (-24); and Inflation reduction (-19). FY 1999 adjustments reflect a NWCF and minor rate adjustment (-44); and Inflation reduction (-29).

(U) Schedule: Delays due to materials and testing failures will move the IHPTET Phase II & III program milestones out approximately three months. Prior budget (FY 1995 and FY 1996) actions are now causing further schedule slips of six months or more in the demonstration of Phase II goals. This funding shortfall may also cause the delay of the Phase III design and component development and slip the Phase III demonstration date. Funding has become the primary driver in the Phase II and Phase III demonstration schedule.

(U) Technical: Major technical problems associated with materials and hardware failures have largely been overcome. Funding shortfalls will result in loss of key technical personnel momentum.

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, Electronics & Computer Technology)
- (U) PE 0602203F (Aerospace Propulsion)
- (U) PE 0602211A (Aviation Technology)
- (U) PE 0603202F (Aircraft Propulsion Subsystem Integration)
- (U) PE 0603216F (Advanced Turbine Engine Gas Generator)
- (U) PE 0603003A (Aviation Advanced Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance, Precision Strike and Air Defense Technology Demonstration

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2145 Cruise Missile Defense	43,537	44,235	31,439	14,703	1,092	2,049	2,617	2,910	CONT.	CONT.
R2266 Mobile Offshore Basing	13,934	13,668	0	0	0	0	0	0	0	27,602
R0834 Naval Science Assistance Program (NSAP) note 1/	6,663	12,533	4,110	4,657	4,767	4,888	5,012	5,146	CONT.	CONT.
R2282 Naval Technology Insertion Program (NTIP) note 2/	8,466	0	0	0	0	0	0	0	0	8,466
R2314 Fleet Advanced Demonstration	0	0	7,771	28,734	49,509	69,200	80,787	89,912	CONT.	CONT.
TOTAL	72,600	70,436	43,320	48,094	55,368	76,137	88,416	97,968	CONT.	CONT.

Notes: 1/ Fiscal year 1996 and 1997 funds were executed under PE 0205658N.
2/ Reflects an FY 1996 Congressional plus-up which was executed in PE 0603217N; there is no NTIP funding inFY 1997 in any Navy program element.

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance, Precision Strike and Air Defense Technology Demonstration

Warfighting Capabilities and the following Joint Mission Areas (JMAs): Joint Strike, Joint Littoral Warfare, Joint Intelligence, Surveillance & Reconnaissance, Nuclear Deterrence and Forward Presence/Deterrence.

(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 Forward Presence/Deterrence 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) Beginning in FY 96, the PE was divided into two projects; Cruise Missile Defense (R2145) and Mobile Offshore Base (R2266). These two projects were both previously funded within project R2145. Beginning in FY 98, this PE will include two additional projects; the Navy Science Assistance Program (R0834) transferred from PE 0205658N, and the Fleet Advanced Technology Demonstration (R2314) a FY 98 new start.

(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 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): New project starting in FY 96 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 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 incorporates the Naval Technology Insertion Program (NTIP) (initiated in FY 1996 in PE 0603217N, Project R2282, 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Global Surveillance, Precision Strike and Air Defense Technology Demonstration

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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2145 Cruise Missile Defense	43,537	44,235	31,439	14,703	1,092	2,049	2,617	2,910	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This is a continuation of a program initiated in FY 94. The CMD 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) 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) PROGRAM ACCOMPLISHMENTS AND PLANS

1. (U) FY 1996 ACCOMPLISHMENTS:
   - (U) ($18,629) Phase I of CMD ACTD effort (continued effort from FY 1994 program start in PE 0603792N).
     (U) Completed:

- (U) Final captive seeker sea clutter data collection, and Navy SM-2 live missile firings against Over the Horizon (OTH) target drones using data from the Mountain Top sensor suite.
- (U) Army simulated missile firings at OTH target drones using data from the Mountain Top sensor suite.
- (U) Phase I of the CMD ACTD.
- (U) Prepared required reports.

• (U) ($24,908) Phase II Activities:
(U) Initiated:
- (U) Design, development, and integration efforts for surveillance platform and advanced missile seeker/fuze.
- (U) Design, development, integration, and planning efforts for the Phase II demonstration to support extended horizon engagement of cruise missiles.
- (U) Design tests for airborne sensors against airborne targets.
- (U) Develop Phase II captive seeker sea/land data collection test plan.
- (U) Expand Makaha Radar Facility (MRF) FY 97 and FY 99 critical experiments/demonstrations (MRF 97 & MRF 99).
- (U) Upgrade weapon control modes, overland performance, and handover.

(U) Completed:
- (U) Upgrade baseline E-2C AEW aircraft and Standard Missile (SM-2) programs.

2. (U) FY 1997 PLAN:

• (U) ($44,235) CMD Phase II
(U) Initiate:
- (U) MRF 97 critical experiments/demonstration

(U) Continue:
- (U) Test planning for MRF 97 and 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROJECT NUMBER: R2145
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology PROJECT TITLE: Cruise Missile Defense

3. (U) FY 1998 PLAN:

- (U) ($31,439) 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.

4. (U) FY 1999 PLAN:

- (U) ($14,703) CMD Phase II
  (U) Initiate:
  - (U) MRF 99 critical experiments/demonstration.
  (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.
  (U) Complete:
  - (U) MRF 99 critical experiments/demonstration.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	48,525	46,311	31,559	12,334

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROJECT NUMBER: R2145
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology PROJECT TITLE: Cruise Missile Defense

(U) Adjustments from FY 1997 PRESBUDG:	-4,988	-2,076	-120	+2,369
(U) FY 1998/1999 PRESBUDG Submission:	43,537	44,235	31,439	14,703

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect a Jordanian F-16 financing rescission (-$56); internal DON adjustments (-$2,500); Inflation reduction (-$560); and SBIR Transfer (-$1,872). FY 1997 adjustments reflect Congressional undistributed reductions (-$2,076). FY 1998 adjustments reflect Naval Working Capital Fund (NWCF) and minor adjustments (-$120). FY 1999 adjustments reflect NWCF and minor adjustments (-$131); and restructure CMD II (+$2,500).

(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 Weapons Technology)
(U) PE 0602121N (Surface Ship and Submarine HM&E Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronics 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)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROJECT NUMBER: R2145
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology PROJECT TITLE: Cruise Missile Defense

(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/Cooperative Engagement Capability)
(U) PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
(U) PE 0603794N (C3 Advanced Technology)
(U) PE 0604310N (Arsenal Ship)
(U) PE 0604366N (Standard Missile Improvements)
(U) PE 0604770F (Joint Surveillance/Target Attack Radar Systems (JSTARS)
(U) PE 0604866C (Patriot Risk Reduction Mitigation)
(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R0834 Naval Science Assistance Program (NSAP)	15,129 1/	12,533	4,110	4,657	4,767	4,888	5,012	5,146	CONT.	CONT.

Notes: 1/ Fiscal years 1996 and 1997 reflect funding executed in PE 0205658N Project R0834 (Navy Science Assistance Program). FY 1996 also includes a Congressional plus-up for Naval Technology Insertion Program (NTIP) executed in PE 0603217N Project R2282 (Commander-in-Chiefs (CINCs) Technology for Rapid Response). There is no NTIP funding for FY1997.
2/ FY 1997 includes a Congressional plus-up for Littoral Airborne Sensor/Hyperspectral (LASH) executed in PE 0603238N. There is no LASH funding for FY 1998.

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 Naval Science Assistance Program (NSAP). Until FY 1997, the approach was to support a large field team of Science and Technology Advisors assigned to operational commands worldwide. During

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

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.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

(U) NSAP (Executed under PE 0205658N/Project R0834 in FY 1996.)

- (U) ($6,163) 30 Scientists and engineers served as primary S&T Advisors to the 30 operational Joint, Naval, and Marine Corps Commands. Conducted liaison in Research, Development, and Test and Evaluation (RDT&E) and acquisition communities to better inform these communities of readiness shortfalls. Provided management of NSAP Headquarters Operations Center (NSAPOPS) and deployed S&T Advisors worldwide. Managed two engineers in NTIP cell at Commander in Chief U.S. Pacific Fleet (CINCPACFLT).

- (U) ($299) Provided S&T Assistance to the operational commands as required, completing ten tasks based on unresolved, priority Command Technology Issues (CTIs) identified as operational readiness deficiencies. Working in response to the CINCs and subordinate commands, the following NSAP tasks were completed: Safe Passage, Mine Counter Measures (MCM); Shipboard High-Frequency E-Mail; Bosnia Blue Book of Available Technologies to Support Adriatic and Ground Operations; Theater Ballistic Missile Defense, Operational Plan Support (Persian Gulf); Submarine Launched Mobile Mine Set and Drift; Flex-Hose Service Life Extension; Ziplock Special Warfare Equipment Protection; RAT-TRAP Random Tracking, Real-Time Acoustic Processor; Marine Corps Mobile Command, Control, Communication, Computer, and Intelligence (C4I) System Architecture; and Inverse Beam Former. Bosnia Blue Book contained the following available technologies, two of which were rapidly fielded into the Commander, Sixth Fleet: All Weather MCM; Cold Weather Building Materials; Night Vision - Training; Cold Weather Operations - Training; Combat Identification; Counter Sniper; Tactical Picture; Tactical Surveillance & Reconnaissance; Specific Emitter Identification (SEI) (fielded); Radar Propagation over Terrain (fielded); Balkan language

translators; Non-lethal Systems; and Mobile, Portable, Deployable Command, Control, Communications, Computers and Intelligence (C4I).

- (U) ($110) Assess effectiveness of NSAP technical products in fulfilling fleet requirements. Developed the NSAP strategic plan for further re-engineering of NSAP and started implementation.

- (U) ($91) Continued utilization and began long-range improvement of communications and information transfer. Conceived, designed and initiated transition to Web page the management tool known as the Global Technical Tactical Information Center (GTTIC).

(U) NTIP (Executed in PE 0603217N/Project R2282 in FY 1996.)

- (U) ($7,416) Inserted ten technologies selected by the Fleet CINCs and the Marine Forces Atlantic/Pacific into operational environments for tactical evaluation. Evaluations to be completed in FY98. Ten technologies inserted are P-3 Electronic Signals Management (ESM) SEI System; Small Ship ESM SEI System; Targeting Avionics System; Littoral Airborne Sensor/Hyperspectral (LASH); Radient Clear MCM System; Chemical Vapor Detector; Fiber Optic Bio-Sensor for Biological Warfare (BW) Agents; Medical Diagnostic Tool; Tactical Collection and Management System; and Radar Propagation over Terrain Model.

- (U) ($950) NTIP Cell at CINCPACFLT planned, organized, and coordinated Integrated Product Execution Teams (IPETs) consisting of the fleet operators and the technology developers to conduct product execution, insertion, and evaluation.

- (U) ($100) Developed, published, and distributed June 1996 edition of ONR Blue Book, Technologies for Rapid Response. Document was provided in hard copy, electronic, and CD-ROM form to make it as easy as possible for the various fleet customers to utilize it.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

2. (U) FY 1997 PLAN:

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

- (U) ($4,333) Supported full complement of 30 scientists and engineers serving as the S&T Advisors to 30 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 for first two quarters of the year. Manage NSAPOPS at Office of Naval Research (ONR), solving identified readiness problems with mature technologies. Provide coordination of operational insertion of these technologies and joint evaluations between the developers and operators. Develop and implement 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 CTIs to focus insertions of on-the-shelf and maturing technologies and to provide requirements documentation to influence longer term development and acquisition programs. Manage technology insertions that solve deficiencies identified by CTIs.

- (U) ($200) Produce documentation of overall effectiveness of the program, develop transition mechanisms for these products to advanced development and acquisition programs, and provide fleet customers and stakeholders with metrics to evaluate NSAP effectiveness. Use 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.)
  Conduct systems integration and engineering of sensors and real-time processing components that together provide a littoral airborne sensor/hyperspectral Anti-Submarine Warfare (ASW) capability aboard Orion P3C aircraft. Conduct operational tests and evaluations during FY97 in Pacific Fleet on well established and calibrated ranges. Following Fleet evaluations and requisite systems modifications, provide two additional LASH installations (Atlantic and European theaters) for evaluations in alternative environments. Provide overall management and

transition direction through an Integrated Product Execution Team (IPET) established with CINCPACFLT.

3. (U) FY 1998 PLAN:

(U) NSAP

- (U) ($3600) 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.
- (U) ($100) Develop and distribute to the CINCs a compendium of maturing technologies for rapid response solutions to immediate readiness issues (ONR Blue Book).
- (U) ($200) Assess effectiveness of NSAP technical products, including ten Blue Book technologies and four Small Business Innovation Research (SBIR) products initiated in FY96, coordinating IPETs to ensure transitions of successful products. Develop measures of success and provide as lessons learned to S&T community to ensure rapid evolution and evaluation of full spectrum of S&T programs in operational environments.
- (U) ($210) GTTIC throughout operational commands to provide 24 hour rapid technical assistance and to conduct overall management of technical requirements and readiness issues.

4. (U) FY 1999 PLAN:

- (U) ($4,657) 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 IPETs 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:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	14,572	5,067	0	0
(U) Adjustments from FY 1997 PRESBUDG:	-557	+7,466	+ 4,110	+ 4,657
(U) FY 1998/1999 PRESBUDG Submission:	15,129	12,533	4,110	4,765

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments reflect Jordanian F-16 financing rescission (-17); Small Business Innovative Research assessment (-197); and internal DoN adjustments (+771). FY 1997 adjustments reflect Congressional Plus-up for LASH (+8,000); and Congressional undistributed reductions (-534). FY 1998 adjustments reflect realignment from 0205658N (+5,223); Navy Working Capital Fund (NWCF) and minor changes (-1,102) and Inflation reduction (-$11). FY 1999 adjustments reflect realignment from 0205658N (+4,700); NWCF and minor adjustments (-$26) and an Inflation reduction (-17).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603238N
PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2314 Fleet Advanced Demonstration	0	0	7,771	28,734	49,509	69,200	80,787	89,912	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 Area assessments, and the Science and Technology 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 1996 PLAN: Not applicable.

2. (U) FY 1997 PLAN: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603238N PROGRAM ELEMENT TITLE: Precision Strike and Air Defense Advanced Technology

PROJECT NUMBER: R2314 PROJECT TITLE: Fleet Advanced Technology Demonstration

3. (U) FY 1998 PLAN:

- (U) ($4,286) DIRECT ATTACK MUNITION AFFORDABLE SEEKER (DAMASK): Initiate FAT 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. Develop imaging template and adapt pattern matching software.
- (U) ($3,485) ADVANCED SURFACE SITUATIONAL AWARENESS: Initiate classified program.

4. (U) FY 1999 PLANS:

- (U) ($6,014) DAMASK: Continue FAD: Fabricate and bench test seeker; design and build signal processor; demonstrate image template generation and matching technology.
- (U) ($4,515) ADVANCED SURFACE SITUATIONAL AWARENESS: Continue classified program.
- (U) ($18,205) Initiate FY 1999-start FADs.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	0	0	0	0
(U) Adjustments from FY 1997 PRESBUDG:	0	0	+7,771	+28,734
(U) FY 1998/1999 PRESBUDG Submission:	0	0	7,771	28,734

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1998 changes reflect DON S&T Realignment to initiate Fleet ATD project (+$7,940) and Navy Working Capital Fund (NWCF) and minor adjustments (-$149) and Inflation reduction (-$20). FY 1999 adjustments reflect an S&T realignment to continue Fleet ATD project (+$28,939); NWCF and minor adjustments (-$140); and Inflation reduction (-$65).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) Schedule: Not applicable.

(U) Technical: Dragonfly Unmanned Aerial Vehicle development effort is deferred.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:
- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602111N (Air and Surface Weapons Technology)
- (U) PE 0602121N (Surface Ship and Submarine HM&E Technology)
- (U) PE 0602122N (Aircraft Technology)
- (U) PE 0602232N (Space and Electronic Warfare (SEW) Technology)
- (U) PE 0602233N (Readiness, Training and Environmental Quality Tech)
- (U) PE 0602234N (Materials, Electronics & Computer Technology)
- (U) PE 0602314N (Electronic Warfare Surveillance Technology)
- (U) PE 0602435N (Oceanographic & Atmospheric Technology)
- (U) PE 0602633N (Undersea Warfare Weapon Technology)

D. (U) Schedule Profile: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
E2194 Electronic Warfare Advanced Technology	7,065	7,070	10,347	10,364	10,449	9,604	9,774	9,994	CONT.	CONT.
R2090 Functional Recognition & Response	6,940	7,399	7,797	8,374	8,701	8,880	9,067	9,271	CONT.	CONT.
TOTAL	14,005	14,469	18,144	18,738	19,150	18,484	18,841	19,265	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., Joint Strike, Joint Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Forward Presence/Deterrence, Maritime Support of Land Forces, Readiness and Training). 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 Joint Director of Laboratories (JDL) Technology Panel for EW which oversees and coordinates Tri-Service 6.2 & 6.3A EW programs. Consequently, this program is planned jointly in accordance with Tri-Service 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 JDL. 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.

(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 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603270N PROJECT NUMBER: E2194
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology PROJECT TITLE: Electronic Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
E2194 Electronic Warfare Advanced Technology	7,065	7,070	10,347	10,364	10,449	9,604	9,774	9,994	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 1996 ACCOMPLISHMENTS:

- (U) ($3,369) Conducted lab and flight tests of integrated Ultraviolet (UV) Missile Approcach Warning System (MAWS), AN/ALE-47, and Bol Chaff dispenser. Completed Raven Laser Warning podded system and flight tested in the United Kingdom on a Royal Air Force Tornado.
- (U) ($728) Verified performance of MAWS algorithms designed to passively detect and predict time to missile impact. Analyzed data from air-to-air missile tests.

- (U) ($2,462) Conducted advanced countermeasures effectiveness analysis and demonstrations of novel implementations of current fleet-deployed countermeasures and new-concept devices.
- (U) ($506) Integrated Army developed directed energy countermeasures sybsystems into TACAIR warning/response suite.

2. (U) FY 1997 PLAN:

- (U) ($1,235) Complete passive missile identification and time-to-intercept techniques. Verify performance during Air-to-Air live fire testing.
- (U) ($1,446) Initiate passive missile identification and tailored-response effectiveness evaluation.
- (U) ($1,965) Demonstrate advanced missile countermeasures techniques.
- (U) ($1,409) Commence feasibility demonstration of TACAIR directed energy countermeasures.
- (U) ($927) Design, fabricate and flight test and integrated missile/laser warning sensor system.
- (U) ($88) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 1998 PLAN:

- (U) ($4,217) 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) ($2,084) Conduct flight tests and evaluations of the integrated EW avionics suite with tailored threat response and enhanced crew situational awareness.
- (U) ($3,220) Continue development of countermeasures to imaging and dual-mode missile seekers.
- (U) ($826) Perform concept demonstration of countermeasures to laser-guided weapons.

4. (U) FY 1999 PLAN:

- (U) ($4,510) Conduct missile live-fire evaluations of the TACAIR directed infrared countermeasures (IRCM) system, with advanced multispectral infrared (IR) missile warning.
- (U) ($3,823) Demonstrate countermeasures to advanced two-color and imaging seekers.
- (U) ($1,275) Develop laser countermeasure capability for the Tactical Air Directed IRCM (DIRCM) system and perform evaluations.
- (U) ($756) Initiate ultra wide band jamming and other Radio Frequency directed energy concepts evaluation.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	$ 7,312	$ 7,371	$ 9,509	$ 9,623
(U) Adjustments from FY 1997 PRESBUDG:	-247	-301	+838	+741
(U) FY 1998/1999 PRESBUDG Submission	$ 7,065	$ 7,070	$10,347	$10,364

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 adjustment reflects a Jordanian F-16 financing rescission (-$8); Small Business Innovative Research assessment (-$37); and execution adjustment (-$202). FY 1997 adjustments reflects Congressional undistributed reductions (-$301). The FY 1998 adjustment reflects Naval Working Capital Fund (NWCF) ($-228); S&T adjustment (+$1,092); and Inflation adjustment (-$26). FY 1999 adjustment reflects NWCF (-$221); S&T adjustment (+$1,000); and Inflation (-$38).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603270N PROJECT NUMBER: E2194
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology PROJECT TITLE: Electronic Warfare Advanced Technology

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

(U) RELATED RDT&E: This Program Element (PE) adheres to Tri-Service Reliance Agreements on EW with oversight and coordination provided by the Joint Director of Laboratories 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 (Electronic Warfare Technology)
(U) PE 0603270F (Electronic Combat Technology)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604270N (EW Development)

D. SCHEDULE PROFILE: Not applicable.

UNCLASSIFIED

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603270N PROJECT NUMBER: R2090
PROGRAM ELEMENT TITLE: Advanced Electronic Warfare Technology PROJECT TITLE: Functional Recognition & Response

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2090 Functional Recognition & Response	6,940	7,399	7,797	8,374	8,701	8,880	9,067	9,271	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 1996 ACCOMPLISHMENTS:

- (U) ($800) Developed generic hardware for inserting improved Functional ID capability into existing receiver systems.
- (U) ($772) Fabricated the integrated suite consisting of chaff, Electric Counter Measures (ECM), Incremental Theory of Diffraction (ITD) and Expert System technology for use against advanced coherent threats.
- (U) ($700) Modified Advanced Active Expendable Decoy (AAED) hardware and commenced tests against imaging radars and radars with polarization diversity/Non-Cooperative Target Recognition.
- (U) ($750) Extended ITD hardware to operate in the Millimeter Wave (MMW) range through the development and integration of a MMW optical link.
- (U) ($850) Demonstrated active and passive methods of countering Proforma links.

- (U) ($900) Fabricated high power radio frequency generator unit for testing Functional ID hardware and software.
- (U) ($800) Modified ALQ-170 testbed to develop parametrically agile missile model to test upgraded ALQ-170 simulators and advanced responsive Electronic Support Measuring systems.
- (U) ($700) Demonstrated artificial intelligence techniques for Generic Countermeasures (CM), Functional ID and Uninitiated Modulation On Pulse (UMOP).
- (U) ($668) Continued field testing of advanced UMOP and SEI techniques into existing receiver and surveillance systems.

2. (U) FY 1997 PLAN:

- (U) ($1,150) Demonstrate Functional ID system for generic hardware.
- (U) ($699) Complete flight test plans for using the optimized chaff (AN/ALE-39), Expert system and AAED integrated suite against surrogate Microwave threats at Naval Air Warfare Center, China Lake.
- (U) ($1,200) Test coordinated onboard jamming and towed decoy using fiber optic link.
- (U) ($1,000) Demonstrate Shipboard sensor fusion hardware.
- (U) ($1,000) Verify fidelity and resolution of generic threat simulator.
- (U) ($1,200) Integrate and test two low probability of intercept seekers for identification and response technique effectiveness.
- (U) ($1,150) Airborne and shipboard test hardware/software to establish effectiveness of newly developed concepts.

3. (U) FY 1998 PLAN:

- (U) ($2,000) Demonstrate optimal Functional ID system architecture.
- (U) ($1,930) Demonstrate combined Functional ID and SEI systems.

- (U) ($1,950) Flight test optimized chaff, expert system and integrated towed decoy.
- (U) ($1,917) Develop Functional ID, SEI and generic countermeasures to support development of Advanced Integrated Electronic Warefare System (AIEWS).

4. (U) FY 1999 PLAN:

- (U) ($2,590) Demonstrate and transition optimal Functional ID architecture into the Navy s Advanced Integrated Electronic Warefare System (AIEWS).
- (U) ($2,650) Demonstrate and transition optimal Functional ID architecture into the Navy s EA-6B and follow-on aircraft.
- (U) ($3,134) Develop Functional ID, SEI and generic CM to support development of AIEWS.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	$ 6,553	$ 7,714	$ 8,320	$ 8,459
(U) Adjustments from FY 1997 PRESBUDG:	+387	-315	-523	-85
(U) FY 1998/1999 PRESBUDG Submission:	$ 6,940	$ 7,399	$ 7,797	$ 8,374

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 adjustment reflects a Jordanian F-16 financing rescission (-$7); Small Business Innovative Research assessment (-$6); and execution adjustment (+$400). The FY 1997 adjustments reflects Congressional undistributed reductions (-$315). FY 1998 adjustment reflects a Navy Working Capital Fund (NWCF) adjustment

(-$581); S & T adjustment ($+79); and Inflation reduction (-$21). The FY 1999 adjustment reflects a NWCF adjustment (-$54); and Inflation reduction (-$31).

