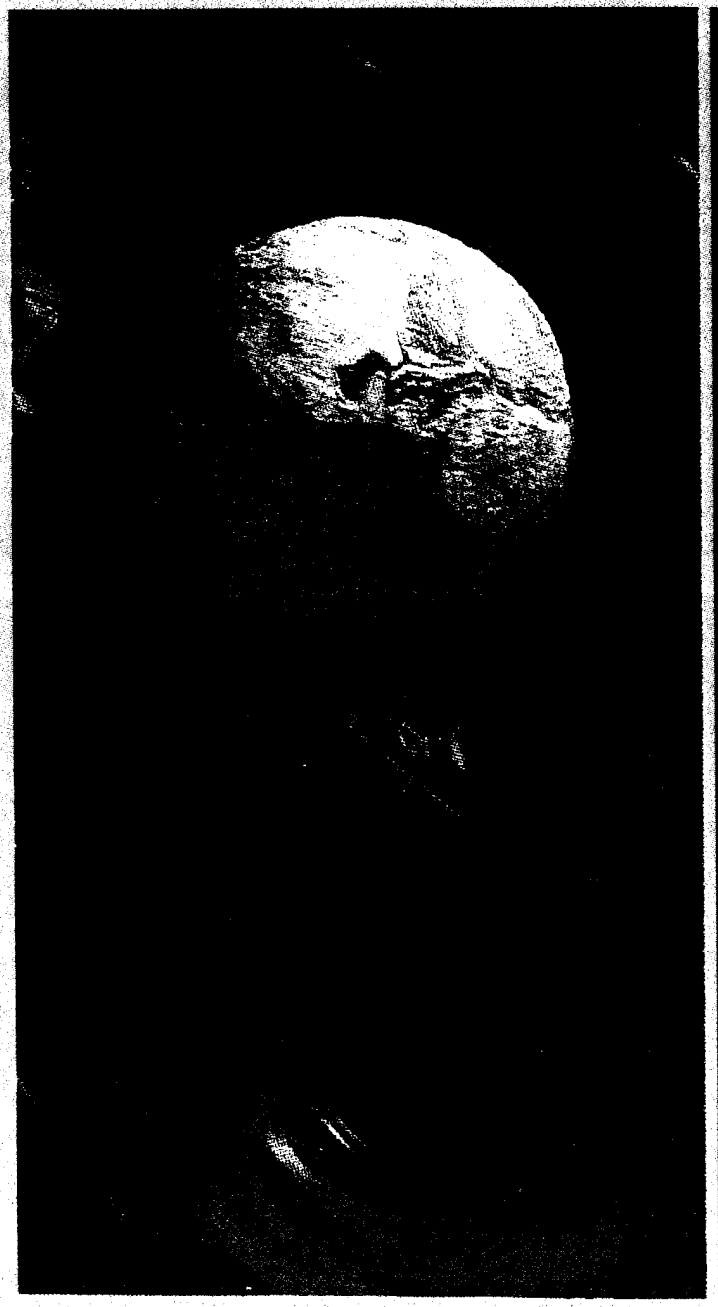

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FY 1997 RDT&E Descriptive Summaries

September 1995

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ADVANCED RESEARCH PROJECTS AGENCY
3701 NORTH FAIRFAX DRIVE
ARLINGTON, VA 22203-1714

SEP 27 1995

MEMORANDUM FOR THE DEPUTY COMPTROLLER (PROGRAM AND BUDGET)

SUBJECT: FY 1997 Budget Estimate Submission

In response to the DoD Comptroller memorandum dated July 10, 1995, the attached budget exhibits are submitted.

Gregory Colocotronis
Comptroller

Attachments:
Exhibit R-1 (PE Level)
Exhibit R-2 (Budget Item Justification Sheets)
Object Classification Summary
PB-1 (FY97 Budget Estimates Summary)
PB-2A (Prog/Financing)
PB-4 (Schedule of Civ & Mil Personnel)
PB-5 (Pay Increase)
PB-15 (Consulting Services)
PB-22 (Mgmt Hdqtrs)
PB-28 (Environmental Proj)
PB-31R (Benefits)
PB-52A (Aeronautical Budget)
PB-52B (Space Budget)
PB-53 (Pay Raise)
OP-8 (Civilian Personnel Costs)
Exhibit 43A (Information Technology)
SA (Security Activities)

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ADVANCED RESEARCH PROJECTS AGENCY

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ADVANCED RESEARCH PROJECTS AGENCY

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SECTION I

FUNDING SUMMARIES

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ IN MILLIONS)