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

(U) RELATED RDT&E PROGRAMS: This PE adheres to Tri-Service Reliance Agreements on EW with oversight and coordination provided by the JDL and is associated with efforts that are being pursued under the following Army and Air Force PEs:

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602204F (Aerospace Avionics)
(U) PE 0602234N (Materials, Electronics and Computer Technology)
(U) PE 0602270A (Electronic Warfare Technology)
(U) PE 0602270N (Electronic Warfare Technology)
(U) PE 0603270A (Electronic Warfare Technology)
(U) PE 0603270F (Electronic Combat Technology)
(U) PE 0603792N (Advanced Technology Transition)

D. SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	15,000	24,597	36,648	42,995	43,263	41,726	42,398	43,153	CONT.	CONT.
R2328 Project M (Congressional Add)	0	4,799	0	0	0	0	0	0	0	4,799
S1848 Gas Turbine Engine Technology	2,734	2,789	3,089	3,302	3,388	3,467	3,541	3,622	CONT.	CONT.
TOTAL	17,734	32,185	39,737	46,297	46,651	45,193	45,939	46,775	CONT.	CONT.

(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 validations 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 Joint Strike, Joint Littoral, Joint Surveillance, Joint Surface Electronic Warfare, Strategic Deterrence, and Maritime Support for Land Forces, and Strategic Sealift relative to reduced signatures and increased survivability.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced 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 development, simulation, or experimental testing of prototype hardware to validate technological feasibility and concept of operations and reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	15,000	24,597	36,648	42,995	43,263	41,726	42,398	43,153	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Ship and Submarine Hull, Mechanical, and Electrical (HM&E) Advanced Technology was created in FY 1996 as a core technology project by the restructuring of Program Element (PE) 0603555N Project R2142. The project develops and demonstrates technological improvements for HM&E systems in support of present and future surface ship and submarine platforms. The purpose of this PE is to develop and demonstrate technology which has been explored for system feasibility at the applied research level, primarily in PE 0602121N, and to focus system level development and demonstration for transition to higher budget category funding or acquisition programs. Thus, this project is a continuing effort which 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 far-field acoustic signature. This technology addresses general submarine signature issues and will be applicable to current and future submarine classes. AVR technology will be demonstrated through a full-scale land-based prototype system and two at-sea acoustic ship trials.

(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 SC-21. ARM technology will be demonstrated in a series of system tests culminating in a final integrated demonstration of a survivable HM&E damage control system.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced Technology
PROJECT NUMBER: R2224
PROJECT TITLE: Ship and Submarine HM&E Advanced Technology

(U) SSHS develops and demonstrates system level technology from a multi-disciplinary approach; currently efforts focus on modular structures for 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. Future efforts will focus on integration of propulsor and hydrodynamic technology into new hull configurations. Additional efforts will demonstrate the integration of other technology disciplines, in particular, the integration of sensor, communication and signature requirements into material/structural systems.

(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 will be placed on 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 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 1996 ACCOMPLISHMENTS:

(U) ($15,000) AVR:
(U) CONTINUED:
(U) Ship installation studies and ship temporary alteration (TEMPALT) preparation.
(U) Testing at Land Based Test Facility to verify system performance.
(U) COMPLETED:
(U) Demonstration of capability to control vibrations on Land Based Test Facility.
(U) Breakdown of Land Based Test Facility and refurbishment of AVR components for ship installation.

2. (U) FY 1997 PLAN:

(U) ($18,100) AVR:
(U) CONTINUE:
(U) TEMPALT installation of AVR system on SSN 688 class submarine.
(U) AVR system evaluation.
(U) COMPLETE:
(U) First of two at-sea acoustic trials of AVR system.

(U) ($1,310) ARM:
(U) TRANSITION:
(U) Technology from PE 0602121N for development of intelligent HM&E ship damage control systems to minimize manning and increase operational reliability.

(U) ($3,228) AES:
(U) TRANSITION:
(U) Technology from PE 0602121N to demonstrate form, fit, and function for shipboard system level applications of PEBB modules. (SSSA)
(U) Technology and development of concepts for prototype QEPM. (QEPM)
(U) Diesel fuel processing technology from PE 0602121N. (SSFC)

(U) ($1,959) Small Business Innovation Research:
(U) Portion of extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

(U) ($3,458) AVR:
(U) CONTINUE:
(U) Second at-sea acoustic trial of AVR system
(U) Removal of AVR system from test platform.
(U) Evaluation of at-sea test data.
(U) COMPLETE:
(U) Preparation of final reports documenting AVR program and transition advanced technology to Naval Sea Systems Command (NAVSEA).

(U) ($6,915) ARM:
(U) CONTINUE:
(U) Development of intelligent HM&E ship control systems to minimize manning and increase operational reliability.
(U) COMPLETE:
(U) Demonstration of survivable, intelligent sensors and accurate damage control characterization. (ARM)

(U) ($23,182) AES:
(U) TRANSITION:
(U) Tools developed in the Submarine Technology Applied Research program to predict electric motor forces. (QEPM)
(U) CONTINUE:

(U) Construction of small-scale motor variants to evaluate passive design parameters in electric motors; generate baseline force and acoustic measurements of small-scale electric motor variants. (QEPM)
(U) Develop requirements for quiet electric propulsion motor for submarine. (QEPM)
(U) Downselect a design for a 2500 kilowatt SSFC.

(U) ($3,093) SSHS:
(U) TRANSITION:
(U) Transition technology from PE 0602121N for development of Machinery Support Systems (MSS) for improved shock and acoustic performance. (MSS)
(U) Transition technology from PE 0602121N to integrate signature and sensor technology into ship materials/structures.

4. (U) FY 1999 PLAN:

(U) ($10,241) ARM:
(U) CONTINUE:
(U) Development of intelligent HM&E ship control systems to minimize manning and increase operational reliability.

(U) ($5,852) SSHS:
(U) CONTINUE:
(U) In-water acoustic demonstration of heavyweight machinery concepts at Intermediate Scale Measurement System. (MSS)
(U) Design heavyweight machinery space configurations supporting both electric drive and conventional propulsion systems. (MSS)
(U) Requirements for demonstration of acoustic and shock performance. (MSS)
(U) Fabrication of large scale structural components to demonstrate integration of signature/sensor technology in structural/material systems.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

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

(U) ($26,902) AES:
(U) CONTINUE:
- (U) Fabrication of a 500KW sub-scale demonstration model. (SSFC)
- (U) Development of design guidelines, tradeoff studies, and land-based test procedures for large scale diesel-fed fuel cells. (SSFC)
- (U) Demonstrate integral active control in quiet electric motors. (QEPM)

(U) COMPLETE:
- (U) Development of requirements for large-scale QEPM demonstration. (QEPM)
- (U) Demonstration of prototype self-synthesizing, dynamically reconfigurable electric distribution systems. (AED)
- (U) Demonstration of physical and computational network system simulations. (AED)
- (U) Multi-functional demonstration of second-generation PEBB modules for form and function. (SSSA)

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	14,491	25,649	28,756	33,359
(U) Adjustments from FY 1997 PRESBUD:	+509	-1,052	+7,892	+9,636
(U) FY 1998/1999 PRESBUD Submission:	15,000	24,597	36,648	42,995

(U) CHANGE SUMMARY EXPLANATION:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced Technology
PROJECT NUMBER: R2224
PROJECT TITLE: Ship and Submarine HM&E Advanced Technology

(U) Funding: FY 1996 adjustment reflects the Jordanian F-16 financing rescission (-$16) and execution adjustments (+$525). FY 1997 reflects Congressional Undistributed Reductions (-$1,052). FY 1998 increase is for SSSA/PEBB (+10,000K), Navy Working Capital Fund(NWCF) and minor adjustments (-$17), Defense S&T Adjustment (-$2,000) and Inflation adjustment (-$91). FY 1999 Increase for SSSA/PEBB (+$10,000), NWCF and minor adjustments (-$205) and Inflation adjustment (-$159).

(U) Schedule:

(U) Technical: Increase to FY 1998 and FY 1999 funding directly supports the development, evaluation and demonstration of SSSA/PEBB.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced Technology
PROJECT NUMBER: R2224
PROJECT TITLE: Ship and 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 (Surface Ship and Submarine HM&E Technology)
(U) PE 0602131M (Marine Corps Landing Force Technology)
(U) PE 0602233N (Readiness, Training and Environmental Quality)
(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 (Personnel/Ship 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 Tri-Service Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced Technology
PROJECT NUMBER: S1848
PROJECT TITLE: Gas Turbine Engine Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
S1848 Gas Turbine Engine Technology	2,734	2,789	3,089	3,302	3,388	3,467	3,541	3,622	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Gas Turbine Engine Technology project develops and demonstrates technology which directly transitions to the fleet to address current gas turbine engine system problems in reliability and safety. The project also continuously upgrades the performance of current fleet gas turbines and develops technology for application on future gas turbines in areas such as efficiency.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:
   - (U) ($434) Design effort on improved axial compressor aero performance.
   - (U) ($800) Variable Rotor Blade Compressor Study.
   - (U) ($1,500) Manufacture and integration of a fully active sensorless magnetic bearing design on to a power turbine rotor.

2. (U) FY 1997 PLAN:
   - (U) ($353) Design study to evaluate component efficiency improvements at part power by active control of external turbine cooling requirements.
   - (U) ($341) Design study to apply Micro-Electronic Machines (MEMSs) technology to increase blade loading and surge control to increase compressor performance.
   - (U) ($1,431) Engine test of magnetic bearing on a power turbine.

(U) ($595) Development and testing of Variable Rotor Blade Compressor.
(U) ($69) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:
(U) ($1,089) Validate rotor blade compressor design.
(U) ($2,000) Engine test using power turbine with magnetic bearings.

4. (U) FY 1999 PLAN:
(U) ($1,302) Engine system demonstration of Rotor Blade Compressor design.
(U) ($2,000) Gas generator rotor test with magnetic bearings.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	2,801	2,908	3,099	3,329
(U) Adjustments from FY 1997 PRESBUD:	-67	-119	-10	-27
(U) FY 1998/1999 OSD/OMB Submission:	2,734	2,789	3,089	3,302

(U) CHANGE SUMMARY EXPLANATION:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603508N PROGRAM ELEMENT TITLE: Ship and Submarine HM&E Advanced Technology PROJECT NUMBER: S1848 PROJECT TITLE: Gas Turbine Engine Technology

(U) Funding: FY 1996 adjustments reflect execution adjustments (-$67). FY 1997 adjustments reflect Congressional undistributed reductions (-$119). FY 1998 changes reflect minor pricing adjustments (-$10). FY 1999 changes reflect minor adjustments (-$27).

(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 (Surface Ship and Submarine HM&E Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602234N (Materials, Electronics, and Computer Technology)
(U) PE 0603573N (Advanced Surface Machinery Systems)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs)

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
C2223 Marine Corps Advanced Technology	26,148	61,127	34,178	39,617	25,225	27,389	28,243	29,131	CONT.	CONT.

A. (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 form 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 being addressed in this program element (PE) are Reconnaissance Standoff Mine Detection for surf zone and ashore; Mine Neutralization; Advanced Infantry and Vehicle Mounted Weapon Systems; application of computer technology and advanced command and control architectures to Battlefield Electronic Support Systems and Command and Control systems; protection from, and tactical employment of, emerging directed energy weapons; and alternative electric very high power/low weight propulsion drive-trains and armor/armament for future vehicles. This is an ongoing program to develop and demonstrate advanced technologies and system concepts in a quasi-operational environment in the less-than-lethal target effect. 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. This also funds the Commandants Warfighting Laboratory (CWL) in conceptual operational assessment of emerging technologies. Specifically this PE directly supports the following capabilities: to promptly engage regional forces in decisive combat on a global basis, and to respond to all other contingencies and missions in the full spectrum of combat 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

(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 or 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. Concepts of operations are validated by means of the Sea Dragon series of Warfighting Experiments.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($2,348) Off Route Smart Mine Clearance (ORSMC): Completed fabrication of system hardware. Finalized signature duplication and surrogate threat emulator efforts. Conducted DT/OT 0. Transitioned to PE 0603612M, Project C2104.

- (U) ($3,688) Joint Advanced Mine Countermeasures (JAMC): Fabricate system prototype. Completed OT 0. Participating in joint Mine Countermeasures (MCM) Advanced Concept Technologies Demonstration (ACTD) with prototype hardware and modeling and simulation (M&S) products.

- (U) ($2,935) Coastal Battlefield Reconnaissance (COBRA): Completed DT-0, initiated OT-O, and Milestone I documentation. Initiated Demonstration/Validation (DEM/VAL) phase documentation and type-A specification. Participating with hardware mounted on Unmanned Aerial Vehicles, in joint MCM ACTD. Transitioned program to PM Management.

  (U) ($1,116) Command and Control (C^2) in the year 2000 (C^2-2000): Completed MAGTF Command, Control, Communication, Computer, and Intelligence (C4I) system software conversion to the Global Command Control System Concept Of Employment. Provided technical support to CWL. Developed the capability to produce a "virtual" command post through the use of visualization software. Conducted capability demonstrations and transitioned

results to applicable MAGTF Command Element (CE) C^2 programs. This program transitioned to PE 0206626M, Marine Corps Command, Control, Communications Systems, Project C2150, MAGTF C4I, Systems Engineering and Integration (SE&I).

- (U) ($568) Joint Tactical Directed Energy Warfare (TDEW) Technology: Continued joint development of frequency agile laser protection and participated in Joint Service TDEW efforts.

- (U) ($3,471) 21st Century Land Warrior (21CLW): Completed initial downsizing and integration efforts. Provided technical support to CWL. Conducted interim experiments with two to four systems, assessing achievement of technical goals and operational utility (joint with Army).

- (U) ($2,000) Joint Integrated Electric Motor Drive (JIEMD): Completed fabrication and integration of testbed platforms featuring electric land propulsion drive, advanced digital control system, and lightweight plastic cooling components. Began testing and evaluation. This constitutes Phase I of a joint, ongoing program with the Army's Tank-Automotive Command (TACOM), Warren, Michigan. Completed conceptual design of future mobility systems and initiate preliminary designs.

- (U) ($2,670) Joint Modeling and Simulation Technology: Developed Technologies to integrate live and virtual simulations in multiple environments. Constructive and virtual representations of dynamic environmental and human features defined at a level of resolution sufficient to depict individuals and squads. Developed technologies to support capabilities to train while deployed and to conduct mission planning and rehearsal.

- (U) ($500) Advanced Light Weight Ground Weaponry (ALWGW): Continued to participate in the Objective Individual Combat Weapon (OICW) Program with the Army to fabricate and test early prototypes.

- (U) ($1,000) Team Target Engagement Simulator (TTES): Completed system integration. Conducted assessments with advanced human interface technology of fire team and rifle squad. Adapt TTES technology to support virtual prototyping and the assessment of tactical value of the 21CLW and other advanced infantry technologies.

Conducted DT 0 and plan Early Operational Assessment. Provided technical support to CWL.

- (U) ($890) Advanced System Air Defense (ASAD): Transitioned Electronic Support Measures (ESM) sensor technology to the Program Manager for Air Defense for integration onto the Avenger air defense platform. Continued development of the passive acoustic sensor.

- (U) ($966) Advanced Amphibious Logistics Demonstration: Demonstrated Recording and Tracking Technologies utilizing a family of radio frequency tags to provide in-transit/total asset visibility of supplies and equipment for garrison and expeditionary operations.

- (U) ($1,000) Integrated Combat Operations Center (ICOC) (formerly Joint C4I Technology): Initiated joint development of technologies to support streamlined command and control, enhanced situational awareness, and rapid decision making on future battlefields. These efforts involve multi-disciplinary technologies to include: psychological, biological, expert systems, and computer visualization and facilitation of high cognitive plane mental and intuitive processes. These technologies will lead to an increase in situational awareness and more rapid decision making by the Commander.

- (U) ($461) Joint Tactical Communications Systems: Continued development to demonstrate the ability to construct a "wireless" command post ashore (joint with Army).

- (U) ($1,000) Forward Observer/Forward Air Controller (FO/FAC): Completed OT 0 testing and demonstration. Completed system type-A specification and initiate transition to DEM/VAL. Provided technical support to CWL. Transitioned to PM Management as Target Location, Designation Handoff System (TLDHS)

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT NUMBER: C2223 PROJECT TITLE: Marine Corps ATDs

- (U) ($1,535) Completed the Commandant s Warfighting Laboratory s initial efforts at planning and preparing for the Hunter Warrior Advanced Warfighting Experiments (AWE).

2. (U) FY 1997 PLAN:

- (U) ($3,378) C^2 Imperative: Develops and demonstrate technologies and concepts for all MAGTF elements, with a focus on the CE. These demonstrations permit the rapid, accurate capture and dissemination of friendly and enemy essential elements of information, permitting greater situational awareness and control of forces. Also addresses reconnaissance, surveillance, target acquisition, and streamlined communications involved in Ć of supporting arms and units in amphibious/maneuver operations. Ongoing ATDs are: ICOC ATD, which will improve the joint interoperability of current and future MAGTF C4I systems by making them operable within the Global Command and Control System (GCCS) and enables intuitive decision making by the Commander in chaotic conditions; Joint Tactical Communications Systems, which expands the target acquisition communications capabilities of forward deployed ground forces and enhances the control of supporting fires to ensure first round destruction; Position Location Reporting System (PLRS), Downsized Master Station (DSMS) ATD, which enhances the mobility of fielded PLRS and expands the data communications capabilities by supporting a Hybird PLRS/EPLRS community.

- (U) ($7,460) Maneuver Imperative: Develops and demonstrates technologies and concepts to enhance the Ground Combat Element (GCE s) abilities to locate, close with, and destroy the enemy and the CSSE s ability to provide logistics support. The principle objectives are to improve tactical mobility, survivability (including joint combat identification/Identification Friend or Foe (IFF)) and readiness in order to facilitate the Marine Corps-unique Operational Concept, (Operational Maneuver from the Sea (OMFTS). Major focus areas are: technologies for a family of future combat and tactical vehicles, incorporating electric armor, electric suspension, hybrid electric propulsion suites, and MCM, which encompasses mobility, low observables and survivability, develops technologies to detect mines, minefields, and countermeasure mines rapidly, at safe standoff and fully integrated with the GCE. Also addresses neutralization of advanced, hardened, and off/route, smart mines, regardless of

fuzing. ATD s include: COBRA and Expeditionary Maneuver Technology.

- (U) ($4,559) Firepower Imperative: Develops and demonstrates 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; munitions lethality; weapon system performance; and unconventional target effects. Emphasis is on reducing the Marine combat load through innovative design and advanced materials while increasing his survivability through greater situational awareness and higher precision at longer range. ATD s include: Advanced Lightweight Ground Weapons and FO/FAC, as well as participation in joint efforts with the Army, e.g. Force 21 Land Warrior.

- (U) ($2,710) Logistics Imperative: Develops and demonstrates technologies to enhance ability to provide combat service support to the MAGTF for both traditional and emerging OMFTS Amphibious Operations. Mission areas emphasized: Supply, which addresses an operationally reliable, cost effective warehousing system with in-transit/total asset visibility of supplies and equipment for platform design; Maintenance, which addresses reduction of down time on ground equipment through prognostics, mobile and seabased maintenance facilities; Transportation, which addresses improvements in cargo handling and transportation means available for ship-to-shore movement of supplies and equipment; reduction in tare and delivery time through improved packaging techniques and materials; Expeditionary Engineering, which addresses enhanced mobility, flexibility, and capability of deliberate engineer equipment available to expeditionary forces; Health Services, which addresses enhancement of capability through use of modular medical facilities; and a systematic approach called Advanced Amphibious Logistics Technology ATDs which will address all functions of Logistics, e.g. Supply Maintenance, Bulk Liquids, etc.

- (U) ($2,993) Training and Education Imperative: Develops and demonstrates technologies to enhance the mental abilities of Marines to deal with battlefield uncertainty and chaos, to assimilate information rapidly enough to be decisive and completely enough to make the decisions good enough to win. The initial efforts will involve M&S in support of training (mission specific), wargaming, concept development, and analysis. The TTES ATD will

transition to advanced prototyping. Emphasis is on entity development and environmental representation reflecting unique Marine Corps missions, organization, and equipment.

- (U) ($36,043) Warfighting Experimentation Imperative: Provides the planning execution, and analysis to include equipment and personnel in support of the CWL in the implementation of the Sea Dragon experimentation process. The CWL serves as an integrating ground for new technologies, as the focal point for warfighting refinements, and as the critical engine to take the Marine Corps forward. The Five Year Experimentation Plan (FYEP) sets forth the vision and actions for the CWL and serves as the guideline for planing and experimentation. The first phase of the FYEP culminates in an Advanced Warfighting Experiment (AWE) named Hunter Warrior, which is conducted in two increments. First increment preparations began in FY 1996 and peak with the AWE in February/March 1997. Hunter Warrior s focus is on the extended, littoral battlefield, employing dispersed forces using an advanced command, control and coordination architecture; enhanced fires and targeting capabilities; and innovative Combat Service Support techniques. As the first increment emphasizes Marine forces, the second increment, the FY 1997 will give more emphasis to naval aspects in the same environment. Several Limited Objective Experiments (LOEs) will be conducted during FY 1997 in support of the AWE. While Hunter Warrior will broadly examine concepts, tactics, techniques, and technologies on the extended littoral battlefield, the LOEs will examine specific Battlefield Engagement Coordination techniques and technologies; non-lethal weapons employment techniques and effects; survivability; precision targeting; mobility; the use of aerial drones; and enhanced C4I. A Special purpose Marine Air-Ground Task Force (Experimental) (SPMAGTF(X)) Command Element supported by Marine forces from First Marine Expeditionary Force (IMEF) has been formed to execute the AWE. This effort has been coordinated with Army, Air Force, and Navy to ensure compatibility and cross connectivity of programs and results. The AWE will be conducted on the West Coast at Marine Corps Base (MCB) Camp Pendleton, California and the Marine Corps Air-Ground Combat Center at Twenty-nine Palms, California.

- (U) ($1,685) Shoulder-launched Multipurpose Assault Weapon (SMAW): Demonstrate 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.

- (U) ($936) Air Defense Alerting Device (ADAD): Conduct developmental and limited tests to assess ADAD s capability to meet USMC passive sensor requirements.

- (U) ($1,363) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with U.S.C.638.

3. (U) FY 1998 PLAN:

- (U) ($3,051) C^2 Imperative: Continues to develop and demonstrate technologies and concepts for the elements of the MAGTF, with a focus on the CE. These demonstrations permit the rapid, accurate capture and dissemination of friendly and enemy essential elements of information, permitting greater situational awareness and control of forces. Also addresses reconnaissance, surveillance, target acquisition, and streamlined communications involved in C^2 of supporting arms and units in amphibious/maneuver operations. Ongoing ATDs are: ICOC ATD, which will improve the joint interoperability of current and future MAGTF C4I systems by making them operable within the GCCS; and enables intuitive decision making by the Commander in chaotic conditions.

- (U) ($5,728) Maneuver Imperative: Continues to develop and demonstrate technologies and concepts to enhance the GCE s abilities to locate, close with, and destroy the enemy and the CSSE s ability to provide logistics support. The principle objectives are to improve tactical mobility, survivability (including joint combat identification/IFF) and readiness in order to facilitate the Marine Corps-unique Operational Concept, (Operational Maneuver from the Sea (OMFTS)). Major focus areas are: technologies for a family of future tactical vehicles, incorporating electric armor, electric suspension, hybrid electric propulsion suites, and MCM, which encompasses mobility, low observables and survivability, develops technologies to detect mines, minefields, and countermeasure mines rapidly, at safe standoff and fully integrated with the GCE. Also addresses neutralization of advanced, hardened, and off/route, smart mines, regardless of fuzing. ATD s include: Joint Standoff Mine Detection System and Expeditionary Maneuver Technology, consisting of efforts in Recon/Surveillance and Future Light Armored Vehicle Technologies. The emphasis is on joint efforts with the Army and Defense Advanced Research Project Agency (DARPA). Transition COBRA program to DEM/VAL (PE 0603612M, Project C2106).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

- (U) ($566) Firepower Imperative: Continues 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. Terminate joint efforts with the Army, e.g. Force 21 Land Warrior and Objective Individual Combat Weapon.

- (U) ($1,763) Logistics Imperative: Continue to develop and demonstrate technologies to enhance ability to provide combat service support to the MAGTF for both traditional and emerging OMFTS Amphibious Operations. Mission areas emphasized: Supply, which addresses an operationally reliable, cost effective warehousing system with in-transit/total asset visibility of supplies and equipment for platform design; Maintenance, which addresses reduction of down time on ground equipment through prognostics, mobile and seabased maintenance facilities; reduction in tare (weight) and delivery time through improved packaging techniques and materials, Expeditionary Engineering, which addresses enhanced mobility, flexibility and capability of deliberate engineer equipment available to expeditionary forces; Health Services, which addresses enhancement of capability through use of modular medical facilities; and a systematic approach called Advanced Amphibious Logistics Technology, ATDs will address all functions of Logistics.

- (U) ($3,070) Training and Education Imperative: Develop and demonstrate technologies to enhance 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. The Team Tactical Engagement ATD will transition to the initial efforts which will involve M&S in support of training (mission specific), wargaming, concept development, and analysis. Emphasis is on entity development and environmental representation reflecting unique Marine Corps missions, organization, and equipment.

- (U) ($20,000) Warfighting Experimentation Imperative: Continue to support the CWL in the implementation of the Sea Dragon process. Serving as the integrating ground for new technologies and as the focal point for warfighting refinements, the CWL will remain the critical engine to take the Marine Corps into the twenty-first

century. FYDP sets forth the vision and actions for the CWL and serves as the guideline for planning and experimentation. The second phase of the FYEP is an AWE named Urban Warrior, focusing on the urban littoral environment. Preparations will begin in April 1997 and conclude with the AWE in May 1999. LOEs supporting the second phase will emphasize experiments that contribute to improving urban warfare capabilities, and culminating in the AWE. LOE areas of experimentation include: C4I; Non-lethal Weapon Systems (Employment, C, and Development); Indirect Fires and Precision Targeting in the Urban Environment; Sensor (Employment, C, and Development); Position Location; Mobility; and Unmanned Vehicles. All LOEs are closely tied to other service efforts including the Military Operations in Urban Terrain (MOUT) ACTD. Urban Warrior will test a full range of improved operational concepts, tactics, and technological developments. The SPAMGTF(X) CE supported by Marine forces from Second Marine Expeditionary Force (II MEF) will execute the Urban Warrior exercise, using a state of the art MOUT facility at Camp Lejeune, North Carolina. This AWE has three increments. The first increment consists of intensive training of an experimental platoon and several LOEs to determine validity of concepts. The second is the training of the SPMAGTF(X) and the third is the actual execution of the Urban Warrior AWE. These last two increments complete in FY 1999.

4. (U) FY 1999 PLAN:

- (U) ($3,805) C^2 Imperative: Continues to develop and demonstrate technologies to make decisions, communicate information and expand awareness in a high tempo, uncertain, and chaotic battlefield. The Expeditionary Integrated Combat Operations Center (EICOC) demonstrates a build #1 prototype capability. The Joint Tactical Comm System demonstrates ultra-wide band secure communications. The Joint Information Warfare effort defines the technical approach and testing exit criteria.

- (U) ($4,658) Maneuver Imperative: Continues to develop and demonstrate technologies that enhance tactical mobility. Survivability of platforms and minimizing the footprint ashore of Marine units. The Joint Stand-Off Mine Detection System develops a capability for day/night operation in the littoral area. The Expeditionary Maneuver Technology effort focuses on demonstrating a hybrid electric Reconnaissance Vehicle.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

- (U) ($1,711) Firepower Imperative: Demonstrate technologies to increase accuracy, range lethality, integration, and timeliness of direct, indirect, and close fires.

- (U) ($2,580) Logistics Imperative: Continues to develop and demonstrate technologies that enable sea-based logistics, a tailored presence ashore (elimination and supply dumps) and reducing consumables. The Expeditionary Bulk liquids effort transitions to DEMVAL.

- (U) ($2,013) Training and Education Imperative: Continues to develop and demonstrate technologies to enhance the cognitive and higher-order abilities of Marine Warfighters. Also will focus on integrating intelligent adversaries into the USMC Family of Mission Training Simulators.

- (U) ($24,850) Warfighting Experimentation Imperative: Continue to support the CWL in the implementation of the Sea Dragon process. Serving as the integrating ground for new technologies and as the focal point for warfighting refinements, the CWL will remain the critical engine to take the Marine Corps into the twenty-first century. The FYEP sets forth the vision and actions for the CWL and serves as the guideline for planning and experimentation. The main effort will be the Urban Warrior AWE, conducted at Camp Lejeune, North Carolina in May/June 1999. The SPMAGTF (X) with subordinate elements, will be fully operational and complete training in preparation to execute the AWE. The Urban Warrior exercise will examine the capabilities necessary to conduct seabased military operations in the unique environment of the urban littoral. Operations Other Than War (OOTW) to Mid-Intensity level conflict will be the scenario of the AWE with objectives to include the ability to achieve battlespace dominance across the spectrum of a time, place, and duration of our choosing. This AWE is synchronized with the Army-led MOUT ACTD effort.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	24,973	20,712	24,357	25,296
(U) Adjustments from FY 1997 PRESBUDG:	+$1,175	+$40,415	+$9,821	+$14,321
(U) FY 1998/1999 PRESBUDG Submit:	26,148	61,127	34,178	39,617

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments include (+$1,016) due to the new Sea Dragon series of Warfighting Experiments per Commandant s Planning Guidance, (-$132) for Jordanian F-16 financing rescission, and (+$291) for minor adjustments. FY 1997 adjustments include (+$37,800) due to new Sea Dragon series of Warfighting Experiments brought about by the Commandant s Planning Guidance and the continuing ATD effort for COBRA, (-$2,711) for Congressional Undistributed Reductions and (+$5,326) for internal USMC realignment. FY 1998 adjustments include (+$7,500) due to the new Sea Dragon series of Warfighting Experiments and a continuing ATD effort for COBRA, (+$2,446) for internal USMC realignment, (-$85) for inflation, and (-$40) for NWCF and minor adjustments. FY 1999 adjustments include (+$14,900) due to the new Sea Dragon series of Warfighting Experiments brought about by the Commandant s Planning Guidance and the continuing ATD effort for COBRA,(-$333) internal USMC realignment, (-$99) due to NWCF minor adjustments and (-$147) due to Inflation.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

(U) RELATED RDT&E:
- (U) PE 0602618A (Ballistics Technology)
- (U) PE 0603004A (Weapons and Munitions Advanced Technology)
- (U) PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
- (U) PE 0603606A (Landmine Warfare and Barrier Advanced Technology
- (U) PE 0603607A (Joint Service Small Arms Programs)
- (U) PE 0603619A (Landmine Warfare and Barrier Advanced Demonstrations)
- (U) PE 0603772A (Battlefield Force Integrations)
- (U) PE 0604207A (STINGRAY)
- (U) PE 0604710A (Night Vision Systems - Engineering Development)
- (U) PE 0604806A (Chemical/Biological Defense Equipment - Engineering Development)
- (U) PE 0604808A (Landmine Warfare and Barrier Engineering Development)
- (U) PE 0602301E (Computing Systems and Communications Technology)
- (U) PE 0602702E (Tactical Technology)
- (U) PE 0603226E (Experimental Evaluation of Major Innovative Technologies)
- (U) PE 0206623M (Marine Corps Ground/Supporting Arms Systems)
- (U) PE 0602131M (Marine Corps Landing Force Technology)
- (U) PE 0603612M (Marine Corps Mine/Countermeasures Systems)
- (U) PE 0603635M (Marine Corps Ground Combat/Support System)
- (U) PE 0604719M (Marine Command Control/Communications Systems (Advanced))
- (U) PE 0204163N (Fleet Communications)
- (U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
- (U) PE 0603555N (Undersea Superiority Technology Demonstrations)
- (U) PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M PROJECT NUMBER: C2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations (ATDs) PROJECT TITLE: Marine Corps ATDs

(U) PE 0603794N (Command, Control, Communications, Advanced Technology)
(U) This program is in compliance with Tri-Service Reliance Agreements.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & ACTUAL	FY 1996 ACTUAL	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
M0095 Fleet Health Technology	11,790	9,172	13,046	11,518	10,581	10,818	11,048	11,303	CONT.	CONT.
M0096 Fleet Health Standards	4,139	5,066	5,286	5,525	5,670	5,798	5,922	6,059	CONT.	CONT.
M2022 Bone Marrow Registry	31,014	19,179	0	0	0	0	0	0	0	148,851
M2284 Prostate Cancer Research	7,093	0	0	0	0	0	0	0	0	7,266
M2285 DOD Head Injury	947	0	0	0	0	0	0	0	0	905
M2286 Blood Storage Research	948	0	0	0	0	0	0	0	0	905
M2287 Navy Biodynamics Lab (NBDL)	2,838	0	0	0	0	0	0	0	0	2,906
M2288 Medical Dev General	1,416	0	0	0	0	0	0	0	0	1,453
M2332 Mobile Medical Device	0	3,836	0	0	0	0	0	0	0	3,836
M2333 Rural Health	0	3,355	0	0	0	0	0	0	0	3,355
M2334 Bone Marrow	0	13,429	0	0	0	0	0	0	0	13,429

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U)COST: (Dollars in Thousands)

PROJECT NUMBER & ACTUAL	FY 1996 ACTUAL	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
M2335 Casualty Stabilization	0	2,491	0	0	0	0	0	0	0	2,491
M2336 Freeze Dried Blood	0	2,400	0	0	0	0	0	0	0	2,400
TOTAL	60,185	58,928	18,332	17,043	16,251	16,616	16,970	17,362	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 return to duty of 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & ACTUAL	FY 1996 ACTUAL	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
M0095 Fleet Health Technology	11,790	9,172	13,046	11,518	10,581	10,818	11,048	11,303	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) blood products, blood substitutes, and hematopoietic stem cells; (2) combat wounds and multiple organ system failure; (3) fleet health in extreme environments; and (4) field diagnostics and medical/dental support capabilities.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($2,400) TREATMENT OF CASUALTIES, TO PREVENT HEMORRHAGIC SHOCK AND COMPLICATIONS ASSOCIATED WITH COMBAT TRAUMA: Initiated the development of new thrusts: (1) validated the feasibilty and efficiency of life ustainment and casualty stabilization interventions including metabolic modulations to reduce oxygen requirements, modes of hibernation induction, hypothermic treatments, and control of exsanguination, (2) initiated studies that developed new approaches to treatment of hemorrhagic shock.

- (U) ($2,800) BLOOD AND BLOOD PRODUCTS: Submitted data to Food and Drug Administration (FDA) for license of (1) human red blood cells frozen with 40% W/V glycerol at -80°C for 20 years, (2) human platelets frozen with 6% DMSO at -80°C for 2 years, and (3) "functionally closed" system to deglycerolize red blood cells enabling post wash storage at 4°C for at least 2 weeks. Completed Phase I clinical trials of enzymatic converted Type B cells to Type O cells. Continued studies on a portable, self contained, durable, deployable ex vivo expansion system for bone marrow stem cells to be used for autologous stem cell transfusion. Continued studies on extended liquid storage of human red cells to 12-16 weeks. Continued studies in lyophilized blood product technologies for improved shelf life.

- (U) ($1,900) MODULATION OF IMMUNE SYSTEM OF CASUALTIES: Validated the results of the in vivo studies with T-lymphocyte costimulatory receptors. Initiated use of the transgenic mouse strains for studies which will elucidate costimulatory treatment mechanisms for specific model diseases.

- (U) ($750) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN EXTREME ENVIRONMENTAL CONDITIONS: Completed the evaluation of the effects of vasopressin, neuropeptide Y, and other transmitters on physiological and behavioral performance under conditions of thermal stress and validated the findings. Initiated studies to reduce or prevent cold related injuries for combat personnel, particulary related to non-freezing cold related injuries in the extremities. Initiated studies to evaluate musculoskeletal injuries in extreme environment and military scenarios and develop methodologies to reduce and/or prevent these injuries. Began to study the value of intervention techniques which preclude high risk individuals.

- (U) ($2,400) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continued to interface the Epidemiological Information System (EPISYS), Shipboard Automated Medical Systems (SAMS) and selected medical databases. Continued to develop models for projecting casualty rates for various battle intensities. Completed the validation of the casualty projection system for shipboard use.

- (U) ($600) NAVY DENTAL RESEARCH: Developed efforts encompassing 1) the systematic, scientific investigation of problems related to the oral health, wellness, disease, and injury of Navy and Marine Corps personnel; 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. Examples of specific, high payoff projects include development of a multimedia diagnostic system for corpsmen; risk assessment strategies and program; dental disease progression methods and diagnostics; and a managed dental care system; and study of Navy dental examination periodicity and mercury contamination of wastewater from Navy dental treatment facilities.

- (U) ($940) PREVENTION AND TREATMENT OF MUSCULOSKELETAL INJURIES: Validated the relative risks assigned to epidemiological, orthopedic and biomechanical factors related to musculoskeletal trauma. Completed the validation of the general classification function previously generated to identify injury-prone individuals and initiate prospective cohort study. Assessed intervention strategies to reduce the incidence, and improve the treatment, of injury.

2. (U) FY 1997 PLAN:

- (U) ($2,300) 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 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. Continue studies into the complications of hemorrhagic shock and late sequelae that may be prevented with early interventions.

- (U) ($2,600) BLOOD AND BLOOD SUBSTITUTES: Continue clinical trials and obtain 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. Continue and 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 B to O conversion regimen for full FDA approvals. Continue the refinement of A to O conversion and begin 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 to improve the usability of frozen red cell units. Continue development of freeze-dried red blood cell units having a minimum of a two-year room temperature shelf-life and ease of use with immediate transfusion post-rehydration. Continue the development of improved frozen and freeze-dried platelet products with 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. Continue the development of liposome encapsulated hemoglobin as an oxygen carrying blood substitute and initiate clinical trials of current formulations. Extend studies of stroma-free hemoglobin oxygen carriers specifically formulated to prevent vasoactive side effects. Continue studies on advanced hemosstasis for arterial venous, and capillary bleeding in tissues and organs; provide heostatic agents in formulations (gels, sponges, and foams) that may be easily delivered to casualty wound sites in combat environments; and test hemostatic agents in large animal models of hemorrage.

- (U) ($1,446) 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. Specifically continue 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. Continue the development of oral cytokine administration techniques that modulate and/or prevent septic sequelae following trauma. Begin large animal studies to demonstrate the efficacy of oral cytokines in preventing complications from combat relevant trauma and hemorrhage.

- (U) ($1,100) PHYSIOLOGICAL ENHANCEMENT OF PERFORMANCE IN MILITARY/EXTREME ENVIRONMENTAL CONDITIONS: Begin formulation of vasopressin regimen 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 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 of musculoskeletal trauma.

- (U) ($1,200) MEDICAL MANAGEMENT TOOLS AND EQUIPMENT USED IN FIELD OPERATIONS: Continue to interface the EPISYS, SAMS and selected medical databases for advanced medical support planning and casualty management. Validate 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. 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.

- (U) ($500) NAVY DENTAL EMERGENCIES: Continue 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.

- (U) ($26) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($3,100) 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.

- (U) ($3,595) 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 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/EXTREMENT 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 war fighting 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.

4. (U) FY 1999 PLAN:

- (U) ($2,680) 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 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. Extend studies to a large animal model and Phase I clinical trials.

- (U) ($3,220) 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/EXTREMENT 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) ($1,327) 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 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 war fighting scenarios and medical support capabilities.

- (U) ($791) 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:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	12,576	12,061	13,002	11,569
(U) Adjustments from FY 1997 PRESBUDG:	-786	-2,889	+44	-51
(U) FY 1998/1999 President Budget s Submission:	11,790	9,172	13,046	11,518

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 reduction resulted in the Jordanian F-16 financing rescission (-13); actual execution (-750); and from FY 1996 SBIR Transfer funds adjustment (-23). The FY 1997 reductions results from the Congressional Undistributed Reductions (-389); and from Realignment Congressional Earmark Freeze Dried Blood M0095 to M2336 (-2,500). The FY 1998 increase results from Navy Working Capital Fund (NWCF) and minor adjustments (+76); and from inflation adjustment (-32). The FY 1999 reduction results from the NWCF and minor adjustments (-9); and from inflation adjustment (-42).

(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)

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROJECT NUMBER: M0095
PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT TITLE: Fleet Health Technology

(U) PE 0602233N (Readiness, Training and Environmental Quality)
(U) PE 0604771N (Medical Development (ENG))
(U) This program is coordinated through the Armed Services Biomedical Research Evaluation and Management Committee.

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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

(U) COST: (Dollars in thousands)

PROJECT NUMBER & ACTUAL	FY 1996 ACTUAL	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
M0096 Fleet Health Standards	4,139	5,066	5,286	5,525	5,670	5,798	5,922	6,059	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 1996 ACCOMPLISHMENTS:

- (U) ($600) MEDICAL STANDARDS FOR SELECTION: Continued development of gender-neutral occupational strength and fitness standards for aviation and shipboard personnel.
- (U) ($800) REDUCE ATTRITION AND INJURY: Developed Physiological Heat Exposure Limit curves for shipboard engine room and firefighting personnel. Developed Physiological Cold Exposure Limit curves for Marine Corps Mountain Warfare Training Center.
- (U) ($275) REDUCE ATTRITION AND INJURY: Continued development of shipboard industrial hygiene expert system; deliver prototype.
- (U) ($200) REDUCE ATTRITION AND INJURY: Completed testing protocol for screening hazardous materials toxicity assessment methodologies for organic nitrate compounds.
- (U) ($284) REDUCE ATTRITION AND INJURY: Delivered pocket-size Light Emitting Diode (LED) dosimeter for Radio Frequency (RF) radiation. Continue dosimetry research on ship topside RF exposures.

- (U) ($850) REDUCE ATTRITION AND INJURY: Developed work-rest cycle operational guidelines for naval firefighters and shipboard engine room personnel. Developed improved cold weather operational guidelines to reduce cold related injuries and enhance performance parameters.

- (U) ($1,130) ENHANCE PERFORMANCE: Developed alertness monitoring/management system. Develop sleep and alertness enhancers.

2. (U) FY 1997 PLAN:

- (U) ($970) UNDERSEA MEDICINE, DIVER DECOMPRESSION, AND OXYGENT TOXICITY: Initiate 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; develop preventive and treatment methods for oxygen toxicity; and enhance protocols for improving submarine rescue operations.

- (U) ($644) SPECIAL OPERATIONAL HUMAN PERFORMANCE GUIDELINES: Provide recommendations for use of biomedical countermeasures to counteract performance decrements associated with sustained operations. Provide field training course/material on fatigue countermeasures for Navy operations.

- (U) ($610) MEDICAL STANDARDS FOR PERSONNEL SELECTION: Continue work in gender-neutral fitness standards for shipboard and aviation duty. Deploy a selection test battery for unmanned aerial vehicle operators.

- (U) ($800) ENHANCE HUMAN PERFORMANCE: Deliver improved countermeasures to heat strain for shipboard engine room chemical/biological protective gear and firefighting personnel. Develop field cooling requirements to prevent

- body heat storage during physical activity and heat exposure while dressed in the standard Navy firefighting ensemble. Quantify the whole body cooling required to extend stay-time in the heat by 100 percent while wearing

the Chemical Biological Radiology (CBR) ensemble. Evaluate the cooling capacity of advance design liquid cooling systems to reduce heat strain during exercise and heat exposure.

- (U) ($675) AVIATION/SPATION DISORIENTATION ATTRITION AND INJURY REDUCTION: Initiate program in identification and prevention of aircraft mishaps due to spatial disorientation, human performance and human factors problems.
- (U) ($578) RADIO FREQUENCY RADIATION EXPOSURE EFFECTS (REDUCE ATTRITION AND INJURY): Conduct field measurement and computational dosimetry study of RF radiation exposures in Navy and Marine Corps operational environments. Determine ocular effects of pulsed microwave exposures.
- (U) ($222) HEALTH PROMOTION; REDUCTION OF MILITARY ATTRITION AND INJURY : Develop guidelines for health promotion from longitudinal analysis of military lifestyle, diet and smoking cessation.
- (U) ($346) REDUCE ATTRITION AND INJURY RELATED TO TOXICITY: Initiate identification of toxicants in shipboard fire smoke that cause acute respiratory distress and identify biological mechanisms involved. Initiate development of Neuromolecular Toxicity Assessment System (NTAS) for health hazard evaluation of neurotoxicants.
- (U) ($187) REDUCE ATTRITION AND INJURY RELATED TO INDUSTRIAL HYGIENE HAZARDS: Deliver validated expert system for shipboard industrial hygiene hazard recognition and survey reporting.
- (U) ($34) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEETDATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROJECT NUMBER: M0096
PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT TITLE: Fleet Health Standards

- (U) ($960) 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.

- (U) ($591) 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.

4. (U) FY 1999 PLAN:

- (U) ($960) 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.

- (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) ($313) 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) ($536) 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.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEETDATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603706N PROJECT NUMBER: M0096
PROGRAM ELEMENT TITLE: Medical Development (Advanced) PROJECT TITLE: Fleet Health Standards

(U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	4,241	5,281	5,313	5,575
(U) Adjustments from FY 1997 PRESBUDG:	-102	-215	-27	-50
(U) FY 1998/1999 President s Budget Submission:	4,139	5,066	5,286	5,525

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The 1996 reduction resulted from the Jordanian F-16 financing rescission (-4); and actual execution (-98). The FY 1997 reduction results from the Congressional Undistributed Reductions (-215). The FY 1998 reduction results from the Navy Working Capital Fund (NWCF) and minor adjustments (-14); and from the inflation adjustment (-13). The FY 1999 reduction results from the NWCF and minor adjustments (-30); and from the inflation adjustment (-20).

(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 Environmental Quality)
(U) PE 0604771N (Medical Development (ENG))

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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 1996 ACTUAL	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
* R0542 Air Human Factors Engineering	558	1,081	1,109	1,129	1,151	1,178	1,203	1,231	CONT.	CONT.
* R1770 Manpower and Personnel Development	3,355	3,836	3,964	4,206	4,316	4,417	4,512	4,615	CONT.	CONT.
* R1771 Ship Human Factors Engineering	2,502	2,095	2,132	2,171	2,202	2,252	2,302	2,355	CONT.	CONT.
* R1772 Education and Training Development	4,402	5,678	5,266	6,435	6,553	6,655	6,769	6,899	CONT.	CONT.
* R1773 Simulation and Training Devices	4,955	5,800	6,341	7,700	7,279	7,317	7,469	7,636	CONT.	CONT.
TOTAL	15,772	18,490	18,812	21,641	21,501	21,819	22,255	22,736	CONT.	CONT.

* Projects Realignment from L code to R code in FY96.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element supports the Joint Support Areas for Manpower & Personnel, Shore 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:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development

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.

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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology PROJECT NUMBER: R0542
PROJECT TITLE: Air Human Factors Engineering Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R0542 Air Human Factors Engineering	558	1,081	1,109	1,129	1,151	1,178	1,203	1,231	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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology PROJECT NUMBER: R0542
PROJECT TITLE: Air Human Factors Engineering Development

(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 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 1996 ACCOMPLISHMENTS:

- (U) ($558) New Starts:
  - (U) A Statement of Work was written and approved for Naval Research Lab (NRL) tasking to incorporate satellite imagery into Aircraft Optical Disk images for AV-8B digital moving-map systems. Delivered satellite imagery to NRL with software to enable them to display/read it. Acquired the image cells of the China Lake area, and combined them into one continuous database. Developed an algorithm to accurately determine the latitude and longitude of every satellite-generated pixel in the database. Built a simulation facility to be used for risk reduction activities prior to flight testing of the imagery.