FY 1997 BUDGET ESTIMATE SUBMISSION

Budget Activity	Title	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate
1	Basic Research	85,369	89,480	84,923	85,936	86,684	88,374	88,286
2	Exploratory Development	837,763	788,226	829,822	901,651	941,400	982,184	1,033,121
3	Advanced Development	1,425,059	1,722,684	1,443,956	1,405,015	1,361,230	1,378,695	1,390,102
6	RDT&E Management Support	35,033	38,844	41,099	41,998	43,486	44,147	44,991
	TOTAL RDT&E - DIRECT	2,383,224	2,639,234	2,399,800	2,434,600	2,432,800	2,493,400	2,556,500
	Reimbursements	15,500	10,000	15,000	15,000	15,000	15,000	15,000
	TOTAL PROGRAM	2,398,724	2,649,234	2,414,800	2,449,600	2,447,800	2,508,400	2,571,500

Exhibit R-1

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ in millions)

FY 1997 BUDGET ESTIMATE SUBMISSION (BES)

PE	PROJ	TITLE	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
61101E	CCS-02	INFORMATION SCIENCES	23.175	24.524	25.109	25.805	26.300	29.500	29.700
	ES-01	ELECTRONIC SCIENCES	34.401	42.600	37.967	37.578	38.009	38.778	37.533
	MS-01	MATERIALS SCIENCES	27.793	22.356	21.847	22.553	22.375	20.096	21.053
	61101E	DEFENSE RESEARCH SCIENCES	85.369	89.480	84.923	85.936	86.684	88.374	88.286
62301E	ST-01	JASONS	1.227	1.195	1.196	1.190	1.200	1.200	1.200
	ST-11	INTELLIGENT SYSTEMS & SOFTWARE	72.617	97.378	106.157	113.498	116.807	111.256	117.007
	ST-19	HIGH PERFORMANCE COMPUTING	234.316	232.709	204.494	208.829	223.557	256.481	267.192
	ST-22	SOFTWARE ENGINEERING TECHNOLOGY	38.424	18.483	19.037	19.609	20.196	20.803	21.428
	ST-23	MONITORING TECHNOLOGIES	19.529	18.851	16.330	0.000	0.000	0.000	0.000
	ST-24	INFORMATION SURVIVABILITY	9.877	35.511	40.000	45.500	44.000	40.000	40.000
	62301E	COMPUTING SYS & COMM TECHNOLOGY	375.990	404.127	387.214	388.626	405.760	429.740	446.827
62702E	TT-03	NAVAL WARFARE TECHNOLOGY	48.593	30.000	35.229	34.837	53.000	66.553	69.172
	TT-04	ADVANCED LAND SYSTEMS TECHNOLOGY	28.373	33.412	39.974	46.986	57.001	55.909	56.686
	TT-05	ADVANCED TARGETING TECHNOLOGY	5.623	0.000	0.000	0.000	0.000	0.000	0.000
	TT-06	ADVANCED TACTICAL TECHNOLOGY	37.287	40.905	64.595	58.567	60.418	57.024	62.728
	TT-10	TRANSTECH	0.000	9.650	17.185	38.685	16.665	7.633	0.000
	62702E	TACTICAL TECHNOLOGY	119.876	113.967	156.983	179.075	187.084	187.119	188.586
62708E	IC-03	INTEGRATED COMMAND & CONTROL TECH	79.375	48.000	45.000	45.000	45.000	45.000	45.000
62712E	MPT-01	MATERIALS PROCESSING TECHNOLOGY	142.592	117.404	118.938	145.414	160.191	161.550	180.327
	MPT-02	MICROELECTRONIC DEVICE TECHNOLOGIES	87.892	60.308	75.451	90.582	92.396	99.222	108.881
	MPT-06	CRYOGENIC ELECTRONICS	17.406	12.333	17.187	21.740	13.283	15.146	15.000
	MPT-07	MILITARY MEDICAL/TRAUMA CARE TECHNOLOGY	14.632	32.087	29.049	31.214	37.686	44.407	48.500
	62712E	MATERIALS & ELECTRONICS TECHNOLOGY	262.522	222.132	240.625	288.950	303.556	320.325	352.708
63226E	EE-21	COMMAND & CONTROL INFORMATION SYSTEMS	51.099	63.508	89.179	126.300	131.000	139.169	139.034
	EE-27	ADVANCED SPACE TECHNOLOGY PROGRAM	8.381	0.000	0.000	0.000	0.000	0.000	0.000
	EE-34	GUIDANCE TECHNOLOGY	9.114	25.888	29.673	25.000	21.600	21.000	20.000
	EE-36	ADVANCED SHIPSENSOR SYSTEMS	32.368	16.561	28.605	31.910	65.508	87.816	99.696
	EE-37	ADVANCED SIMULATION	74.148	75.489	48.419	42.279	45.698	62.948	65.353
	EE-39	UNMANNED UNDERSEA VEHICLE SYSTEMS	34.339	15.116	0.000	0.000	0.000	0.000	0.000
	EE-40	CRITICAL MOBILE TARGETS	109.771	123.364	0.000	0.000	0.000	0.000	0.000
	EE-41	AIR DEFENSE INITIATIVE	34.281	23.476	21.777	28.579	30.479	25.690	25.690
	EE-45	GLOBAL GRID COMMUNICATIONS	43.289	45.108	42.024	48.392	33.916	32.750	39.549
	EE-46	DEFENSE SIMULATION INTERNET (DSI)	14.737	27.239	39.675	3.000	0.000	0.000	0.000
	EE-47	FAST SHIP/FUTURE SHIP	0.000	0.000	16.382	25.000	25.000	0.000	0.000
	EE-48	COMBAT HYBRID POWER SYSTEM	0.000	0.000	15.000	20.000	20.000	10.000	0.000

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ in millions)

FY 1997 BUDGET ESTIMATE SUBMISSION (BES)

PE	PROJ	TITLE	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
	EE-49	TIER III UAV	0.000	24.675	14.749	5.000	0.000	0.000	0.000
	EE-50	BATTLEFIELD AWARENESS	0.000	0.000	95.201	109.866	113.155	124.400	126.787
	EE-CLS	CLASSIFIED	170.291	179.111	178.638	162.550	165.655	229.440	235.648
	63226E	EEMIT	581.818	619.535	619.322	627.876	652.011	733.213	751.757
63569E	AS-01	ADVANCED SUBMARINE TECHNOLOGY	31.575	9.501	0.000	0.000	0.000	0.000	0.000
	63570E	DEFENSE REINVESTMENT	208.067	500.000	0.000	0.000	0.000	0.000	0.000
63739E	MT-01	DISTRIBUTED SENSOR SYSTEM	0.000	1.907	50.000	50.000	50.000	50.000	50.000
	MT-02	MMIC	20.472	0.000	0.000	0.000	0.000	0.000	0.000
	MT-03	INFRARED FOCAL PLANE ARRAY	42.979	36.744	44.772	19.000	14.000	0.000	0.000
	MT-04	ELECTRONIC MODULE TECHNOLOGY	113.540	103.482	64.929	71.804	134.823	164.783	183.034
	MT-05	TACTICAL INFORMATION SYSTEMS	14.033	22.064	17.721	22.784	21.646	23.000	27.500
	MT-06	MICROWAVE & ANALOG FRONT END TECHNOLOGY	19.475	48.841	47.921	59.114	58.201	17.467	27.811
	MT-07	CENTERS OF EXCELLENCE	35.785	22.142	0.000	0.000	0.000	0.000	0.000
	MT-08	MANUFACTURING TECHNOLOGY APPLICATIONS	47.798	78.942	63.850	33.455	23.000	9.951	0.000
	MT-10	ADVANCED LITHOGRAPHY	56.321	39.003	51.404	40.000	40.000	40.000	40.000
	MT-11	COMPUTER AIDED ACQ AND LOGISTICS SUPPORT (CALS)	33.755	34.247	10.604	0.000	0.000	0.000	0.000
	MT-12	MEMS	0.000	30.991	42.800	47.060	48.549	24.281	0.000
	63739E	ADVANCED ELECTRONICS TECHNOLOGIES	384.158	418.363	394.001	343.217	390.219	329.482	328.345
63744E	SM-01	ADVANCED SIMULATION - NATIONAL GUARD	27.910	5.399	0.000	0.000	0.000	0.000	0.000
63745E	EM-01	SEMICONDUCTOR MANUFACTURING TECHNOLOGY	88.327	89.554	0.000	0.000	0.000	0.000	0.000
63746E	MR-01	MARITIME TECHNOLOGY	50.780	49.657	49.708	50.000	0.000	0.000	0.000
63747E	EV-01	ELECTRIC VEHICLES	14.170	0.000	0.000	0.000	0.000	0.000	0.000
63757E	CO-01	COOPERATIVE AGREEMENT PROGRAM	0.004	0.000	0.000	0.000	0.000	0.000	0.000
63800E	JA-01	JOINT ADVANCED STRIKE TECHNOLOGIES	0.000	30.675	80.925	83.922	19.000	16.000	10.000
63805E	GC-01	DUAL USE APPLICATIONS PROGRAMS	0.000	0.000	300.000	300.000	300.000	300.000	300.000
63889E	CD-01	COUNTERDRUG	38.250	0.000	0.000	0.000	0.000	0.000	0.000
65114E	BL-01	BLACKLITE	4.725	4.745	4.730	4.683	5.000	5.000	5.000
65898E	MH-01	MANAGEMENT HEADQUARTERS (R&D)	30.158	34.099	36.369	37.315	38.486	39.147	39.991
99900E	EA-01	EXPIRED ACCOUNT ADJUSTMENTS	0.150	0.000	0.000	0.000	0.000	0.000	0.000
	AGENCY TOTAL		2383.224	2639.234	2399.800	2434.600	2432.800	2493.400	2556.500
	BA-01	TOTAL	85.369	89.480	84.923	85.936	86.684	88.374	88.286
	BA-02	TOTAL	837.763	788.226	829.822	901.651	941.400	982.184	1033.121
	BA-03	TOTAL	1425.059	1722.684	1443.956	1405.015	1361.230	1378.695	1390.102
	BA-06	TOTAL	35.033	38.844	41.099	41.998	43.486	44.147	44.991
	AGENCY TOTAL		2383.224	2639.234	2399.800	2434.600	2432.800	2493.400	2556.500