2. (U) FY 1997 PLAN:

- ($1,081) Continuations:
  - (U) Plan demonstration to show that the 3-D scene generation system can display satellite imagery from the viewpoint of the aircraft. Schedule demonstration.
  - (U) Build 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).
  - (U) Integrate with Aircraft Avionics. This task will include integration of necessary hardware and software into the aircraft avionics.

3. (U) FY 1998 PLAN:

- ($1,109) Completions:
  - (U) 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.

4. (U) FY 1999 PLAN:

- ($1,129) New Starts:
  - (U) Initiate a technology demonstration program to assess the utility of enhanced imagery to improve lethality while reducing the threat of information warfare.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	1,043	1,126	1,134	1,149

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R0542
PROJECT TITLE: Air Human Factors Engineering

(U) Adjustments from FY 1997 PRESBUDG:	-485	-45	-25	-20
(U) FY 1998/1999 President s Budget Submission:	558	1,081	1,109	1,129

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 reduction is due to actual execution (-484); and from the Jordanian F-16 financing rescission (-1). The FY 1997 reduction is due to Congressional Undistributed Reductions (-45). The FY 1998 reduction results from Navy Working Capital Fund (NWCF) changes and minor adjustments (-25); and from inflation adjustment (- 3). The FY 1999 reduction results from NWCF and minor adjustments (-16); and from inflation adjustment(-4).

(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 (Readiness, Training and Environmental Quality)
(U) PE 0603792N (Advanced Technology Transition)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1770
PROJECT TITLE: Manpower and Personnel Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1770 Manpower and Personnel Development	3,355	3,836	3,964	4,206	4,316	4,417	4,512	4,615	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 1996 ACCOMPLISHMENTS:

- ($1,076) New Starts:
  - (U) Developed a system to estimate officer accession requirements and to develop cost effective officer accession plans.

- (U) Demonstrated benefits of integrating officer planning, management, and analytical systems to eliminate duplication of effort as officer planners and managers reorganize to separate functional groups and locations.
- (U) Demonstrated how to obtain a more effective and efficient enlisted community management process to improve manning/readiness levels.
- (U) Tested and evaluated client-server technology for accessing corporate personnel and billet files for integrated Active Duty, both officer and enlisted, and Reserve management.

• ($515) Continuations:
- (U) Designed and tested alternative econometric models for allocating distribution-impacting pays, such as sea pay, sub-pay and hazardous duty pay to skill groups; developed econometric models for allocating retention impacting pays and bonuses, given new Navy skill categories and career paths.

• ($1,764) Completions:
- (U) Developed an assignment execution monitoring system to measure policy compliance and to provide feedback for corrective action.
- (U) Demonstrated a system to effect assignment policy tradeoffs.
- (U) Developed a decision support system to integrate the management of recruiting, delayed entry program, enlistment incentives, initial skill training and enlisted strength planning to improve ability of these systems to respond to each other.
- (U) Developed recruit attrition and advancement forecasting models; incorporated new models into enlisted strength policy analysis model; tested and evaluated resulting system in operational setting.

2. (U) FY 1997 PLAN:

• ($1,924) New Starts:

- (U) Initiate Training Costs for Navy Personnel Models Project; capitalize 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) Initiate Permanent Change of Station (PCS)/Temporary Duty Under Instruction (TEMDUINS) impact on Navy Personnel Unit Readiness Project; develop mathematical modeling techniques in assignment optimization to improve linkage between personnel unit readiness and PCS/TEMDUINS budgets; additionally, impacts on insufficient funding as relates to readiness will be explored.
- (U) Initiate Distribution System 2000 Prototyping Project; explore 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) Initiate Computer Communications Technology for Recruiting Project; identify and integrate into the design of an overall system architecture promising technologies to improve recruiting effectiveness.

• ($1,392) Continuations:
- (U) Develop client-server prototype for integrated access to active duty and reserve, officer and enlisted, personnel and billet file systems.
- (U) Develop officer accession planning prototype system that recognizes strength constraints, accession source mixes and prevailing recruiting conditions.
- (U) Develop integrated force structure/personnel prototype tool using Accordion Model proof of concept for enlisted community development.

• ($520) Completions:
- (U) Develop and implement 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1770
PROJECT TITLE: Manpower and Personnel Development

3. (U) FY 1998 Plan:

- ($375) New Starts:
  - (U) Determine feasibility of econometric modeling of special pays (reenlistment bonuses) to influence retention and improve readiness.

- ($3,189) Continuations:
  - (U) Continue developing client/server technology for use by manpower/personnel managers (was FY 1996 New Start).
  - (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 New-start projects.

- ($400) Completions:
  - (U) Develop integrated pilot system for officer accession planning and personnel management.

4. (U) FY 1999 Plan:

- ($356) New Starts:
  - (U) Determine feasibility of econometric modeling of bonus pays to influence retention and improve readiness.

- ($1,000) 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.

- ($2,850) Completions:
  - (U) Complete development of the Assessment Planning Model that will calculate personnel flows for training and their associated training costs.
  - (U) Complete 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) Complete PCS/TEMDUINS Model to provide improved decision making, bound resource expenditures per assignment cycle (every two weeks), and improve linkages between personnel unit readiness and PCS/TEMDUINS budgets.
  - (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.
  - (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.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	3,749	3,998	3,978	4,243
(U) Adjustments from FY 1997 PRESBUDG:	-394	-162	-14	-37
(U) FY 1998/1999 President s Budget Submission:	3,355	3,836	3,964	4,206

(U) CHANGE SUMMARY EXPLANATION:

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1770
PROJECT TITLE: Manpower and Personnel Development

(U) Funding: The FY 1996 reduction results in the Jordanian F-16 financing rescission (-4); and from actual execution (-390). The FY 1997 reduction results from the Congressional Undistributed Reductions (-162). The FY 1998 reduction results from the NWCF and minor adjustments (-4); and from the inflation adjustment (-10). The FY 1999 reduction results from the NWCF and minor adjustments (-21); and from the inflation adjustment (-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 (Readiness, Training, and Environmental Quality)
(U) PE 0603007A (Human Factors, Personnel and Training Advanced Technology
(U) PE 0603227F (Personnel, Training, and Simulation Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1771 Ship Human Factors Engineering	2,502	2,095	2,132	2,171	2,202	2,252	2,302	2,355	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 1996 ACCOMPLISHMENTS

- ($595) New Starts:
  - (U) Completed requirements analysis of the software and hardware needs for the Open Systems Workstation (OSAW) design. Selected, ordered and integrated the software and hardware into the prototype ergonomic OSAW. Conducted successful demonstration at request of sponsor.

- (U) Completed a study on the feasibility of a laboratory simulation of the sonar multi-ping classification algorithms developed at the University of Texas Applied Research Laboratories for the purpose of evaluating human-system interface design options. Constructed a color-code for Doppler information consistent with a proposed color-code for classification information. Completed the design of a series of quantitative experiments evaluating the performance of the Naval Undersea Warfare Center (NUWC) Active Adjunct Processor notional display suite augmented with color-coded Doppler information.

- ($1,441) Continuations:
  - (U) Completed development of prototype 2 Dimension (2D) and 3D visualizations related to Information Warfare (IW) data. Linked visualizations to nodal analysis tools. Initiated analysis for development of IW planning tools, collaborative linkages and information management systems for the Command and Control Warfare Commander (C2WC). Conducted demo in Joint Warrior Interoperability Demonstration 96.
  - (U) Completed installation of a prototype Political-Military Anchor Desk--Research, Analysis Information System (PMAD-RAIS) at USCINCPAC Gaming and Simulation Facility. The PMAD-RAIS prototype consists of a three tier client-server architecture that provides researchers the ability to search local and remote databases for information on political-military, economic, and sociological developments relating to the Pacific Command area of responsibility. Search results are ranked by relevance, context, and validity. The output of the PMAD-RAIS has been used to respond to "short-fuse" information requests from the staff and to prepare background papers for senior decision makers.
  - (U) Completed a usability study of application tools designed for command staff document generation. The performance evaluation and determination of the value added by these tools was successfully completed at Chief of Naval Operations (OPNAV), Commander in Chief, Pacific Fleet (CINCPACFLT), CINCLANTFLT, and Type Commanders(TYCOMS).

- ($466) Completions:

- (U) The final increment of the Combat Information Center (CIC) software build resulted in the following: transition of Human Computer Interface (HCI) control/display products developed in the preceding incremental builds to TAC-4 workstations, linking of HCI software with an operational Navy tactical data base, a new interface for constructing display doctrine statements on CIC operator consoles and an expanded set of symbol set choices and enhancement coding dimensions for use in constructing display doctrine statements and variable coded symbology track "filters." Two empirical tests of the variable coded symbology concept, which allows vehicular track symbols to be visually emphasized or receded on the same tactical situation display, were also completed.
- (U) Initiated development of a web-based human factors data collection system in support of a prototype study and evaluation of the Disaster Relief Anchor Desk user interface. Established a formal relationship with the Pacific Disaster Center (PDC) and then became the CINCPAC technical representative to the PDC. Completed work on the Damage Prediction upgrade system installation at CINCPAC and at the Maui High Performance Computing Center. Supported CINCPAC and other organizations during several major military and civilian exercises.

2. (U) FY 1997 PLAN:

- ($422) New Starts:
  - (U) An applied research program, Tactical Decision-Making Under Stress (TADMUS), will transition into this program element for a shipboard advanced technology demonstration. Emphasis will be on improved user-computer interface and display design for anti-air warfare. Prototype display formats developed under the 6.2 program will be modified and enhanced to be compatible with the hardware and software capabilities of shipboard combat systems.
  - (U) Evaluate 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 will be completed for selected warfare area such as Anti Air Warfare, Antisubmarine Warfare (ASW) and Anti Surface Warfare. This will be combined with an 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.

- ($816) Continuations:
  - (U) Continue development and user evaluation of the OSAW. Complete integration of hardware, user-computer interface and ergonomic design of the workstation. Conduct demonstrations and user evaluation workshops.
  - (U) Complete laboratory performance evaluation of Active Adjunct Processor displays with color-coded Doppler information, including surface duct and variable depression search displays. Develop a color-code recommendation for the multi-ping classification algorithms included in the Active Adjunct Processor. Develop a recommendation for the query-readout area of the human-system interface for the multi-ping classification system. Design a laboratory evaluation of the performance of the recommended multi-ping classification interface.

- ($857) Completions:
  - (U) Complete development and prototype testing in both shore and afloat environments of the C2WC information management and planning module. Document C2W module requirements. Transition software and requirements to Joint Maritime Command Information System (JMCIS) program.
  - (U) Continue development and refinement of existing prototype architecture, particularly in the implementation of object-oriented linking. The database management system will be improved and streamlined, and an advanced user interface will be implemented. New collaborative tools will be added, information manipulation and presentation tools will be enhanced, and intelligent agent capabilities will be added. Product will transition to Gaming and Simulation facility (J-53) at CINCPAC.
  - (U) The usability evaluation of the remaining application tools, OPNAV Requirements, Help, Training, and Activity will be completed and overall before-after performance improvement determined. The completed

integrated package will transition to CINCLANTFLT N-8 as well as other Fleet and TYCOM commands in both the Atlantic and Pacific theater.

3. (U) FY 1998 PLAN:

- ($566) New Starts:
  - (U) Develop a capability/readiness monitoring and planning system to allow ships to effectively manage non-organic assets during catastrophic conditions. Major emphasis during the first year will be function and compatibility analysis of selected weapon systems.
  - (U) A detailed requirements analysis will be conducted of the collaborative needs required for distributed decision-makers in a battlefield/battlegroup environment as well as an assessment of the tools available to meet these needs. A preliminary hardware and software architecture will be developed to address these collaborative issues. Architecture will be modified based upon user evaluation and performance measurement.

- ($750) Continuations:
  - (U) Enhanced user-computer interfaces will be developed for the 3-D 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 HCI devices and to generate the 3D rendering displays.
  - (U) The re-hosted TADMUS software will be evaluated in a TAC-4 environment and new display parameters will be added based upon user evaluation from both laboratory and field tests. Approved TADMUS software will be incorporated into actual shipboard combat system computers and the displays will be located within CIC for real-world testing and evaluation.

- ($816) Completions:
  - (U) Complete user evaluations and overall system integration of OSAW. Document design and complete user s manual. Transition the technology adopted by the OSAW to the next-generation TAC and UYQ-70 program.

- (U) Complete laboratory performance testing of the recommended multi-ping classification interface for the Active Adjunct Processor. Coordinate with NUWC on the transition of laboratory tested interface recommendations into the Active Adjunct Processor design specifications.

4. (U) FY 1999 PLAN:

- ($721) New Starts:
  - (U) The emphasis upon reduced shipboard manning within the Navy requires that a detailed analysis be conducted upon the human factors engineering (HFE) consequences of this goal. Reduced manning implies either (1) fewer people doing more jobs; (2) more jobs being automated, increasing the system monitoring role required of the personnel left onboard or, more likely; (3) some combination of the two. An HFE evaluation will be performed for both these approaches on selected shipboard systems deemed critical to mission success. The hardware, software, cognitive and physiological consequences of reduced manning will be assessed and prototype new system architecture proposed and evaluated.
  - (U) Address the need within certain military documentation (e.g. Operations(OP) Plans, OP Orders, Commander s Estimate) to have immediate access to the reference materials that was abstracted to produce the final document. A concept of hyper-linkages between the main document and its component inputs will be evaluated to see if it meets this need. Currently, no Commercial-off-the-Shelf software has the specific capability required by the military, and a prototype document creation/management software user interface will be designed and tested.

- ($700) Continuations:
  - (U) Autonomous ships must still be able to conduct cooperative engagements with other ships. Interface strategies and the user-computer interface issues in linking weapon systems across platforms will be the major emphasis for this year.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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) Prototype architecture system for battlefield collaboration will continue to be refined based upon user evaluation, field testing and assessment of value added by the prototype system. Emphasis this year will be upon user-interface design and development of measures of effectiveness for evaluating the quality of the tactical decision-making of the distributed users.

• ($750) Completions:
- (U) Software metrics will be developed to allow the measurement of performance of the operators doing specific task portions of the JMCIS application. This will permit a quantitative evaluation of the actual value added by 3D rendering. High fidelity scenarios will be developed for operator testing. Those 3D rendering features which show improved operator performance will be transitioned into the JMCIS program.
- (U) Complete at-sea demonstration of revised TADMUS display software. Incorporate all user evaluations in embedded training modules and then transition to Third Fleet Flag Ship.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	2,015	2,183	2,190	2,212
(U) Adjustments from FY 1997 PRESBUDG:	487	-88	-58	-41
(U) FY 1998/1999 President s Budget Submission:	2,502	2,095	2,132	2,171

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 increase results from minor reprogrammings to support changes in requirements (+605); from the Jordanian F-16 financing rescission (-2); and from the Administrative and Personal Services Rescission (-116). The FY 1997 reduction results from the Congressional Undistributed Reductions (-88). The FY 1998 reduction results from the NWCF and minor adjustments (-53); and from the inflation adjustment (-5). The FY 1999 reduction results from the NWCF and minor adjustments (-33); and from the inflation adjustment (-8).

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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) 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 (Readiness, Training, and Environmental Quality)
(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1772
PROJECT TITLE: Education and Training Development

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1772 Education and Training Development	4,402	5,678	5,266	6,435	6,553	6,655	6,769	6,899	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 1996 ACCOMPLISHMENTS:

- ($1,123) New Starts:
  - (U) Began development of Interactive Multisensor Analysis Training (IMAT) applications to submarine sonar employmen Conducted technology demonstration. Full system procurement planned for FY99.
  - (U) Began development of IMAT application to electromagnetic and electro-optical sensor systems.

- ($2,878) Continuations:
  - (U) Analyzed the Surface Warfare Officer School (SWOS) Prospective Engineering Officer (PEO) course content. Conducted a training analysis for PEO materiel assessment task and drafted materiel assessment training scenarios. Determined feasibility of developing a virtual environment suitable for training engineering officers to do materiel assessment in a virtual environment. Developed measures of performance and effectiveness for PEO materiel assessment training. Completed initial conversion of DDG-51 main engine room CAD drawings into virtual scenes for the training prototype.
  - (U) Continued development of IMAT for Undersea Warfare: IMAT is being applied in all Navy undersea warfare communities (Aviation, Surface, Subsurface).
  - (U) Conducted IMAT waterfront/pre-deployment training for combined submarine/P-3 exercises -- result was significant improvement in at-sea submarine antisubmarine warfare performance, and increased contact time for P-3.
  - (U) Continued development of training seat reservation and school seat allocation systems for more efficient training throughput and increased fleet readiness. Completed the Show-up Rate Model, Booking Level Authorization Module, Student Demand Forecasting Model, and the Capacity Allocation Model for the Quota Management System. Effort received written endorsement for implementation from Assistant Secretary of the Navy, Manpower and Reserve Affairs on 9 January 1996 and Chief of Naval Education and Training on 5 March 1996.

- ($401) Completions:
  - (U) Completed initial IMAT evaluation in aviation and surface A Schools -- results indicated significant performance improvements in basic undersea warfare skills.
  - (U) Completed development, implementation, and evaluation of multimedia (IETM) Automated Classroom authoring and training system at Service School Command, Great Lakes. Demonstrated gas turbine C school course time reductions and improved student performance using IETM/Automated Classroom.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1772
PROJECT TITLE: Education and Training Development

2. (U) FY 1997 PLAN:

- ($4,493) Continuations:
  - (U) Finalize materiel assessment case-based training scenarios and embed case-based learning strategies into virtual scenes for the training prototype. Convert DDG-51 remaining main engine spaces from CAD drawings into virtual scenes for the Virtual Environment (VE) training prototype. Initiate testing and revision of the VE training prototype.
  - (U) Continue development/demonstration of IMAT systems
  - (U) Complete 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.

- ($1,185) Completions:
  - (U) Complete IMAT development in A-School acoustics for aviation, surface, subsurface schools.

3. (U) FY 1998 PLAN:

- ($3,338) Continuations:
  - (U) Implement VE Training for Engineering prototype training program at 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.
  - (U) Continue development of on-board submarine sonar/combat systems operator training using IMAT methodology.

- ($1,928) Completions:

- (U) Complete IMAT development and evaluation in shore school based Undersea Warfare training.

4. (U) FY 1999 PLAN:

- ($6,435) Continuations:
  - (U) Substantive evaluation, including on-board data collection will be accomplished through iterative development and field testing. For evaluation purposes, prototype systems would 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.

B. (U) PROGRAM CHANGE SUMMARY

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	4,858	5,920	6,057	7,111
(U) Adjustments from FY 1997 PRESBUDG:	-456	-242	-791	-676
(U) FY 1998/1999 President s Budget Submission:	4,402	5,678	5,266	6,435

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 reduction results from the Jordanian F-16 financing rescission (-5); from the Administrative and Personal Services Rescission (-113); and from actual execution (-338). The FY 1997 reduction results from the Congressional Undistributed Reductions (-242). The FY 1998 reduction results from NWCF and minor adjustments (-7);

from BRAC/IV Transfer of NPRDC (-588); from Defense Science & Technology adjustment (-200); from inflation adjustment (-13); and from Military and Civilian Pay Rate adjustments (+17). The FY 1999 reduction results from the BRAC/IV Transfer of NPRDC (-640); from NWCF and minor adjustments (-33); from inflation adjustment (-24); and from the Military and Civilian Pay Rate adjustments (+21).

(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 (Readiness, Training and Environmental Quality)
(U) PE 0604703N (Personnel, Training, Simulation, and Human Factors)
(U) PE 0603007A (Human Factors, Personnel, and Training Advanced Technology)
(U) PE 0603227F (Personnel, Training, and Simulation Technology)
(U) PE 0605798D (Joint Services Manpower and Personnel Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1773
PROJECT TITLE: Simulation and Training Devices

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1773 Simulation and Training Devices	4,955	5,800	6,341	7,700	7,279	7,317	7,469	7,636	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the Shore 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 skilled personnel to handle complex weapons that may not be fired for extended periods (Strategic Deterrence); training for near-real-time targeting (Joint Strike); training operators and decision makers to respond to data received and processed at increasing speeds (Joint Space and Electronic Warfare/Intelligence); and training personnel to deal with target sets that are variable and difficult to identify as friendly or hostile (Joint Surveillance).

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- ($4,239) Continuations:

- (U) Demonstrated vastly improved shipboard instructor support based on new technology onboard a ship in support of afloat training and Battle Force Tactical Training (BFTT) in order to improve tactical team training and complex decision-making.
- (U) Continued to improve innovative instructional and simulation techniques for sonar employment using Commercial-Off-the-Shelf (COTS) hardware in order to greatly improve training and to reduce system costs by a factor of ten.
- (U) Completed a cognitive task analysis of electronic warfare and anti-air warfare positions. Completed the requirements for an automated performance recording system to greatly improve deployable training and decision making. Continued the development of a human performance model in order to automate performance assessment of individual and team skills.
- (U) Continued to improve 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.

• ($716) Completions:
- (U) Completed Distributed Interactive Simulation (DIS) technology demonstration showing solutions to Naval aviation problems allowing aviation trainers to be networked together for team tactical training and mission rehearsal. Transitioned DIS technology to UH-1 trainer to improve training and mission rehearsal including other services and allies.

2. (U) FY 1997 PLAN:

• ($1,106) New Starts:

- (U) Develop Transportable Strike/Assault Rehearsal System for precision strike. Select training and mission rehearsal requirements, simulation components and supporting databases.

- ($4,694) Continuations:
  - (U) Demonstrate, test and evaluate Shipboard Instructor 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.
  - (U) Demonstrate 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) Demonstrate 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) Demonstrate 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.

3. (U) FY 1998 PLAN:

- ($1,281) New Starts:
  - (U) Develop the training function of readiness. To develop this relationship, training effectiveness will be determined from Measures of Effectiveness (MOEs)/Measures 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) 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.

- ($2,140) Continuations:
  - (U) Demonstrate Transportable Strike/Assault Rehearsal System for precision strike. Evaluate training mission rehearsal requirements, simulation components and supporting data bases.

- ($2,920) 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.
  - (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:

- ($2,760) New Starts:
  - (U) Initiate the integration and development of Virtual Environment Training Technology for seated tasks such as those performed by Naval Aviators, in order to improve the fidelity and significantly reduce the costs and physical size of aviation training devices.

- (U) Initiate the development of simulations which model human cognitive interface with a complex system. These simulations will permit the manipulation of human capabilities in order to ascertain the combinations which lead to maximum man-machine system performance.
- (U) Initiate the development of a nonintrusive, compact, portable, shipboard trainer to be made available at duty stations to instruct in skill performance. Trainer will be modifiable via software to instruct various skills as they are required on-board ship.

• ($2,900) Continuations:
- (U) Demonstrate the training function of readiness. To develop this relationship, training effectiveness will be determined from MOEs/MOPs data, which in turn will be investigated for their ability to predict readiness. Readiness indicators, or the criteria, will be derived from performance during operational exercises.
- (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:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	5,595	6,046	6,547	7,747
(U) Adjustments from FY 1997 PRESBUDG:	-640	-246	-206	-47
(U) FY 1998/1999 President s Budget Submission:	4,955	5,800	6,341	7,700

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: Manpower, Personnel, and Training Advanced Technology Development
PROJECT NUMBER: R1773
PROJECT TITLE: Simulation and Training Devices

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 reduction results from Jordanian F-16 financing rescission (-6); from actual execution (-418); and from Administrative and Personal Services Rescission (-216). The FY 1997 reduction results from the Congressional Undistributed Reductions (-246). The FY 1998 reduction results from the NWCF and minor adjustments (-7); from Defense Science & Technology adjustments (-200); from inflation adjustment (-16); and from Military and Personal Pay Rate adjustments (+17). The FY 1999 reduction results from the NWCF and minor adjustments (-40); from inflation adjustment (-28); and from Military and Civilian Pay Rate adjustments (+21).

(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 (Readiness, Training and Environmental Quality)
(U) PE 0603216A (Synthetic Flight Simulator Devices Development)
(U) PE 0603227F (Personnel, Training and Simulation Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	13,149	13,535	14,314	15,277	17,104	17,973	18,363	18,759	CONT.	CONT.
R2206 Environmental Requirements Advanced Technology (ERAT)	5,432	5,621	3,935	4,795	6,034	6,170	6,302	6,447	CONT.	CONT.
R2289 Automatic Schematic Capture Auto, Navy (ASCAN)	3,390	0	0	0	0	0	0	0	0	3,390
R2337 Smart Base	0	19,181	0	0	0	0	0	0	0	19,181
R2338 Nickel-Zinc Battery	0	957	0	0	0	0	0	0	0	957
TOTAL	21,971	39,294	18,249	20,072	23,138	24,143	24,665	25,206	CONT.	CONT.

(U) In Fiscal Year 1996 project T1910 changed to R1910, reflecting shift to Office of Naval Research cognizance.

(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 LEAD project applies advanced technology to logistics needs and problems to: improve weapons systems support to reduce logistics life cycle costs; and improve readiness by reducing weapons system repair downtime. 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 new project. Program response to affordabililty requirements includes research and development on antifouling hull coatings, waterfront infrastructures, automated test program set generation, and laser weld repair technologies.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) The Navy S&T program includes projects that focus on or have attributes that enhance the affordability of warfighting systems. Efforts under projects R2289 Automatic Schematic Capture Auto, Navy (ASCAN), R2337 Smart Base and R2338 Nickel Zinc Battery reflect short-term Congressional Plus-ups.

(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R1910 Logistics Engineering Advanced Demonstrations (LEAD)	13,149	13,535	14,314	15,277	17,104	17,973	18,363	18,759	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The LEAD project improves weapon system readiness and supportability through development of advanced logistics technology. Tasks in this project typically fall into one of the following categories: electronics logistics, amphibious logistics, waterfront structures, advanced diagnostic techniques, or automated manufacturing and repair. This project facilitates transition of concepts from Applied Research to other research and development categories or directly to the fleet.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) Sustainable Hardware and Affordable Readiness Practices (SHARP)
  - (U) ($860) Demonstrated advanced electronic packaging cooling and interconnect techniques for support of high performance electronics. Efforts include high temperature packaging, transmit and receive module and optical backplane interconnect developments.
  - (U) ($956) Developed methods to capture electronic circuit assembly design with all of its constituent elements, independent of technology.
  - (U) ($780) Initiated development/technology insertion and demonstration of AA low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) ($1,662) Demonstrated improved repairability and logistics support in cost efficient and timely transportable techniques and processes for replacing nonprocurable and unreliable electronic circuit assemblies.

Specific efforts included demonstrating analog modeling and simulation and first pass prototyping and assisting weapon system designers in using commercial off the shelf (COTS) products.

- (U) Shipboard Flexible Computer Integrated Manufacturing (FCIM):
  - (U) ($900) Transitioned afloat-based FCIM to fleet implementation.
- (U) Interactive Electronic Technical Manuals (IETM):
  - (U) ($780) Completed prototype package defining automated technical data conversion process for government-owned and proprietary software.
  - (U) ($520) Transferred technical manual conversion technology and prototype processes to government programs and the public domain.
- (U) Real-Time Infrared System Test Set (RTIR):
  - (U) ($1,390) Designed and fabricated a greater definition infrared array (256x256 pixels) for use in built-in test equipment to expand its usability across systems.
- (U) Laser Weld Repair of Naval Materials:
  - (U) ($529) Developed and demonstrated ship propeller shaft repair using a laser working cell.
- (U) Diamond Film as Electronic Module Substrate:
  - (U) ($790) Fabricated Standard Electronic Modules (SEM) format E size diamond film on substrates/heatsinks and electronic circuitry on 6" x 6" SEM-E substrates.
- (U) Automated Shipboard Fueling System:
  - (U) ($570) Completed engineering design for DDG-51 automated fueling system and performed simulation tests.
- (U) Next Generation Test Generator (NGTG):

- (U) ($900) Developed and demonstrated the capability to perform fault diagnostics using neural network technology to develop test program set (TPS) software for electronic systems.

- (U) Waterfront Structures Repair and Upgrading:
  - (U) ($900) Initiated effort to demonstrate improved performance of new technology for waterfront structures.

- (U) Advanced Lighterage for High Sea State Operations:
  - (U) ($1,392) Initiated development of the Amphibious Cargo Beaching Lighter and its open-sea connection system.

- (U) Gas Turbines Intelligent Lubrication Monitoring System:
  - (U) ($220) Initiated effort to develop and demonstrate an approximate reasoning system for monitoring the lubrication system of a gas turbine engine.

2. (U) FY 1997 PLAN:

- (U) SHARP:
  - (U) ($812) 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) ($556) Develop methods to capture electronic circuit assembly design with all of its constituent elements, independent of technology.
  - (U) ($780) Continue development/technology insertion and demonstration of AA low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) ($460) Develop/evaluate commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) ($775) Demonstrate 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 COTS products.
- (U) ($470) Evaluate the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.

- (U) RTIR:
  - (U) ($792) Demonstrate full scale RTIR test set in a realistic field environment and begin transition to weapon systems programs. Perform optics upgrade fabrication and perform system integration.

- (U) Laser Weld Repair of Naval Materials:
  - (U) ($960) Develop and demonstrate a laser repair cell utilizing a 3-dimensional telerobotic manipulator. Begin transition of dual-use technology to government and commercial activities. Complete integration of 3-dimensional laser cell components. Construct the working cell and develop a software control interface.

- (U) Diamond Film as Electronic Module Substrate:
  - (U) ($520) Perform thermal, electrical and environmental module and enclosure tests and demonstrations. Perform module and enclosure integration, test the thermal and environmental enclosures, and perform an end-of-project demonstration.

- (U) Battery Charger/Analyzer:
  - (U) ($915) Develop battery diagnostics and charge technology that will reduce maintenance and extend the service life of the batteries.

- (U) Power Measurement Systems:
  - (U) ($1,237) Develop and demonstrate new low cost radio frequency (RF) power measurement devices.

- (U) NGTG:

- (U) ($600) 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) ($1,302) Continue effort to demonstrate and evaluate improved lighterage platforms and connector systems.

- (U) Waterfront Structures Repair and Upgrading:
  - (U) ($806) Continue effort to demonstrate improved performance of new technology for waterfront structures.

- (U) Gas Turbines Intelligent Lubrication Monitoring System:
  - (U) ($350) Develop and demonstrate an approximate reasoning system for monitoring the lubrication system of a gas turbine engine.

- (U) Water Mitigators for Ordnance Facilities:
  - (U) ($600) 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) ($900) 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 during the initial stages of an amphibious assault.

- (U) Low Cost RF Power Measurement Devices:
  - (U) ($700) 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

3. (U) FY 1998 PLAN:

- (U) SHARP:
  - (U) ($1,002) 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) ($773) Continue development/technology insertion and demonstration of AA low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
  - (U) ($598) Develop/evaluate commercial and/or military photonics components and processes for application in advanced avionics systems.
  - (U) ($1,104) 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) ($560) Evaluate the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.

- (U) NGTG:
  - (U) ($700) Develop and demonstrate the capability to perform fault diagnostics using neural network technology to develop TPS software for electronic systems.

- (U) Advanced Lighterage for High Sea State Operations:
  - (U) ($1,319) Continue effort to demonstrate and evaluate improved lighterage platforms and connector systems.

- (U) Waterfront Structures Repair and Upgrading:
  - (U) ($1,439) Continue effort to demonstrate improved performance of new technology for waterfront structures.

- (U) Joint Logistics Over the Shore (JLOTS) System Improvements
  - (U) ($1,341) Develop and demonstrate technologies to improve operational system/platform stability in sea states 3 and above.

- (U) Battery Charger/Analyzer:
  - (U) ($1,223) 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) ($931) 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) ($1,241) 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 during the initial stages of an amphibious assault.

- (U) Low Cost RF Power Measurement Devices:
  - (U) ($1,290) 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) Sea State 3 Crane Control System Demonstration:
  - (U) ($793) Demonstrate an improved load movement control with an enhanced Rider Block Tagline System (RBTS), improved man-machine interface, and crane operator training asset.

4. (U) FY 1999 PLAN:

- (U) SHARP:

- (U) ($827) Continue development/technology insertion and demonstration of AA low magnetic signature lithium thionyl chloride cells into existing sea mine systems.
- (U) ($775) Develop/evaluate commercial and/or military photonics components and processes for application in advanced avionics systems.
- (U) ($1,149) 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) ($749) Continue to evaluate the benefit of inserting a different battery chemistry or a removal battery into the performance specification for sonobuoys.
- (U) ($688) Investigate above-deck radar system components to determine causes and potential solutions for corrosion of connectors/interconnectors.

• (U) Power Measurement Systems:
- (U) ($1,373) Develop and demonstrate new low cost RF power measurement devices.

• (U) Advanced Lighterage for High Sea State Operations:
- (U) ($971) Continue effort to demonstrate and evaluate improved lighterage platforms and connector systems.

• (U) Waterfront Structures Repair and Upgrading:
- (U) ($1,237) Continue effort to demonstrate improved performance of new technology for waterfront structures.

• (U) JLOTS System Improvements
- (U) ($1,330) Develop and demonstrate technologies to improve operational system/platform stability in sea states 3 and above.

• (U) Information Support
- (U) ($793) Develop techniques to increase the portability of computer based maintenance and logistics systems.

- (U) Battery Charger/Analyzer:
  - (U) ($1,199) 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) ($775) 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) ($936) 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 during the initial stages of an amphibious assault.

- (U) Low Cost RF Power Measurement Devices:
  - (U) ($1,470) 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) Sea State 3 Crane Control System Demonstration:
  - (U) ($1,005) Demonstrate an improved load movement control with an enhanced RBTS, improved man-machine interface, and crane operator training asset.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	14,702	14,110	14,976	15,317

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) Adjustments from FY97 PRESBUDG:	-1,553	-575	-662	-40
(U) FY 1998/1999 PRESBUDG Submission:	13,149	13,535	14,314	15,277

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 adjustments are as follows: Jordanian F-16 financing rescission (-$17);and Actual Execution Adjustments (-$1,536). FY 1997 change reflects Congressional Undistributed Reductions (-$575). FY 1998 adjustments reflect: Navy Working Capital Fund (NWCF) and minor adjustments (-$1,687); and S&T adjustments (+$1,025). FY 1999 adjustment NWCF and minor adjustments (-$40).

(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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2206 Environmental Requirements Advanced Technology (ERAT)	5,432	5,621	3,935	4,795	6,034	6,170	6,302	6,447	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: 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 1996 ACCOMPLISHMENTS:

(U) Environmentally Sound Ships:

- (U) Non-Polluting/Biodegradable Antifouling Hull Coatings:
  - (U) (2,252) Completed small scale test of coatings. Evaluated ship patch/stripe tests and transitioned to the Naval Sea Systems Command 6.4 Demonstration and Validation Program.

- (U) Shipboard Non-Oily Wastewater Treatment:

  - (U) ($350) Conducted ship demonstration of non-oily wastewater minimization technologies.

- (U) Automated Underwater Hull Maintenance/Monitoring System:

- (U) ($2,830) Completed initial vehicle design and selected vehicle command and control system.

2. (U) FY 1997 PLAN:

- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) ($1,070) Initiate multi-national program for full scale pierside demonstration of shipboard produced blackwater (sewage) and graywater by combined advanced treatment technologies (aeration and membrane treatment).

- (U) Marine Mammal Mitigation:
  - (U) ($973) Develop mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals. Develop safety criteria for the impact of environmental sound on marine mammals.

- (U) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) ($2,569) Develop prototype cleaning tool under commercial contract and conduct field tests on image analysis process for underwater operations. Initiate fleet trials.

- (U) Shipboard Non-Oily Wastewater Treatment:
  - (U) ($368) Demonstrate and deliver wastewater minimization technologies.

- (U) Thermoacoustic Cooling:
  - (U) ($641) Develop and demonstrate a 3-ton capacity thermoacoustic refrigeration unit for shipboard application to replace chemical-based Rankine cycle refrigerators.

3. (U) FY 1998 PLAN:

- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) ($971) Continue multi-national program for full scale pierside demonstration of shipboard produced blackwater (sewage) and graywater by combined advanced treatment technologies (aeration and membrane treatment).

- (U) Marine Mammal Mitigation:
  - (U) ($685) Continue to develop mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals. Continue to develop safety criteria for the impact of environmental sound on marine mammals.

- (U) Automated Underwater Hull Maintenance/Monitoring System:
  - (U) ($1,109) Continue to develop prototype cleaning tool under commercial contract and conduct field tests on image analysis process for underwater operations. Initiate fleet trials.

- (U) Thermoacoustic Cooling:
  - (U) ($1,170) Develop and demonstrate a 3-ton capacity thermoacoustic refrigeration unit for shipboard application to replace chemical-based Rankine cycle refrigerators.

4. (U) FY 1999 PLAN:

- (U) Aerated Non-Oily Wastewater Membrane Treatment System Demonstration:
  - (U) ($843) Continue multi-national program for full scale pierside demonstration of shipboard produced blackwater (sewage) and graywater by combined advanced treatment technologies (aeration and membrane treatment).

- (U) Marine Mammal Mitigation:
  - (U) ($919) Continue to develop mitigation technologies for minimizing the impact of Navy acoustic operations on protected marine mammals. Continue to develop safety criteria for the impact of environmental sound on marine mammals.

- (U) Thermoacoustic Cooling:

- (U) ($1,305) Continue to develop and demonstrate a 3-ton capacity thermoacoustic refrigeration unit for shipboard application to replace chemical-based Rankin cycle refrigerators.

- (U) Innovative Coatings Husbandry Technologies:
  - (U) ($1,728) Demonstration a new generation of minimally adhesive, toxicant free, self-cleaning hull coating technology.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President s Budget:	6,043	5,860	5,932	5,928
(U) Adjustments from FY97 PRESBUDG:	-611	-239	-1,997	-1,133
(U) FY 1998/1999 PRESBUDG Submission:	5,432	5,621	3,935	4,795

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: The FY 1996 adjustments are as follows: Jordanian F-16 financing rescission (-$7); and Actual Execution Adjustments (-$604). The FY 1997 changes reflect Congressional Undistributed Reductions (-$239). The FY 1998 adjustments reflect: Navy Working Capital Fund (NWCF) and minor adjustments (-$658); Terminated Advanced Oil Content Monitor (AOCM) Initiative (-$2,000); S&T adjustment (+$671); and Inflation (-$10). The FY 1999 adjustments are as follows: NWCF and minor adjustments(-$15); Terminated AOCM Initiative (-$1,100); and Inflation (-$18).

(U) Schedule: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R2206
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Environmental Requirements Advanced Technology

(U) Technical: AOCM effort terminated.

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)
(U) PE 0602121N (Surface Ship Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET Date: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603712N PROJECT NUMBER: R2206
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology PROJECT TITLE: Environmental Requirements Advanced Technology

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FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
X1933 Undersea Warfare (USW) Advanced Technology Demonstration	12,008	8,423	11,476	11,869	12,995	13,591	13,883	14,205	CONT.	CONT.
X1959 Critical Sea Tests (CST) Phase II	3,691	0	0	0	0	0	0	0	0	97,084
H2089 Advanced Collection Technology	5,784	4,276	5,388	7,408	6,680	7,353	7,510	7,682	CONT.	CONT.
R2339 Environmentally Compliant Torpedo Fuel	0	2,398	0	0	0	0	0	0	0	2,398
R2142 Shallow Water Surveillance Advanced Technology	24,947	26,307	30,939	34,035	35,985	35,620	36,379	37,223	CONT.	CONT.
R2267 USW Weapons Advanced Technology	0	2,695	6,982	8,532	10,152	10,267	10,376	10,503	CONT.	CONT.
TOTAL	46,430	44,099	54,785	61,844	65,812	66,831	68,148	69,613	CONT.	CONT.

FY 1997 and outyears reflects a realignment within the PE to support a new start Undersea Warfare (USW) Weapons Advanced Technology effort.

(U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this PE. In countering the troubling proliferation of quiet diesel submarines to third world countries and Russia s continued heavy investment in submarine technology, work within this PE provides an enabling capability for power projection and force sustainability. The approach protects the country s capital investment in submarine, surface ship and air Antisubmarine Warfare (ASW) assets both by

developing commercial off-the-shelf upgrade options for today s ASW suites and by exploring those high risk/high payoff technologies that promise affordable, break-through operational capabilities in three to ten years. Emphasis is on development of fieldable prototypes, components and systems necessary to demonstrate and validate concepts and techniques previously developed in 6.1 and 6.2 or developed and suggested by industry/academia.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

(U) This research directly supports the Department of Defense Joint Warfighting Science and Technology Plan and the Defense Technology Area Plans. Within the Navy the effort supports the following Navy Joint Mission Areas (JMAs): Forward Engagement/Deterrence; Joint Littoral Warfare; Intelligence, Surveillance, and Reconnaissance; and Maritime Support.

(U) While the program addresses technical issues associated with a broad range of high interest operational areas, the emphasis is on shallow water environments.

(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.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 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
X1933 Undersea Warfare (USW) Advanced Technology Demonstration	12,008	8,423	11,476	11,869	12,995	13,591	13,883	14,205	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: (U) This project develops and demonstrates prototype USW system components that build on concepts, algorithms and technologies initiated within 6.1 and 6.2 programs. It also supports the advanced development of sensors, nodes and arrays and provides for transition of the joint U.S.-Canadian [classified material deleted] project in FY 1997 (further details are available at a higher classification level). The major components in this project are: [classified material deleted]/Regional Field Development (terminates in 1997), Advanced Acoustic Source Technology, and Advanced Full Spectrum Processing. Joint Mission Areas supported by this project include: Joint Littoral Warfare, Intelligence, Surveillance, and Reconnaissance, Forward Engagement/Deterrence, and Maritime Support. Specifically:

(U) The [classified material deleted] project develops and demonstrates advanced fiber-optic sensors and transmission methods, suitable for use in the undersea environment, as well as deployment methods for such systems. The work addresses Joint Littoral Warfare and [classified material deleted] in shallow water environments. This project ends in FY 1997.

(U) The Advanced Active Source Technology Initiative focuses on developing smaller, lighter-weight, and lower-cost broadband transducers for use in both wide-area and tactical undersea surveillance applications against diesel-electric

submarines operating in shallow waters. This work addresses intelligence, surveillance, and reconnaissance issues of real-time detection, localization, classification and tracking of undersea threats as well as maritime support requirements. The intent is to enable our forces to dominate the local undersea battlespace in the vicinity of logistic and replenishment forces.

(U) The Full Spectrum Processing work within this project supports joint littoral warfare by developing signal processors capable of detecting and classifying [classified material deleted] which emanate from [both diesel-electric and nuclear threat] submarines. This work also helps meet Forward Engagement/Deterrence needs associated with SSBN passive acoustic detection systems.

(U) These efforts also support the Navy's joint warfare strategy by providing an improved capability to dominate the surface and undersea battlespace. This project is service (Navy) unique.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($3,822) SPINNAKER/Regional Field Development:
  - (U) Conducted system deployment and performance assessments of the project SPINNAKER system.
  - (U) Successfully demonstrated [classified material deleted] from the deployment site.
  - (U) Conducted FY 1996 ICESHELF exercises and completed analysis of the previous year's exercise.
  - (U) Conducted extensive environmental surveys in the vicinity of Canadian Forces Station Alert.

- (U) ($3,397) Advanced Acoustic Source Technology:
  - (U) Designed, developed and evaluated Lead Zirconium Titanate (PZT) slotted cylinder and Lead Magnesuim Niobate (PMN) flextensional single-element, hihger frequency acoustic sources.

- (U) ($4,789) Advanced Full Spectrum Processing:
  - (U) Upgraded fieldable prototypes with concurrent passive processing and analysis of submarine [classified material deleted].
  - (U) Developed a robust automated capability for passive detection of [classified material deleted] events.
  - (U) Updated [classified material deleted] processing with improvements based on lessons learned from operational performance and [classified material deleted] processing development.

- (U) Expanded [classified material deleted] processing for other high-priority threats including the [Russian Akula, Improved Akula, Delta IV, Sierra and selected U.S. Los Angeles and Sturgeon] class submarines.
- (U) Transitioned [classified material deleted] processing to the AN/BQR-22 system.
- (U) Participated in at-sea exercises which demonstrated the value-added of full spectrum processing.

2. (U) FY 1997 PLAN:

- (U) ($1,333) [classified material deleted] /Regional Field Development:
  - (U) Repair the [classified material deleted] [classified material deleted] array.
  - (U) Conduct system validation. Transfer data analysis and performance assessment efforts to Canada.
  - (U) Terminate development efforts. Close out logistics support and transfer logistics equipment to Canada.

- (U) ($5,518) Advanced Acoustic Source Technology:
  - (U) Complete fabrication of thermally biased PMN flextensional and PZT slotted cylinder single-element sources in the Low Frequency Active/Surveillance Towed Array Sensors (SURTASS/LFA) frequency band.
  - (U) Complete planning for a FY 1998 competitive procurement of a multi-element array using the most mature source technology.
  - (U) Test a Terfenol-D inverse flextensional single-element source at Lake Seneca and continued development of a three-element array.

- (U) ($1,433) Advanced Full Spectrum Processing:
  - (U) Demonstrate in a submarine adjunct processor and transition [classified material deleted] detectors into submarine and surveillance engineering development projects.
  - (U) Characterize threat and environment parameters to test and demonstrate passive [classified material deleted] class submarines.
  - (U) Assess performance of potential active classification algorithms to support concurrent active/passive processing.

- (U) ($139) Portion of the etramural program reserved for Small Business Innovation Research Assessment.in accordance with 15 U.S.C. 638.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology PROJECT NUMBER: X1933 PROJECT TITLE: Undersea Warfare Advanced Technology Demonstration

3. (U) FY 1998 PLAN:

- (U) ($6,557) Advanced Acoustic Source Technology:
  - (U) Award contract for development of the most promising acoustic source technology into a prototype three-element array.
  - (U) Develop single-element slotted cylinder sources using PMN or similar advanced ceramic material as the driver material. Test at Lake Seneca.
  - (U) Complete planning for a competitive procurement in FY 1999 to develop a three-element array from the most promising of the tested single-element sources developed using PMN or other advanced driver ceramic materials. Award contract for a three-element array from the most promising single-element source.
  - (U) Transition Terfenol-D inverse flextensional acoustic source technology to SURTASS LFA.

- (U) ($4,919) Advanced Full Spectrum Processing:
  - (U) Demonstrate multi-mode (concurrent active/passive processing) advanced processing on an air adjunct prototype to improve classification and false alarm rate performance of Maritime Patrol Aircraft.
  - (U) Continue to characterize threat and environment parameters to test and demonstrate passive [classified material deleted] detection/classification processing against [classified material deleted] class submarines.
  - (U) Implement active classification algorithms from exploratory development programs to support evaluation and integration of advanced processing for compact LFA (CLFA), air, submarine, surface, and surveillance platforms.
  - (U) Implement state-space, non-linear, and volumetric processing to support multi-line towed arrays.

4. (U) FY 1999 PLAN:

- (U) ($4,405) Advanced Acoustic Source Technology:
  - (U) Conduct evaluations of the three-element prototype array developed in FY 1998 to support the acoustic source requirements of SURTASS/LFA surface towed, submarine/air deployed, and leave behind/bottom mounted acoustic source projects.
  - (U) Develop the most promising single element acoustic source technology from the PMN slotted cylinder or other advanced material efforts in FY 1998 into a three-element array.
  - (U) Conduct in-water tests of the three-element PMN, or other advanced material, slotted cylinder array developed in FY 1998 to verify array performance and inter-element interaction.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: X1933 PROJECT TITLE: Undersea Warfare Advanced Technology Demonstration

- (U) ($7,464) Advanced Full Spectrum Processing:
  - (U) Demonstrate multi-hypothesis information processing on an air adjunct prototype for [classified material deleted] submarine signals.
  - (U) Continue to characterize threat and environment parameters to test and demonstrate active and passive auto detection/classification processing against [classified material deleted] class submarines.
  - (U) Continue implementation of and demonstrate active classification processing for the CLFA system and air, submarine, surface, and surveillance platforms.
  - (U) Develop multi-dimensional (sensor, mode, beam, time) processing for all source (clutter, submarine, mine, torpedo) auto detection/classification.
  - (U) Develop performance metrics and apply in the statistical evaluation of the impact of multi-dimensional fusion on system performance for all USW platforms.
  - (U) Implement and demonstrate environmentally adaptive and predictive processing.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: X1933 PROJECT TITLE: Undersea Warfare Advanced Technology Demonstration

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	$12,219	$8,886	$11,622	$12,034
(U) Adjustments from FY 1997 PRESBUDG:	-$211	-$463	-$146	-$165
(U) FY 1998 PRESBUDG Submission:	$12,008	$8,423	$11,476	$11,869

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments include (-$32) Administrative and Personal Services, (-$64) Jordanian F-16 financing rescission, (-$151) Small Business Innovation Research Transfer, and (+$36) for execution adjustments. FY 1997 adjustments include (-$463) due to Congressional Undistributed Reductions. FY 1998 adjustments include ($+286) for Science and Technology adjustment,($-29K) Inflation, and (-$111) for NWCF and minor adjustments. FY 1999 adjustments include (-$44) due to Inflation and (-$121) due to NWCF and minor adjustments.

(U) Schedule: Not applicable.

(U) Technical: Not applicable.

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

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: X1933 PROJECT TITLE: Undersea Warfare Advanced Technology Demonstration

(U) RELATED RDT&E:

(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602315N (MCM, Mining, and Special Warfare Technology)
(U) PE 0602435N (Ocean and Atmospheric Technology)
(U) PE 0603254N (Air ASW Systems Development)
(U) PE 0603553N (Surface ASW)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604261N (Acoustic Search Sensors (ENG)
(U) PE 0604311N (Integrated Undersea Surveillance System)
(U) PE 0603555N (Undersea Warfare Weapons Advanced Technology)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: H2089 PROJECT TITLE: Advanced Collection Technology

(U) COST (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
H2089	Advanced Collection Technology (ACT)									
	5,784	4,276	5,388	7,408	6,680	7,353	7,510	7,682	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project builds advanced development and prototype devices used for the [classified material deleted] on both diesel-electric and nuclear submarines operating on the surface and while submerged. [classified material deleted] is required to ensure the viability of current and future anti-submarine warfare (ASW) system and to aid in the development of fleet tactics for employing these systems. Existing ASW technologies, primarily passive acoustics, were designed for and employed against the former Soviet deep water nuclear submarine threat. Modifications to these systems and technologies were also relied on to [classified material deleted]. [classified material deleted] Russian threat to include the [classified material deleted]. Since these platforms are much quieter than they have been in the past, greater reliance is being placed on active acoustics, magnetics, radar, and optically based technologies and systems. For most of these technologies, very little, if any, [classified material deleted] exists. This data is essential in that it allows weapon systems designers to optimize performance parameters and theater commanders to create optimal tactics for employment of existing and emerging systems.

(U) In particular, the project is developing the Navy Underwater Acoustic Multiple Ping (NUAMP) Sonobuoy to replace the current AN/SSQ-90 Acoustic Multiple Ping Sonobuoy. NUAMP is a family of "A" size sonobuoys each at a specific acoustic frequency. The AN/SSQ-90 AMP sonobuoy which will be replaced is a much larger "B" size bomb bay launched store. The NUAMP family consists of sources at the following frequencies: [classified material deleted]. The NUAMP is used to collect [calibrated acoustic target strength] measurements at these frequencies.

(U) Other efforts within the project include:

- (U) Extended Direct Measurement Program (EDMP) aimed at collecting [classified material deleted] measurements at various aspect angles. EDMP employs current Extended Echo Ranging (EER) sources and sensors for the collection of this data.
- (U) Advanced Magnetic Anomaly Detection (ADCAP MAD) aimed at increasing the detection range of current MAD systems to provide [classified material deleted] submarine magnetic signature data.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology PROJECT NUMBER: H2089 PROJECT TITLE: Advanced Collection Technology

(U) The [classified material deleted] devices and techniques developed within the project are transitioned to Project BEARTRAP for [classified material deleted]. Project BEARTRAP provides this [classified material deleted] to ONI for evaluation and dissemination to weapon system developers and other interested parties. This project supports the Joint Mission Areas of Joint Littoral Warfare, Joint Surveillance, Strategic Deterrence and Strategic Sealift Protection.

(U) These efforts also support the Navy's joint warfare strategy "From the Sea" by providing an improved capability to dominate the surface and undersea battlespace. This project is service (Navy) unique.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($3,755) Continued:
  - (U) developmental testing of the [classified material deleted] system.
  - (U) development of a real time [classified material deleted] capability in a stand alone signal processor and associated post mission algorithms.
  - (U) development of a real time NUAMP sonobuoy [classified material deleted] capability in a stand alone signal processor and associated post mission algorithm for shallow water.
  - (U) Complete fabrication of NUAMP F_0, F_1, F_2, F_3, $F_{4/5}$, and F_6 sonobuoys for test and evaluation.

- (U) ($1,889) Continued development of an ADMAD system providing a wide-band sensor data collection capability of magnetic [classified material deleted].

- (U) ($140) Continued development of new signal processing software for a stand alone signal processor to achieve maximum performance from acoustic and non-acoustic data collection systems.

2. (U) FY 1997 PLAN:

- (U) ($1,032) Complete developmental and certification testing of [classified material deleted] collection systems.

- (U) ($3,001) Continue development of an ADMAD (ADCAP MAD) system providing a wide-band sensor [classified material deleted] data over the complete frequency band.

- (U) ($136) Continue development of new signal processing software for a stand alone signal processor to achieve maximum performance from acoustic and non-acoustic data collection systems.

- (U) ($107) Portion of the extramural program reserved for Small Business Innovative Research Assessment.in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($4,971) Continue development of an ADCAP MAD system providing a wide-band sensor [classified material deleted] data over the complete frequency band.

- (U) ($417) Continue development of a new signal processing software for a stand alone processor to acheive maximum performance from acoustic and non-acoustic data collection systems.

4. (U) FY 1999 PLAN:

- (U) ($4,990) Continue development of an advanced long range MAD system for magnetic [classified material deleted] data collection.

- (U) ($990) Continue development of a new signal processing software for a stand alone processor to acheive maximum performance from acoustic and non-acoustic data collection systems.

- (U) ($1,428) Initiate the development of a shallow water NUAMP and EER [classified material deleted] data collection capability.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	$6,110	$4,458	$5,426	$7,490
(U) Adjustments from FY 1997 PRESBUDG:	-$326	-$182	$-38	$-82

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology PROJECT NUMBER: H2089 PROJECT TITLE: Advanced Collection Technology

(U) FY 1998 PRESBUDG Submission:	$5,784	$4,276	$5,388	$7,408

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustment include (-$326) execution adjustments. FY 1997 adjustments include (-$182) due to Congressional Undistributed Reductions. FY 1998 adjustments include (+$136) for Science and Technology adjustment, (-$13) for Inflation and (-$85) for minor adjustments. FY 1999 adjustments include (-$13) for inflation and (-$69)for NWCF and minor adjustments.

(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 0602314N (Undersea Surveillance and Weapons Technology)
(U) PE 0603254N (ASW Systems Development)
(U) PE 0603553N (Surface ASW)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0604212N (ASW and Other Helo Development)
(U) PE 0604221N (P-3 Modernization Program)
(U) PE 0604261N (Acoustic Search Sensors)

D. (U) SCHEDULE PROFILE: Not Applicable.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	FY 1997 ESTIMATE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2142 Shallow Water Surveillance Advanced Technology	24,947	26,307	30,939	34,035	35,985	35,620	36,379	37,223	CONT.	CONT

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops and demonstrates technologies designed to maintain near-perfect real-time knowledge of the enemy and communicate that knowledge to battlegroup units. There are three major efforts in this project: Airborne/Shipborne Periscope Detection, Lightweight Broadband Variable Depth Sonar, and Littoral Warfare Advanced Development.

(U) The Airborne/Shipborne Radar Periscope Detection sub-project is developing and demonstrating technologies that will make reliable radar detection of a periscope feasible for maritime patrol aircraft and surface combatants. Operators of current radar systems are swamped with false alarms caused by sea return and confusion targets such as small craft and debris. This problem is most acute in the littoral environment. Transition platforms for airborne applications will be P-3 s and S-3 s, and platforms for shipborne applications will be destroyers, cruisers and aircraft carriers. The technical effort involves automating the detection and discrimination process to remove false alarms without degrading the probability of detection of a periscope.

(U) The Lightweight Broadband Variable Depth Sonar (LBVDS) sub-project is developing and demonstrating a high-risk/high-payoff technology solution to the Navy’s shallow water undersea warfare problem. The effort is aimed at proving that new high energy-dense transducer materials can be used to make small, lightweight acoustic projectors, and that broad bandwidth

acoustic signals can detect small submarines in shallow water. The hypothesis is that the approach will yield an immediate performance improvement of 10 to 15 dB and will be upgradeable to yield a 20 to 25 dB improvement. Because of its promised performance and its relatively low life cycle cost, the technology was included as a prime candidate in the Concept Study for the Surface Combatant of the 21st Century (SC-21) This system will be inter-operable with and complementary to the Navy's existing SQQ-89 Undersea Warfare (USW) system.

(U) The Littoral Warfare Advanced Development (LWAD) sub-project sponsors cost-effective, at-sea, proof-of-concept experiments for undersea warfare science and technology initiatives that show promise for near term transition to fleet systems. The effort concentrates on technologies associated with the detection, classification, and localization of quiet diesel electric submarines and mines in shallow water. To assess the performance of these initiatives in highly variable undersea battlespace, at-sea experiments are conducted in areas with environmental features that are known to be challenging for current sensing systems. LWAD s management structure utilizes inputs from fleet representatives, system commands, and science and technology communities in establishing the technical and operational focus of each experiment. These representatives also assist in crafting the transition strategy for successfully tested technologies. Experiments span the spectrum of cost and effort from major experiments, or System Concept Validations (SCV), to smaller scale, quick response Focused Technology Experiments (FTE).

(U) This research directly supports the Department of Defense Joint Warfighting Science and Technology (S&T) Plan and the Defense Technology Area Plans. Within the Navy the effort supports the following Navy Joint Mission Areas (JMAs): Forward Engagement/Deterrence; Joint Littoral Warfare; Intelligence, Surveillance, and Reconnaissance; and Maritime Support.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($15,810) Airborne/Shipborne Periscope Detection:
  - (U) Completed laboratory testing of brassboard components.
  - (U) Completed and tested discriminator/tracker system. Automatic detection, track while scan, and indirect discriminator tested successfully in a simulated high target density environment.

- (U) ($5,809) LBVDS:
  - (U) Initiated development of a Lightweight Broadband Variable Depth Sonar for surface ships that will detect and classify small, quiet, slow moving submarines and mines in shallow water environments.

- (U) ($3,328) LWAD:

- (U) Conducted:
  - (U) Advisory Board meeting of Fleet, Office of the Chief of Naval Operations, Systems Commands, and S&T representatives to best match S&T requirements with transition opportunities. This meeting shaped the FY96 at-sea test schedule.
  - (U) Two FTEs:
    (U) 1. FTE 96-1: At-sea testing to support Air Antisubmarine Warfare Systems Program Office, PMA-264 s Air Deployed Active Receiver and Air Deployed Low Frequency Projector system research. Leveraged testing to include risk reduction for PMA-299 s Airborne Low Frequency Systems (ALFS) shallow water performance research. Test cost reduction achieved through use of United Kingdom submarine assets.
    (U) 2. FTE 96-2: Initial risk reduction testing on ALFS to surface ship SQS-53C active sonar interoperability. Leveraged testing to include multi-sensor data fusion and transient localization research.
  - (U) Incorporated previously planned FTE 96-3 test objectives of coherent and incoherent source shallow water performance evaluation into FTE 97-1.
  - (U) Signed a memorandum of agreement between LWAD, H-60 Helicopter Program Office, PMA-299, outlining the technology transition plans for surface/air active sonar interoperability technologies validated by LWAD at-sea testing.

2. (U) FY 1997 PLAN:

- (U) ($11,997) Airborne/Shipborne Periscope Detection:
  - (U) Complete:
    - (U) End-to-end brassboard acceptance test, to establish that system meets design goals and is ready for field testing.
    - (U) Brassboard system shore tests against a calibrated sphere target and confusion targets. This shore test will allow operation from both airborne and shipborne altitudes.
    - (U) Conduct flight testing of the brassboard system. During these tests, data will be collected to establish that motion compensation and land exclusion are working properly, as well as establishing airborne detection and false alarm performance against periscopes.
    - (U) Finalize ship fleet demonstration unit configuration.

- (U) ($9,563) LBVDS:
  - (U) Model and analyze broadband transmit subsystem, broadband receive subsystem, and control processing and display subsystems.
  - (U) Initiate:

- (U) Detailed system design and subsystem specifications.
- (U) Fourth generation Lead Magnesium Mioliate (PMN) transduction material maturation.

- (U) Conduct:
  - (U) System requirements review.
  - (U) The first in a series of three annual sea test using the Broadband Active Sonar Testbed (BAST), to demonstrate current system capabilities and collect data for further signal processing and broadband transmit/receive subsystem development.

- (U) ($4,250) LWAD:
  - (U) Recover and refurbish high priority/cost equipment from previous USW sea test programs, providing significant cost-savings by reducing the need for new procurements to support major LWAD sea tests.
  - (U) Conduct SCV 97-1 validating technologies in surface ship to airborne active sonar interoperability in shallow water and tactical exploitation of the littoral environment using active surface (SQS-53C) and air sonar (ALFS) sensors. Seven USW S&T projects will leverage this at-sea test.
  - (U) Conduct FTE 97-1 evaluating coherent and incoherent source shallow water performance to support PMA-264 s future decision on viable advanced airborne sources. Four USW S&T projects will leverage this at-sea test.

- (U) ($497) Portion of extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 USC.638.

3. (U) FY 1998 PLAN:

- (U) ($8,942) Airborne/Shipborne Periscope Detection:
  - (U) Complete:
    - (U) Ship testing of the brassboard system. Data will be collected to validate shore test results, ship motion compensation algorithms, and additional false alarm and cued Doppler discrimination.
    - (U) Analysis of collected brassboard system data to establish the flight demonstration unit configuration which will meet full real-time performance requirements.
    - (U) Fleet testing during fleet ASW exercise.
    - (U) Fleet Demonstration Unit (FDU) design and fabrication.

- (U) ($14,097) LBVDS:
  - (U) Initiate:

- (U) Detailed design development for the control processing and display subsystem, transmit subsystem, receive subsystem, and tow body subsystem.
- (U) Conduct:
  - (U) Initial design review.
  - (U) PMN material formulation selection.
  - (U) The second in a series of three annual sea tests using the BAST testbed, to demonstrate the performance of broadband signal processing techniques, and to provide data for further algorithm development and refinement.

- (U) ($7,900) LWAD:
  - (U) Complete the analysis of SCV 97-1, surface ship to airborne active sonar interoperability in shallow water. Transition validated technologies to PMO-411 s SQS-53C improvement program and to PMA-299 s ALFS developmental program.
  - (U) Conduct up to three FTEs. As a result of guidance and feedback from the USW community candidate technologies include:
    (U) 1. FTE 98-1: Risk reduction effort to evaluate the performance of advanced towed array configurations in rejecting shallow water noise while adapting to the environment to achieve signal gain. This supports PMS-425 future towed array acquisitions.
    (U) 2. FTE 98-2: Initial broadband active sonar data acquisition in shallow water environments to support PMO-411 s development of the next generation towed active source.
    (U) 3. FTE 98-3: Risk reduction effort to evaluate potential candidate technologies for the next generation of wide area surveillance sources compatible with littoral acoustic surveillance.

4. (U) FY 1999 PLAN:

- (U) ($8,122) Airborne/Shipborne Periscope Detection:
  - (U) Complete:
    - (U) Acceptance test of the FDU.
    - (U) Shore, flight and ship test of FDU.
    - (U) Fleet demonstration of real time performance which meets full operational requirements.

- (U) ($16,169) LBVDS:
  - (U) Initiate system integration and verification.
  - (U) Conduct:
    - (U) Final design review.

- (U) The third in a series of three annual sea tests, to demonstrate real-time at-sea performance of signal processing techniques and to validate that system performance goals have been met.

- (U) ($9,744) LWAD:
  - (U) Conduct Advisory Board meeting of Fleet, OPNAV, SYSCOM, and S&T representatives to best match S&T requirements with transition opportunities and shape the FY99/00 at-sea test schedule.
  - (U) Complete the analysis of FY-98 FTEs. Transition validated technologies and incorporate analysis results in future planning.
  - (U) Conduct SCV 99-1. Candidate technologies include:
    - (U) Demonstrate and quantify USW performance enhancements through the data fusion of available USW sensing technologies.
    - (U) Demonstrate and quantify the performance enhancements of broadband active source use with multistatic advanced receive arrays in a littoral environment.
    - (U) Conduct up to three FTEs to address emerging technology issues and transition opportunities identified by the USW community and the analysis of previous LWAD at-sea testing.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	$23,722	$27,429	$31,401	$34,463
(U) Adjustments from FY 1997 PRESBUDG:	+$1,225	-$1,122	-$462	-$428
(U) FY 1998 PRESBUDG Submission:	$24,947	$26,307	$30,939	$34,035

(U) CHANGE SUMMARY EXPLANATION:

(U)Funding: FY 1996 adjustments include (+$1,252) update to reflect actual execution and (-$27) due to Jordanian F-16 financing rescission. FY 1997 reduction (-$1,122) due to Congressional Undistributed. FY 1998 adjustments due to (-$78) Inflation,(+1,619) for Science and Technology adjustment and (-$2,003) due to NWCF and minor adjustments. FY 1999 adjustments due to (-$126) Inflation and (-$302) for NWCF and minor adjustments.

(U) Schedule: None.

(U) Technical: None.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

PROJECT NUMBER: R2142 PROJECT TITLE: Shallow Water Surveillance Advanced Technology

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

(U) RELATED RDT&E:

- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602435N (Ocean and Atmospheric Technology)
- (U) PE 0603254N (Air ASW Systems Development)
- (U) PE 0603553N (Surface ASW)
- (U) PE 0603785N (Combat Systems Oceanographic Performance Assessment (CSOPA)
- (U) PE 0603792N (Advanced Technology Transition)
- (U) PE 0604221N (P-3 Modernization Program)
- (U) PE 0604261N (Acoustic Search Sensors (ENG)
- (U) PE 0204311N (Integrated Surveillance System)
- (U) PE 0604503N (Submarine System Equipment Development)
- (U) PE 0604784N (Distributed Surveillance Systems)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: FEBRUARY 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2267 Undersea Warfare (USW) Weapons Advanced Technology	0	2,695	6,982	8,532	10,152	10,267	10,376	10,503	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project will address issues associated with maintaining a technology base for future torpedo production. It will be integrated with the existing Undersea Warfare Weapon Technology Applied Research program (PE 0602633N) and will enhance undersea weapon related Advanced Technology Demonstrations by sponsoring component prototyping efforts which will subsequently be available for transition to future weapon upgrade and acquisition programs. The project will focus on life-cycle affordability initiatives including simulation-based design, increased hardware and software commonality across weapon types, and the use of Commercial Off The Shelf (COTS) hardware. Cost effective design opportunities in the area of warheads, guidance and control units and propulsion packages for both lightweight and heavyweight weapons will be explored.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS: Not applicable.

2. (U) FY 1997 PLAN:

- (U) ($754) Initiate development of a comprehensive simulation-based design capability for affordability incorporating validated models and simulations of weapon hydrodynamics, propulsion systems, guidance and control systems, and warhead effectiveness capable of supporting geographically distributed design teams.

- (U) ($800) Initiate system concept development of a [classified material deleted] a quiet diesel target.

- (U) ($800) Develop safe, affordable, alternative concepts for Mk-46 and Mk-50 lightweight and MK-48 heavyweight exercise torpedoes, such as rechargeable electric or thermal systems which permit rapid exercise unit turnaround without unit tear-down.

- (U) ($200) Validate radiated noise predictions for polymer ejection torpedo quieting technology.

- (U) $141) Portion of the extramural program reserved for Small Business Innovation Research Assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($1,082) Complete torpedo design synthesis models. Initiate model development related to manufacturing, operations, and maintenance models for simulation-based torpedo designs. Continue cost and performance optimization model development.

- (U) ($1,300) Evaluate hydrodynamic system design for gas discharge and stability at speed. Validate design procedure for control surfaces.

- (U) ($800) Initiate design of prototype torpedo system components for very low cost but realistic training launches for a current torpedo.

- (U) ($1,000) Conduct experiment to determine optimum quieting approach for short term cost effective self- and radiated-noise reduction.

- (U) ($2,000) Initiate implementation of broadband COTS processor technology for insertion in Advanced Capability (ADCAP) to allow low cost enhancement for bi-static cooperative engagement. Integrate processing with prototype intelligent controller.

- (U) ($800) Initiate development of a multi-mode warhead for use as a common warhead for anti-submarine, anti-ship, and anti-torpedo applications from a lightweight or reduced length heavyweight weapon.

4. (U) FY 1999 PLAN:

- (U) ($1,332) Complete manufacturing, operations, and maintenance cost analysis model. Complete performance optimization model to be used in torpedo cost effectiveness studies.

- (U) ($1,900) Initiate design of prototype vortex-aluminum/seawater combustor for integration into the high speed supercavitating weapon. Evaluate guidance system concept for high speed weapon.

- (U) ($700) Evaluate prototype refueling system for a current torpedo variant. Transition concept to Torpedo Program Office (PMS 404) Phased Prototyping Program.

- (U) ($1,300) Complete evaluation of quieting approach. Transition system to both Lightweight and ADCAP torpedo programs (PE s 0708011N and 0603506N respectively).

- (U) ($2,000) Complete system implementation for bi-static, broadband acoustic processing using COTS hardware. Initiate bi-dynamic processing architecture to enhance cooperative engagement capability and fully utilize weapon speed to improve detection and localization.

- (U) ($1,300) Initiate fabrication of multi-mode warhead system components applicable to all torpedo sizes and integrate Micro Electronic Machine Systems based safe & arm subsystems into warhead concept.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	0	$2,810	$4,008	$4,610
(U) Adjustments from FY 1997 PRESBUDG:	0	-$115	+$2,974	+$3,922
(U) FY 1998 PRESBUDG Submission:	0	$2,695	$6,982	$8,532

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1997 adjustments include (-$115) due to Congressional Undistributed Reductions. FY 1998 adjustments include (+$3,095) for Science and Technology adjustment and (-$121) NWCF and minor adjustments. FY 1999 adjustments include (+$4,000) for Science and Technology adjustment and (-$78) NWCF and minor adjustments.

(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 0602314N (Undersea Warfare Surveillance Technology)
(U) PE 0602435N (Ocean and Atmospheric Technology)
(U) PE 0603254N (Air ASW Systems Development)
(U) PE 0603553N (Surface ASW)
(U) PE 0603792N (Advanced Technology Transition)
(U) PE 0603506N (Surface Ship Torpedo Defense)
(U) PE 0604310N (Arsenal Ship)
(U) PE 0708011N (Manufacturing Technology Development)

D. (U) SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	47,786	39,942	41,602	44,492	49,682	46,607	47,591	48,688	CONT.	CONT.
R2340 Power Blade	0	865	0	0	0	0	0	0	865	865
TOTAL	47,786	40,807	41,602	44,492	49,682	46,607	47,591	48,688	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) The previous focus of this Program Element (PE) was to demonstrate and evaluate the capability to adapt the Magic Lantern Advanced Development Model system to meet the shallow water (SW) and surf zone (SZ) minefield detection goals. In FY 1996, this PE was combined with the appropriate advanced technology demonstrations (ATDs) previously in PE 0603555N and refocused to more effectively transition 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 five major areas:

- Mine Countermeasure techniques for clandestine surveillance and reconnaissance; mine hunting and clearance; and organic ship protection.
- Battlefield surveillance, reconnaissance, and targeting.

- Naval fire support.
- Command, control, communications, information processing, and mission planning supporting land battles.
- Force mobility and survivability.

(U) Task 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 tasl was completed in FY 1995.

(U) Task ADVANCED MINE AND OBSTACLE CLEARANCE was begun in FY 1993 and includes the ATD 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 rocke 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 ATD known as ADVANCED LIGHTWEIGHT INFLUENCE SWEEP SYSTEI (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 fo

completion in FY 1999 and will be transition 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 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) appliquØ will be developed to facilitate system integration, allow for mission planning, and provide improved displays for operational commanders.

(U) Task ADVANCED AIRBORNE TARGET DESIGNATOR was begun in FY 1996 and is designed to improve targeting of precision guided munitions (PGM) from over-the-horizon (OTH) battlefield objects in support of Naval Surface Fires (NSF). Efforts include laser target rangefinding and laser designation from unmanned and manned platforms, rapid reporting of targets in existing and compatible formats.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

(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 technological feasibility and concept of operations and reduce technical risk prior to initiation of a new acquisition progra or transition to an ongoing acquisition program.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

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 1996 ACTUAL	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
R2226 Mine and Expeditionary Warfare Advanced Technology	47,786	39,942	41,602	44,492	49,682	46,607	47,591	48,688	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 1996 ACCOMPLISHMENTS:

- (U) ($15,374) ADVANCED MINE and OBSTACLE CLEARANCE: Finished dynamic bench testing of fire control systems and begun installation upon LCAC. Demonstrated fire control and deployment of both line charge and net array subsystems from motion platform on land. Awarded contract for final 1/5 scale BZ array glider deployment after successful demonstration of smaller prototype. Demonstrated lethality of BZ array against land mines. Demonstrate lethality of SZ sub-array design against SZ mines.

- (U) ($11,725) ADVANCED MINE SWEEPING: Continued fabrication and factory testing of full-scale acoustic subsystem and concluded critical design review of magnetic subsystem. Continued integration of subsystems on both fast target remote-controlled boats and air cushion platforms for demonstration testing in FY 1998.

- (U) ($6,462) ADVANCED DEGAUSSING: Completed deperming test on full-scale surface combatant. Continued corrosion, stray, and eddy current source reduction analyses for MCM ships.

- (U) ($3,105) ADVANCED SURVEILLANCE/RECONNAISSANCE: Surveyed advanced satellite, aircraft and surface craft based sensors to assess their ability for surveillance and reconnaissance of littoral battle spaces and to determine the effectiveness for mine and expeditionary warfare applications. Demonstrated during fleet exercise PURPLE STAR (CJTFEX96-2) the production and timely dissemination of new intelligence products revealing beach defenses, topographical and environmental information.

- (U) ($1,096) MODELING AND SIMULATION: Held a series of wargames and simulation exercises to investigate and document the military utility of potential Expeditionary Warfare systems. Initiated effort for configural mine theory. Transition to PE 0603502N.

- (U) ($6,800) JCM ACTD: Planned and coordinated initial preparations for the two major ACTD demonstrations including performance assessment, execution, system configurations training and logistic support. Defined communication links and initiated system simulation development to integrate both new and existing systems into an effective mine countermeasure/countermine force. Began planning for support of residual equipment which will be left with the operational forces after completion of the two demonstrations. Worked closely with Fleet, Force, and Army operational staffs to ensure user requirements were fully considered and integrated into the ACTD planning process.

- (U) ($1,464) ADVANCED AIRBORNE TARGET DESIGNATOR: Surveyed a variety of technologies and approaches for laser rangefinding and fire targeting reporting compatible with the Marine Corps Forward Observer/Forward Air Controller. Determined that demonstration on an existing helicopter is the most cost-efficient platform.

- (U) ($1,510) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Conducted a preliminary investigation of optimizing land-to-sea communication networks for supporting OTH NSF operations.

- (U) ($250) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Initiated a survey of prototype airborne radar that could provide an all-weather Moving Target Indicator, target acquisition and fire control capability for targeting of munitions delivered OTH by Naval Surface Fire Support.

2.(U) FY 1997 PLAN:

- (U) ($12,096) ADVANCED MINE and OBSTACLE CLEARANCE: Demonstrate at-sea deployment of inert line charge and SZ array from air cushion platform using fire control algorithms and control of LCAC. Begin transition of the explosive array technology to PE 0603502N for integration with tactical delivery systems. Continue fabrication of final sub-scale BZ net array and delivery system.

- (U) ($7,900) ADVANCED MINE SWEEPING: Continue fabrication and testing of acoustic and magnetic subsystems, and begin implementation and integration aboard platforms. Complete final laboratory tests of magnetic and acoustic subsystems.

- (U) ($6,000) ADVANCED DEGAUSSING: Complete analysis of test results of ship deperming and algorithm development of degaussing controllers. Complete corrosion current source reduction analyses for MCM ships. Continue stray, and eddy current source reduction analyses for MCM ships. Initiate closed loop degaussing tests with on-board sensor suite on a surface combatant to develop prediction algorithms.

- (U) ($2,098) ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue utilizing advanced sensors to measure critical battle space parameters and quantify their effectiveness. Demonstrate capabilities in automatic target recognition and multi-sensor data fusion. Participate in JCM ACTD Demo.

- (U) ($1,200) MODELING AND SIMULATION: Continue modeling and simulation to investigate the military utility of potential Mine and Expeditionary Warfare systems. Provide background for selection of prototyping projects.

- (U) ($7,000) JCM ACTD: Conduct 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. The demonstration will emphasize enhanced near-term/near shore countermine capabilities. Begin analysis of demonstration data. Continue planning and other preparations for the second demonstration. Continue planning for support of "residual" equipment.

- (U) ($1,323) ADVANCED AIRBORNE TARGET DESIGNATOR: Begin effort to integrate laser rangefinder aboard helicopter with Global Positioning System (GPS), and radio communication links back to fire control coordinator. Initiate packaging and configuration design studies. Conduct lab testing of prototype hardware and software.

- (U) ($1,400) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Perform limited communication system interoperability tests in a laboratory and range environment. Develop a simulation characterizing network performance in an operational environment.

- (U) ($100) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Initiate packaging studies and cost analyses. Initiate integration of radar, signal processor and data link. Conduct laboratory and limited field tests of hardware and software modules.

- (U) ($825) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3.(U) FY 1998 PLAN:

- (U) ($7,825) 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: Finish integration of acoustic and magnetic subsystems on platform. Conduct final tests of both systems and perform field tests. Demonstrate ALISS in the JCM ACTD demo. Transition to PE 0603502N.

- (U) ($5,900) ADVANCED DEGAUSSING: Finish tests of closed-loop degaussing algorithms, advanced deperming, and stray field minimization. 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) ($1,500) MODELING AND SIMULATION: Continue 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 Manuever 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 appliquØ. 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: Continue efforts to integrate laser rangefinder aboard helicopter with GPS, and radio communication links back to fire control coordinator. Complete packaging and configuration designs. Begin preparations for final range tests and field tests with live fires.

- (U) ($1,900) EXPEDITIONARY WARFARE COMMUNICATIONS NETWORKING: Continue performing communication system interoperability tests in a laboratory and range environment. Develop prototype mobile route for airborne platforms.

- (U) ($1,650) SURFACE SURVEILLANCE, TARGET ACQUISITION, AND FIRE CONTROL: Continue 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) ($6,327) 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.

4.(U) FY 1999 PLAN:

- (U) ($2,935) 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 modeling and simulation to investigate the military utility of potential Mine and Expeditionary Warfare systems. Provide background for selection of prototyping projects.

- (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) ($3,500) ADVANCED AIRBORNE TARGET DESIGNATOR: Complete efforts to integrate laser rangefinder aboard helicopter with GPS, and radio communication links back to fire control coordinator. Demonstrate system in field tests with live fires. Determine accuracy of targeting to resulting fire locations.

- (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: Conduct final field tests and determine final resolution and accuracy of radar systems under a variety of weather and environmental conditions.

- (U) ($6,140) 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. Begin algorithm development for computer-aided identification.

- (U) ($6,000) RAPID MINEFIELD SURVEILLANCE: Initiate development of a wide-area, rapid surveillance system capable of detecting minefields in the SZ/BZ environmental areas with a probability of detection of 0.95 at a rate of 80 square nautical miles per hour, which meets the Operational Requirements Document for SW MCM Reconnaissance and Detection. Anticipated resolution using LIDAR imaging is 3 inches. The approach is to use the STIL technology with a more powerful, higher repetition laser with the STIL receiver technology deployed upon a fixed-wing aircraft capable of low altitude flights. The efforts for this year will be focused upon laser technology upgrades, faster receiver arrays, design for multi-spectral receivers for fluorescent signatures and initial design of system integration. Further emphasis will be upon algorithm for detection of minefield 3-dimensional multi-spectral imagery.

- (U) ($6,000) UNDERWATER NEUTRALIZATION OF MINES: Initiate development of a system for neutralization of mines. Candidate systems being considered include: directed energy, focused pressure shock waves that can penetrate and neutralize mines in SW environments, and articulated tracked vehicles for operations up to 2000 feet water

depth 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) ($5,717) 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 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:

	FY1996	FY1997	FY1998	FY1999
(U) FY 1997 President s Budget:	$39,002	$42,753	$41,636	$44,764
(U) Adjustments from 1997 PRESBUDG:	+$8,784	-$2,811	-$34	-$272
(U) FY 1998/1999 OSD/OMB Budget Submission:	$47,786	$39,942	$41,602	$44,492

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustments include (+$10,000) for FY 1996 Supplemental, (-$80) for Administrative and Personal Rescission, ($-207) for Jordanian F-16 financing rescission, (-$413) for SBIR transfer and ($-516) for minor

adjustments. FY 1997 adjustments include (-$900) for Congressional Earmark, and (-$1,911) for Congressional Undistributed Reductions. FY 1998 adjustments include (-$34) due to NWCF and minor adjustments. FY 1999 decrease of (-$272) due to NWCF and minor adjustments.

(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 Surveillance and Weapons Technology)
(U) PE 0602315N (MCM, Mining and Special Warfare Technology)
(U) PE 0602435N (Oceanographic and Atmospheric Technology)
(U) PE 0603502N (Surface and Shallow Water MCM)
(U) PE 0603513N (Shipboard System Component Dev)
(U) PE 0603528N (Non-Acoustic ASW)
(U) PE 0603612M (Marine Corps Mine Countermeasures)
(U) PE 0603640M (Marine Corps Advanced Technology)
(U) PE 0604373N (Airborne Mine Countermeasures)
(U) PE 0604784N (Distributed Surveillance System)

D. (U) SCHEDULE PROFILE: Not Applicable.

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FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 199

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 1996 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
R1889 Advanced Technology Demonstration	73,663	67,134	87,285	97,269	139,364	121,826	124,394	127,246	CONT.	CONT.
R2290 SLICE	2,840	1,918	0	0	0	0	0	0	0	4,758
TOTAL	76,503	69,052	87,285	97,269	139,364	121,826	124,394	127,246	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 Mission Area/Support Area assessments, and the Science and Technology 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. Fiscal years 1996 and 1997 funds for project R2290 reflect Congressional increases to complete construction for a demonstration of a new low waterplane design of a small waterplane area twin hull ship, and to evaluate the concept by conducting mission oriented sea trials focusing on the modular nature of the SLICE payload system. 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 199

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1996 ACCOMPLISHMENTS:

(U) ($1,000) DATA/VOICE INTEGRATION -- Completed ATD: completed final demonstration. Provided integrated data and voice services network for tactical communication systems and transitioned to communications support systems (CSS) advanced development.
(U) ($420) LOW PROBABILITY OF INTERCEPT (LPI) COMMUNICATIONS -- Completed ATD of a LPI communication system that will allow aircraft to communicate covertly at greater range.
(U) ($2,000) LPI SENSORS -- Completed ATD: completed integration and installation of airborne system, conducted shipboard/flight testing of the sensor system to demonstrate performance in classifying radar contacts based on unique Doppler signature, and transitioned optical sensor system to advanced development.
(U) ($4,125) AIR VEHICLE DIAGNOSTIC SYSTEM (AVDS) -- Completed ATD: completed flight and ground demonstrations of fully-integrated system and evaluated performance. Prepared data package for transition of technology to operational systems.
(U) ($5,000) ADVANCED HYBRID PROPULSOR -- Completed ATD: conducted 1/4 scale propulsor performance demonstration on th Large Scale Vehicle at Lake Pend Oreille, ID. Evaluated acoustic performance.
(U) ($5,475) HIGH FREQUENCY SURFACE WAVE RADAR (HFSWR) -- Continued ATD: exercised simulator to examine effects of various threat scenarios, prepared system specifications, and awarded contract for shipboard demonstration system.
(U) ($4,000) EAGER (PREFERENTIAL ACQUISITION DECOY) -- Continued ATD: completed system design, fabricated test hardware, integrated subsystems, and bench tested.
(U) ($5,000) SHALLOW WATER (SW) TORPEDO GUIDANCE AND CONTROL (G & C) -- Continued ATD: demonstrated SW classification and environmental adaptation to achieve enhanced performance against diesel-electric submarines in SW environments.
(U) ($8,200) ADVANCED ENCLOSED MAST/SENSOR SYSTEM -- Continued ATD: conducted land-based testing of full-scale structural mast to confirm predictions/design.
(U) ($4,800) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Initiated ATD to improve ship self defense against anti-ship cruise missiles, via highly maneuverable intercept missile technology. Defined performance requirements and developed required control system algorithms.

(U) ($3,600) SMART SKINS ARRAY -- Initiated ATD to embed large aperture antenna arrays in aircraft skin for improved sensor performance. Completed design verification and subcomponent testing.
(U) ($4,400) TACTICAL AIRCRAFT DIRECTED INFRARED COUNTERMEASURES (DIRCM) -- Initiated ATD to track and jam infrared (IR) guided missile threats to aircraft. Completed performance testing of mid-IR laser and developed system software for pointer/tracker.
(U) ($ 600) ADVANCED MISSILE AIRFRAME -- Initiated ATD to demonstrate a hybrid missile airframe to restore U.S. tactical advantage against advanced air threats. Initiated design of airframe and jet reaction control device.
(U) ($4,200) COMPETENT MUNITIONS FOR THE 5" GUN -- Initiated ATD to demonstrate a low cost, highly accurate guidance and control package for improved naval surface fire support from surface ship 5" guns. Conducted inertial guidance gyro demonstration.
(U) ($3,000) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Initiated ATD to improve shipboard training. Completed integration of enabling technologies including: eye tracking, advanced computer technology, helmet-mounted displays, and advanced visualization techniques.
(U) ($4,500) ADVANCED ELECTRONIC COUNTERMEASURES (ECM) TRANSMITTER FOR SHIP DEFENSE -- Initiated ATD to provide more effective soft-kill capability against anti-ship cruise missiles. Completed system design and performance trade-off.
(U) ($5,000) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SUPER HIGH FREQUENCY (SHF) PHASED ARRAY ANTENNA -- Initiated ATD t improve submarine connectivity with the littoral battleforce. Performed module design and layout for phased array demonstration.
(U) ($1,500) BALL-JOINT GIMBAL FOR JOINT STRIKE WEAPONS -- Initiated task to demonstrate a low-cost, ball-joint gimbal for future strike weapon seekers. Completed seeker design tradeoff studies. Designed, fabricated, and evaluated prototype ball-joint gimbal. This task transitioned to PE 0603217N, Project R0447, in FY 1997 for continued development and flight test demonstration.
(U) ($1,500) PRECISION STRIKE NAVIGATOR (PSN) -- Initiated task to demonstrate a highly accurate, compact, low-cost Inertial Measurement Unit (IMU) that will provide pinpoint guidance even if Global Positioning System is lost. Completed waveguide design and fabrication and initiated fabrication of PSN IMU. This task transitioned to PE 0603217N, Project R2264, in FY 1997 for continued development and flight test demonstration.
(U) ($3,500) CONCENTRIC CANISTER LAUNCHER (CCL) -- Initiated task to demonstrate a full-scale universal modular CCL that offers flexibility for increased missile firepower with significant reduction in weight and cost. Defined electrical architecture; selected materials; analyzed, developed and integrated methodology and techniques to build and

install an integral ship weapons module into a ship; initiated design of a shock collar prototype. This task transitioned to PE 0603217N, Project R0447, in FY 1997 for continued development and demonstration.
(U) ($1,843) Selected and performed planning for FY 1998-start ATDs. Conducted independent reviews of on-going ATD programs.

3. (U) FY 1997 PLAN:

(U) ($4,500) EAGER (PREFERENTIAL ACQUISITION DECOY) -- Complete ATD: complete preliminary testing, assemble demonstration vehicle, integrate vehicle and payload, and conduct final demonstration.
(U) ($4,000) SW TORPEDO G & C -- Complete ATD: demonstrate the complete SW detection/classification/homing processing system using the MK50 and ADCAP sensors.
(U) ($7,900) ADVANCED ENCLOSED MAST/SENSOR SYSTEM -- Complete ATD: fabricate at-sea mast, install and conduct initial performance demonstration of at-sea mast; transition to advanced development for extended at-sea trials.
(U) ($6,000) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Continue ATD: complete performance assessment and hardware/software integration.
(U) ($4,200) TACTICAL AIRCRAFT DIRCM -- Complete ATD: demonstrate advanced laser-based countermeasures against infrare seeking missiles through flight testing and field demonstrations of developed hardware and countermeasures techniques.
(U) ($5,000) COMPETENT MUNITIONS FOR THE 5" GUN -- Continue ATD: conduct inertial guidance fuse package demonstration.
(U) ($4,000) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Continue ATD: conduct demonstration of an advanced training prototype system.
(U) ($5,500) ADVANCED ECM TRANSMITTER FOR SHIP DEFENSE -- Continue ATD: complete fabrication, assemble and conduct component/subsystem testing.
(U) ($6,000) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SHF PHASED ARRAY ANTENNA -- Continue ATD: build X-band module and perform design qualification tests.
(U) ($4,388) LOW COST MISSILE SYSTEM -- Initiate ATD to demonstrate performance capability of a low cost, wingless and finless tactical missile to deliver payload at supersonic speeds. Perform design of airframe, actuator, control system and combuster and begin fabrication of subsystems.

(U) ($3,950) MULTIFUNCTION ELECTROMAGNETIC RADIATING SYSTEM (MERS) -- Initiate ATD to demonstrate a low cost, shipboar antenna system that merges several sensors into a single antenna system. Complete antenna design and initiate fabrication of performance model.
(U) ($3,000) "BEST BUY"-LOW COST CAPABILITY MULTIPLICATION FOR FIVE-INCH FIRE SUPPORT PROJECTILES -- Initiate ATD to demonstrate a high capacity projectile utilizing a high lift-to-drag composite airframe for launch from a five-inch gun. Design and fabricate quick-connect joint which connects payload and propellant sections.
(U) ($4,000) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Initiate 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. Define system architecture including data rate/range capabilities, allocated frequencies and bandwidth. Develop interconnect and test principal elements in local at-sea tests.
(U) ($2,000) ADVANCED COMMUNICATIONS INTELLIGENCE (COMINT) VOICE PROCESSING -- Initiate ATD to demonstrate speech processing system to automatically interpret, sort and prioritize intercepted voice COMINT signals. Complete system design and performance trade-off; assemble and integrate algorithms.
(U) ($478) Portion of extramural program reserved for Small Business Innovative Research assessment in accordance wit 15 U.S.C. 638.
(U) ($2,218) Select and perform planning for FY 1999-start ATDs. Conduct independent reviews of on-going ATD programs.

4. (U) FY 1998 PLAN:

(U) ($3,900) HIGHLY RESPONSIVE MISSILE CONTROL SYSTEM -- Complete ATD: fabricate, evaluate and assemble two control test vehicles; conduct flight test demonstrations of achievable time response and maneuver levels.
(U) ($4,200) SMART SKINS ARRAY -- Continue ATD: fabricate Advanced Development Model (ADM) and conduct ADM ground test/analysis.
(U) ($4,000) 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) ($4,665) ADVANCED EMBEDDED TRAINING FOR SHIPBOARD SYSTEMS -- Complete ATD: conduct final demonstration of shipboar prototype and evaluate system performance.

(U) ($4,000) ADVANCED ECM TRANSMITTER FOR SHIP DEFENSE -- Complete ATD: complete system integration, lab and field testing, and conduct final demonstration.
(U) ($4,000) MULTI-BEAM, MULTI-FREQUENCY, SUBMARINE SHF PHASED ARRAY ANTENNA -- Complete ATD: complete X-band antenna array fabrication; conduct demonstration in marine environment and demonstrate dual-band subassembly.
(U) ($6,095) LOW COST MISSILE SYSTEM -- Continue ATD: complete fabrication of subsystems. Integrate subsystems, conduc aerodynamic/wind tunnel testing, hardware-in-the-loop simulation and booster insensitive munitions testing.
(U) ($2,500) SOLID STATE VISIBLE/LONG WAVE INFRARED (LWIR) COLOR NIGHT VISION SYSTEM -- Initiate ATD to demonstrate a sensor-fusion night vision device that enables perceptual separation of terrain types and objects. Complete design of low-light charged couple device (LL CCD) imager and develop real-time processing for image enhancement and visible-LWIR fusion.
(U) ($5,950) MERS -- Continue ATD: complete fabrication of performance model and conduct mast mock-up performance tests; build demonstration model and perform shipboard environmental tests.
(U) ($1,500) ANTITORPEDO TORPEDO (ATT) TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Initiate ATD to improve surface ship and submarine point defense against torpedoes, via ATT technology. Conduct in-water demonstrations against maneuvering torpedo targets in a clean environment.
(U) ($7,000) "BEST BUY" -- Continue ATD: fabricate and test composite airframe; fabricate and test high lift-to-drag airframe.
(U) ($5,000) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Continue ATD: demonstrate a real-time voice/data link betwee submarine and surface vessel at 35 nautical miles (NM) and a real-time slow scan video link between submarine and submarine at 2.5 NM.
(U) ($4,000) 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. 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) ($5,500) 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) ($4,000) ADVANCED COMINT VOICE PROCESSING -- Continue ATD: fabricate and assemble voice processor components; conduct subsystem testing.
(U) ($4,500) 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) ($4,000) 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) ($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) ($3,900) 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) ($3,900) SURVIVABLE MULTI-MISSION STANDOFF WEAPON/SENSOR PLATFORM -- Initiate ATD to demonstrate performance capability of a low-cost, wingless, subsonic, survivable standoff weapon airframe. Fabricate Ground Test Vehicle and conduct wind tunnel tests.
(U) ($1,675) Select and perform planning for FY 2000-start ATDs. Conduct independent reviews of on-going ATD programs

5. (U) FY 1999 PLAN:

(U) ($2,700) 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 accurat 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) ($5,000) SOLID STATE VISIBLE/LONG WAVE INFRARED (LWIR) COLOR NIGHT VISION SYSTEM -- Continue ATD: complete fabrication of LL CCD imager; conduct testing of discrete LL CCD and LWIR elements in a fusion configuration. Develop human visual performance measurements.
(U) ($5,000) MERS -- Complete ATD: install aboard ship and conduct at-sea demonstration.

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

(U) ($5,000) ATT TECHNOLOGY FOR SURFACE AND SUBMARINE APPLICATIONS -- Continue ATD: continue simulation based design and begin at-sea tests in realistic environments.
(U) ($5,000) "BEST BUY" -- Complete ATD: conduct long-range firing demonstration of projectiles ability to dispense submunitions over target area.
(U) ($5,000) ADVANCED TACTICAL ACOUSTIC COMMUNICATIONS -- Complete ATD: demonstrate multi-net connectivity between submarines, ships, and aircraft at ranges up to 110 NM.
(U) ($5,900) DNA VACCINES FOR COMPLEX MULTISTAGE ORGANISMS AND OTHER ORGANISMS OF MILITARY IMPORTANCE -- Complete ATD complete safety, immunogenicity, and protective efficacy studies of vaccines in human volunteers and transition malaria vaccines to advanced development for testing at field sites in Asia, Africa, and South America.
(U) ($4,800) PLASMA-ARC PYROLYSIS OF SHIPBOARD SOLID WASTE -- Continue ATD: design and fabricate a full-scale plasma-arc pyrolysis unit; design and test molten metal/glass removal and slag cooling subsystem; demonstrate suitable secondary combustion subsystem to control air emissions.
(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) LOW OBSERVABLE MULTI-FUNCTION STACK -- Continue ATD: begin component fabrication. Complete performance predictions and component testing.
(U) ($5,500) LELFAS -- Continue ATD: conduct land-based demonstration of the power source.
(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) ($5,400) 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) ($6,500) SURVIVABLE MULTI-MISSION STANDOFF WEAPON/SENSOR PLATFORM -- Continue ATD: fabricate and test Flight Test Vehicle; conduct system integration and radar cross section testing.
(U) ($19,986) Initiate FY 1999-start ATDs.
(U) ($1,675) Select and perform planning for FY 2001-start ATDs. Conduct independent reviews of on-going ATD programs.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 199

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	75,594	104,424	125,930	141,693
(U) Adjustments from FY 1997 PRESBUDG:	-1,931	-37,290	-38,645	-44,424
(U) FY 1998 PRESBUDG Submit:	73,663	67,134	87,285	97,269

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 decrease reflects Bosnia 2 cut (-$4,800); Jordanian F-16 financing rescission (-$87) and below threshold reprogrammings (+$2,965). FY 1997 decrease due to Congressional general reductions (-$34,424) and undistributed Congressional reductions (-$2,866). FY 1998 decrease based on a change in program priorities (-$29,933); Navy Capital Working Fund (NCWF) and rate adjustments (-$8,712). FY 1999 decrease based on a change in program priorities (-$43,358); NCWF carryover and rate adjustments (-$1,066).

(U) Schedule: Reductions have delayed demonstrations of high value technologies which are essential to the Navy s future warfighting capabilities.

Reductions have forced a significant curtailment of both ongoing and new-start ATDs for FY 1997 -- The High Frequency Surface Wave Shipboard Radar, Advanced Missile Airframe, Littoral Warfare Real-Time Electromagnetic Interference Management System, and the Missile Agility/Kinematic Enhancement ATDs have been terminated in FY 1997. The Anti-Torpedo Torpedo Technology for Surface and Submarine Applications, Solid State Visible/LWIR Color Night Vision System, Plasma-Arc Pyrolysis of Shipboard Solid Waste, and DNA Vaccines for Complex Multistage Organisms ATDs have been delayed from FY 1997 to FY 1998. In addition, continuation of the Smart Skins Array ATD has been delayed from FY 1997 to FY 1998.

Both AVDS and Advanced Hybrid Propulsor ATDs have encountered minor schedule slippages which will not adversely impact program milestones.

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N PROJECT NUMBER: R1889
PROGRAM ELEMENT TITLE: Advanced Technology Transition PROJECT TITLE: Advanced Technology Demonstration

(U) Technical: N/A

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

(U) RELATED RDT&E:
(U) PE 0601153N (Defense Research Sciences)
(U) PE 0602111N (Air and Surface Weapons Technology)
(U) PE 0602121N (Surface Ship and Submarine HM&E Technology)
(U) PE 0602122N (Aircraft Technology)
(U) PE 0602232N (Space and Electronic Warfare (SEW) Technology)
(U) PE 0602233N (Readiness, Training and Environmental Quality Tech)
(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)
(U) PE 0603217N (Air Systems Advanced Technology)

D. SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	FY 1997 ESTIMATE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY2003 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
X2091 Space and Electronic Warfare (SEW) Advanced Technology	14,609	15,731	16,301	16,932	17,394	17,735	18,111	18,530	CONT.	CONT.
R2239 Advanced Targeting	8,632	12,299	7,467	948	944	938	957	979	CONT.	CONT.
TOTAL	23,241	28,030	23,768	17,880	18,338	18,673	19,068	19,509	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) develops communications technologies, real-time precision targeting information and decision aids which support the effective utilization of naval forces in conducting Joint operations with the other Services or our allies. Efforts include development of high capacity, low-probability-of-intercept communication; distributed networks; distributed command and control real-time multi-level secure systems; integrated voice/data/video communications techniques; software specification tools; algorithms for specific target identification and precision targeting; interactive collaborative decision aids; and supporting technologies for a multi-mission broadband antenna and Command, Control, and Communications (C3) embedded training.

(U) This PE primarily supports the following Joint Mission Areas and Support Areas: Strike Warfare, Littoral Warfare, Intelligence, Surveillance and Reconnaissance, Strategic Deterrence, Sealift/Protection, and Readiness/Training. The focus is on development and demonstration of next-generation C3 systems, demonstrating a capability to perform precision targeting aided by real-time interactive force level planning and rehearsal in a joint arena supporting a multi-platform environment, aircraft, and submarines. There are two projects supported by the PE:

1. (U) SEW Advanced Technology (X2091) -- This project is pursuing work in telecommunications, networking, security, and real time decision aids for Joint military operations. Efforts will develop and demonstrate a multinet, multi-media

communications controller that provides a smart software-intelligent interface between user Transmit/Receive communications systems capable of adjusting bandwidth/frequency to balance system loading, as well as state-of-the-art telecommunications technologies such as high data rate local-area-networks (LAN) that can meet unique military data transfer requirements using commercially developed Asynchronous Transfer Mode (ATM)/Synchronous Optical Network technologies. These high speed LANs will provide the ability to perform collaborative strike planning in the Real-Time Support for Joint Power Projection project by developing and integrating multi-node expert computer workstations and intelligent data bases, through ATM networking which will eventually operate in the gigabits per second regime. Information can then be communicated electronically from a shipboard multi-beamed steerable antenna interoperating with reconnaissance and surveillance sensors and aircraft to enhance joint strike planning among Navy platforms and between other Services. In addition, integrating of real-time information from sources such as the Precision Signals Intelligence (SIGINT) Targeting System (PSTS) and tactical reconnaissance and surveillance data will greatly improve asset allocation, precision targeting and execution of strike missions.

2. (U) Advanced Targeting (R2239) -- the Precision Signal Targeting System (PSTS) is a Joint Service/Defense Agency effort to develop and demonstrate the capability to provide tactical users with near-real-time target identification and precision targeting information, sensor-to-shooter target updating, and Battle Damage Assessment. PSTS will enhance the tactical utility/applicability of existing national assets and provide the tactical commander with performance improvements in terms of targeting accuracy, targets of interest, timeliness, and target identification. Technical challenges include development of advanced signal processing and data fusion algorithms for target detection and classification; and exploitation of multiple signal characteristics for specific emitter identifications.

(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 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.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N PROJECT NUMBER: X2091
PROGRAM ELEMENT TITLE: C3 Advanced Technology PROJECT TITLE: (SEW) Advanced Technology

(U) COST: (Dollars in thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
X2091 Space and Electronic Warfare (SEW) Advanced Technology	14,609	15,731	16,301	16,932	17,394	17,735	18,111	18,530	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Demonstrate advanced technology components, subsystems and systems that will improve the Navy's Command, Control and Communications (C3) distributed networks in areas such as high 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 narrow bandwidth communication circuits. Capabilities realized from these efforts will contribute to the Navy's ability to maintain an accurate situation assessment and tactical picture in near-real-time through shared knowledge of threatening situations which can then be communicated to all forces in near-real-time. Projects will be conducted in the following areas: (1) Automated Integrated Communication Systems (AICS) that utilizes digital networking techniques to integrate wideband voice/data/video data for transmitting over narrowband communication links; (2) Specification Tools for Software Requirements (STSR) as a prototype toolset to create high quality specifications needed to develop high-assurance mission critical C3 systems; (3) Multi-Level Secure (MLS) systems that provide embedded security for communicating at multi-security levels; (4) Supporting technologies; e.g., Multi-Mission Broadband Antennas (MMBA); (5) Real-Time Support for Joint Power Projection operations (JPP/RTS) that provides collaborative strike force planning and mission execution for Joint service systems; and (6) Verification & Validation of Mission Critical Systems (VVMCS) is a toolset and methodology based on formal methods to verify and validate that a developed mission-critical system satisfies its requirements. (7) Programmable Intelligent Digital Electronics (PRIDE) will develop/obtain, demonstrate, evaluate and transition PRIDE hardware engines based on industry consensus standard open architectures for a series of Navy and Joint applications. The applications will range from secure Joint Tactical Information Distribution System (JTIDS) waveforms for Joint Maritime Communications System (JMCOMS) to Command Control Communications Computers and Intelligence/Combat Direction System (C4I/CDS) embedded training for the warrior at sea to exploit/attack/protect functions for Information Warfare. High Data Rate Communications (HDRC) for Small Platforms will develop and demonstrate a shipboard Very Small Aperture Terminal (VSAT) capable of providing high data rate capabilities to FFG-7 and DDG-963 ships. Initial goals are for full duplex data exchange rates of 1.5 MBPS with scaleability to 45 MBPS utilizing Code Digital Multiplexing Analysis (CDMA) techniques. Cryptologic Unified Build On-Line Trainer (COLT) will develop an embedded cryptologic C4I interactive simulation and training capability for use by shore-based and deployed forces.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N PROJECT NUMBER: X2091
PROGRAM ELEMENT TITLE: C3 Advanced Technology PROJECT TITLE: (SEW) Advanced Technology

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($1,036) STSR: Completed reports on toolset software design, and user guide. Conducted full-scale demonstration of the enhanced toolset (specification editor, consistency checker, simulator and initial verifier capabilities) on an avionics weapons scenario. Demonstrated toolset at the Software Technology Conference (STC 96). Initiated technology transition of toolset to software developers.
- (U) ($1,225) AICS: Developed Network Management Systems Segment Specification required for shipboard distributed network systems. Completed Integration of Communication Automation Manager (CAM) and Network Manager.
- (U) ($1,041) MLS: Demonstrated high assurance, locally, distributed MLS strike planner. Evaluated several different security architectures for strike planning and command and control management.
- (U) ($1,025) JPP/RTS: Developed advanced in-cockpit situation awareness units for demonstration in multiple AH-64 units and ground control centers. Demonstrated air ground coordination and targeting in DEEP LOOK 96.
- (U) ($3,909) JPP/RTS: Integrated new technology modules for strike planning and execution with collaborative planning and query services and other technology efforts directed toward Global Command and Control System development at Navy demonstration site (Naval Strike Warfare Center, Fallon, Nevada) and aboard the USS THEODORE ROOSEVELT (CVN-71). Module installed on fleet workstations to allow collaborative planning, three dimensional (3D) visulation evaluation, and monitoring of a strike operation. Distributed algorithms, collaborative planning tools, a scaleable high performance shipboard LAN, and tactical aircraft planning workstations, actual tactical information were utilized to demonstrate in real-time, optimized planning and routing of a strike mission coordinated from the Joint Maritime Communication Information System (JMCIS).
- (U) ($3,955) JPP/RTS: Designed technology insertion device and conducted simulation of advanced real-time information flow to the Advanced Joint cockpit with on-board defensive and offensive decision aids and improved situation awareness. Unit deployed to the Sixth Fleet.
- (U) ($2,418) JPP/RTS: Demonstrated a 155 megabit per second strike planning LAN with interfaces to distributed mission planning and intelligence at Navy Research and Development Center and aboard the aircraft carrier USS THEODORE ROOSEVELT (CVN-71). LAN was accepted by and transferred to type Commander as Rapid Transition Effort.

2. (U) FY 1997 PLAN:

- (U) ($749) STSR: Transition technology of enhanced STSR toolset to Navy C3 users, JMCIS, SC-21, multi-level security developers and commercial organizations. Evolve toolset into a production strength tool.
- (U) ($910) MLS: Test and evaluate network security requirements resulting from the FY 1996 MLS Strike planning comparisons against assurance strategy/security architecture and security policy.
- (U) ($1,937) AICS: Conduct analysis and specification of Communication Plan (COMMPLAN) processing requirements. Develop integration framework for AICS and JMCOMS/Automated Digital Network System (ADNS), Integrated Network Manager (INM). Develop architecture for Web-based management of INM. Implement SNMPv2 prototype with security features.
- (U) ($2,244) MMBA: Develop and demonstrate prototype of multi-function multi-beam antennas in three frequency spectrums: below 2Ghz, above 2Ghz, and in the Defense Global Broadcast System (GBS) frequency spectrum (X-Ka band). Conduct extra high frequency (EHF) Satellite Communications (SATCOM) GBS two dimensional (2D) 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.
- (U) ($4,256) JPP/RTS: Major transition of Office of Naval Research (ONR) 6.2 decision making technology into JPP/RTS, including plan optimization and multiple interdependent routing algorithms. Integrate real-time joint intelligence, surveillance, and reconnaissance (ISR) sources into a common, integrated display, supporting planning and operations. Conduct Joint multi-laboratory demonstrations of interoperable planning and execution systems for Commander Joint Task Force, Joint Air Force Component Command, and strike commander in power projection planning and employment of Joint strike assets.
- (U) ($1,491) JPP/RTS: Integrate and demonstrate Navy/Joint force planning and execution capabilities and participate in a Joint/National planning, targeting and retargeting exercise.
- (U) ($2,720) JPP/RTS: Conduct Joint Navy/Air Force flight demonstration to assess advanced cockpit information management, situation awareness, and retargeting capability in F/A-18. Demonstration will support transition/implementation decision.
- (U) ($800) JPP/RTS: Demonstrate and test 622 megabit per second LAN prototype supporting ATM aware advanced planning, intelligence, and shipboard interior communications systems.
- (U) ($500) JPP/RTS: Engineering support to the Naval Sea Systems Command (NAVSEA) topside design branch (SEA 03KQ4) as related to LPD17 Advanced Enclosed Mast/Sensor (AEM/S) design.
- (U) ($124) Portion of Extramural Program reserved for Small Business Innovation Research Assessment in accordance with 15 U.S.C. 638.

3. (U) FY 1998 PLAN:

- (U) ($800) VVMCS: Demonstrate capability for specifying timing and accuracy requirements. Enhance simulator to symbolically execute system behavior based on timing and accuracy requirements as well as functional requirements. Demonstrate initial capability for verifying critical functional properties using model checking technology. Demonstrate an initial capability to generate functional, accuracy, and timing oriented test cases for the system integration and testing phase of a C3 software development.
- (U) ($900) MLS: Develop a security architecture and demonstrate prototype which will support read and write capability of both unclassified and Secret message traffic (and e-mail) and run both Secret and unclassified application programs from a single JMCIS/Global Command Conrol System (GCCS) workstation.
- (U) ($1,469) AICS: Update AICS network management architecture document and the AICS system segment specification documents with results of FY98 testing. Define automated management and control of shipboard voice systems (e.g., secure telephones, etc.) shall be undertaken. Conduct operational demonstration of ATM hardware used in the AICS and ADNS Research Development Test & Evaluation (RDT&E) test facilities. Produce AICS Network Management Architecture Document and the AICS System Segment Specification Document incorporating FY98 updates.
- (U) ($1,000) HDRC: Conduct CDMA study, CDMA modem specifications and procurement, conduct CDMA/VSAT link modeling, development and prototype. Conduct analysis of network and satellite management issues.
- (U) ($1,000) PRIDE: Complete development and demonstrate a PRIDE-based software radio with secure JTIDS waveforms. Demonstrate high frequency(HF)/very high frequency (VHF)/UHF waveforms with available prototype multi-functional antennas. Continue cost/performance tradeoff studies for SC-21, CV(X), Smart Ship and Arsenal Ship applications.
- (U) ($2,250) MMBA: Conduct shipboard demonstration of FY-97 multi-functional antenna demonstrations. Continue developmental testing of 2D phased array GBS antenna.
- (U) ($4,257 JPP/RTS: Mature technology capability demonstrated during FY97 in the joint laboratory environment and demonstrate integrated power projection planning and optimization, execution monitoring, intelligence, and re-targeting capabilities in Joint demonstration facility with interconnections to Battle Labs. Participate in Joint field exercise (Roving Sands, Project Strike, or equivalent).
- (U) ($3,625) JPP/RTS: Demonstrate 622 megabit per second shipboard LAN prototype with interfaces to global and theater level network control and management. LAN will provide ATM-aware network management and host advanced Navy/Joint power projection tools on fleet workstations and host shipboard interior communications and advanced multi-media distribution. Planned shipboard demonstration platform is CVN or LHD.
- (U) ($1,000) COLT: Develop an embedded cryptologic C4I interactive training simulation, mission planning and analysis tool for use by shore-based and deployed forces.

4. (U) FY 1999 PLAN:

- (U) ($1,000) VVMCS: Demonstrate advanced capability for verifying critical functional properties using model checking technology. Add capability for not only identifying violations of critical system properties but in addition for producing counter examples that demonstrates violations. Integrate the verifier with the specification editor, the consistency checker, and the simulator. Demonstrate an initial capability to use automated test cases of an example C3 system.
- (U) ($900) MLS: Develop the security architecture and build and demonstrate prototype to manage separate Unclassified, Secret, and Sensitive Compartmented Information (SCI) networks from a single workstation.
- (U) ($1,732) AICS: Iterate and refine the operational demonstration of ATM and AICS implementation. Update the AICS Network Management Architecture Document and the AICS System Segment Specification Document.
- (U) ($1,100) HDRC: Conduct engineering testing of subsystems. Conduct systems integration testing. Demonstrate RF subsystem, line of signal (LOS) subsystem, and Full Spectrum Management Subsystem.
- (U) ($1,400) PRIDE: Develop and demonstrate a prototype PRIDE-based embedded trainer for both CDS and C4I applications. Conduct limited at-sea evaluation. Conduct feasibility study for PRIDE-based sonar and radar embedded training.
- (U) ($3,200) MMBA: Conduct full scale shipboard test of integrated multi-function multibeam antenna operating in the UHF, EHF and GBS frequency regime.
- (U) ($2,500) JPP/RTS: Demonstrate 2.4 gigabit shipboard LAN with advanced high speed transport protocols, advanced congestion management to accommodate C3I, combat, and ship inter-communications distribution to support interactive planning and serve as backbone shipboard LAN for SC-21, CVN-X, and following ships.
- (U) ($4,100) JPP/RTS: Conduct major integrated demonstration of planning and execution capabilities, including flight demonstration, in conjunction with Air Force battle management demonstrations Joint Forces Air Componet Commander (JFACC) Advanced Concept Technology Demonstration (ACTD), national intelligence, and battlefield visualization demonstrations. Provide 2.4 gigabit per second communications backbone.
- (U) ($1,000) COLT: Build and demonstrate cryptologic C4I interactive training, mission planning and analysis prototype for use by shore-based and deployed forces.

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President’s Budget:	15,038	16,445	19,653	17,088
(U) Adjustments from FY 1997 PRESBUDG:	-429	-714	-3,352	-156

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N PROJECT NUMBER: X2091
PROGRAM ELEMENT TITLE: C3 Advanced Technology PROJECT TITLE: (SEW) Advanced Technology

(U) FY 1998/1999 PRESBUDG:	14,609	15,731	16,301	16,932

(U) CHANGE SUMMARY EXPLANATION:
(U) Funding: FY 1996 adjustment reflects a Jordanian F-16 financing rescission (-$17); SBIR transfer (-$243); Execution adjustment (-$169). FY 1997 adjustment reflects congressional undistributed adjustment (-$714). FY 1998 adjustment reflects Navy Working Capital Fund (NCWF) and minor adjustments (-$921); Inflation (-$41) and S&T adjustment (-$2,390). FY 1999 reduction reflects NWCF adjustment (-$156).

(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. SCHEDULE PROFILE: Not applicable.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1997

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N
PROGRAM ELEMENT TITLE: C3 Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1996 ACTUAL	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
R2239 Advanced Targeting	8,632	12,299	7,467	948	944	933	957	979	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Precision Signal Targeting System (PSTS) addressed in the Director of Defense, Research, and Engineering Global Surveillance and Communications Thrust 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 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 geolocation, and modeling and simulation to assure optimal resource allocation for cooperative precision targeting and primary mission performance.

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1996 ACCOMPLISHMENTS:

- (U) ($1,890) Demonstration 3. Completed Demonstration 3. Demonstrated the capability to process fused national and tactical data at the GUARDRAIL Integrated Processing Facility (IPF) located in Savannah, GA. Demonstration

3 included upgraded processing algorithms, integration of a time of arrival (TOA) Acquisition and Precision Measurement System, and specification and acquisition of a live fire target radar emulator

- (U) ($2,720) Demonstration 4. Demonstration 4 occured in Korea and demonstrated a limited deployed PSTS capability. Communication emitter data collected during demonstration 4 supported development of communication emitter geolocation algorithms used in subsequent demonstrations. Demonstration 4 included integration of additional specialized signal processing algorithms into the IPF, use of specialized broad band point to point communications supported high data rate transfer of Pulse Descriptive Words (PDWs), and inclusion of data fusion algorithms into the Landmark processor.

- (U) ($2,199) Systems Engineering. Completed requirements analysis, operations concept development, planning and procedures, scheduling, and execution of Demonstration 3. Initiated requirements analysis, operations concept development planning and procedures, and scheduling activities for Demonstration 4. In addition, defined and executed system engineering tasks including 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) ($978) Portable Tactical Testbed. Began specification and implementation of a Portable Tactical Testbed capable of receiving Common Data Link information and producing geolocations based on Signals Intelligence (SIGINT) or Communications Intelligence (COMINT).

- (U) ($845) Integrated Airborne Deployed Strike Surveillance (IADSS). Initiated a systems engineering system study to determine the architecture and system requirements for an unmanned aerial vehicle (UAV) deployed autonomous controlled sensor suite to provide SIGINT and COMINT data for PSTS processing. Also initiated a system architecture study to define how IADSS and PSTS fits into the overall Command, Control, Communications, Computer and Intelligence (C4I) architecture.

2. (U) FY 1997 PLAN:

- (U) ($4,451) Demonstration 5. Demonstration 5 will be conducted in Continental United States and will demonstrate 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 will include the specification and acquisition of a COMINT target emitter capable of emulating a broad variety of COMINT transmitters.

- (U) ($3,448) Systems Engineering. Will complete requirements analysis, operations concept development, planning and procedures, and scheduling for Demonstration 5. In addition, systems engineering tasks initiated in FY96 will continue. These studies include 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) ($1,000) IADSS. Based on the study results obtained during FY96, perform a detailed system engineering study to define sensor suite, communications, and autonomous management requirements and design. This design will provide the basis for integrating a sensor suite and autonomous management system to support a demonstration of IADSS in conjunction with PSTS.
- (U) ($2,400) Portable Tactical Testbed. Complete the implementation and integration of the Portable Tactical Testbed for use with Demonstration 6.
- (U) ($1,000) Integrated Sensor Tasking (IST). Continue development of an Integrated Sensor Tasking effort to provide the capability to coordinate the collection management of tactical and national assets to support tactical exploitation of PSTS capabilities.

3. (U) FY 1998 PLAN:

- (U) ($4,022) Demonstration 6. Demonstration 6 will be conducted in Korea and will demonstrate 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) ($2,418) Systems Engineering. Will complete requirements analysis, operations concept development, planning and procedures, and scheduling for Demonstration 6. Will complete system engineering studies as required to meet Demonstration 6 and to support technology transition.
- (U) ($834) Portable Tactical Testbed. Provide engineering, operations and maintenance support for the Portable Tactical Testbed for Demonstration 6.
- (U) ($193) Technology Transfer. Complete documentation and configuration management of final PSTS systems including the tactical testbed.

4. (U) FY 1999 PLAN:

- (U) ($948) Logistics Support. Provide engineering, operations and maintenance support for deployed PSTS systems.

FY 1998/1999 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 1996

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603794N PROJECT NUMBER: R2239
PROGRAM ELEMENT TITLE: C3 Advanced Technology PROJECT TITLE: Advanced Targeting

B. (U) PROGRAM CHANGE SUMMARY:

	FY 1996	FY 1997	FY 1998	FY 1999
(U) FY 1997 President's Budget:	$10,666	$12,823	$8,305	$955
(U) Adjustments from FY97 PRESBUDG:	-2,034	-524	-838	-7
(U) POM-98 Submission:	$ 8,632	$12,299	$7,467	$948

(U) CHANGE SUMMARY EXPLANATION:

(U) Funding: FY 1996 adjustment reflects a Jordanian F-16 financing rescission (-$12); and Execution Adjustment (-$2,022). FY 1997 adjustment reflects minor Congressional undistributed adjustments(-$524). FY 1998 adjustment reflects Navy Working Capital Fund (NCWF) and minor adjustments(-$238) and S&T adjustment (-$600). FY 1999 adjustment reflects minor internal adjustments (-$7).

(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.