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
OBJECT CLASSIFICATION
($ in Thousands)

		FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate
Personnel Compensation				
11.1	Full-Time Permanent	10,532	11,456	11,106
11.3	Other Than Full-Time Permanent	461	475	489
11.5	Other Personnel Compensation	962	566	542
11.8	Special Personnel Services Payments	4,984	7,003	9,106
	Total Personnel Compensation	16,939	19,500	21,243
Direct Obligations				
11.9	Total Personnel Compensation	16,939	19,500	21,243
12.0	Civilian Personnel Benefits	1,861	2,019	1,975
21.0	Travel and Transportation of Persons	3,102	3,443	3,733
23.1	Rental Payments to GSA	2,102	2,333	2,450
23.2	Rental Payments to Others	183	203	255
23.3	Communications, Utilities and Miscellaneous Charges	7,033	7,833	8,633
24.0	Printing and Reproduction	27	30	32
25.5	R&D Contracts	2,451,560	2,505,947	2,362,373
25.1	Consulting Services	47,473	44,224	44,342
26.0	Supplies and Materials	470	522	575
31.0	Equipment	1,914	1,978	2,076
	Total Direct Obligations	2,532,664	2,588,032	2,447,687
Reimbursable Obligations				
25.5	R&D Contracts	15,500	10,000	15,000
Total Obligations		2,548,164	2,598,032	2,462,687

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
SUMMARY OF FY 1997 DEFENSE BUDGET ESTIMATES
($, in millions)

Appropriation Account Title	Direct Budget Plan (TOA)				Budget Authority				Outlays			
	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate
RDT&E, Defensewide	2,383	2,639	2,400	2,435	2,383	2,639	2,400	2,435	2,386	2,488	2,478	2,422

Exhibit PB-1

Identification code: 97-0400-DE		Obligation Summary Estimate FY 1995	Estimate FY 1996	Estimate FY 1997
Program by activities:				
	Direct Program:			
01.000	Basic Research (6.1)	83,472	88,860	85,884
02.000	Exploratory Development (6.2)	765,534	800,423	814,075
03.000	Advanced Technology Development (6.3A)	1,653,563	1,661,832	1,507,371
06.000	Management Support (6.5)	30,095	36,917	40,357
	Total Direct Obligations	2,532,664	2,588,032	2,447,687
R01.000	Reimbursable Obligations	15,500	10,000	15,000
	Total Obligations	2,548,164	2,598,032	2,462,687
	Financing:			
	Offsetting collections from:			
F11.010	New Federal Funds (-)	-15,500	-10,000	-15,000
F14.020	New Non-Federal Sources	-4		
	Unobligated balance available, start of year:			
F21.020	For completion of prior year budget plans	-718,882	-476,645	-527,847
F22.410	Unobligated balance transferred from other account	-26,502		
	Unobligated balance available, end of year:			
F24.020	For completion of prior year budget plans	476,645	527,847	479,960
	Total Budget Authority	2,263,921	2,639,234	2,399,800
	Budget authority:			
F40.010	Appropriation EN/EST	2,799,322	2,639,234	2,399,800
F40.700	Reduction pursuant to P.L. 104-6 (-)	-460,866		
F40.710	Reduction pursuant to P.L. 104-19 (-)	-7,300		
F40.780	Reduction pursuant to P.L. 103-335 (-)	-68,355		
F41.220	Transferred to other accounts (-)	-35,000		
F42.000	Transferred from other accounts	36,120		
	Total Budget Authority	2,263,921	2,639,234	2,399,800

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

September 1995

Identification code: 97-0400-DE

		Obligations Fiscal Year 1994 Estimate FY 1995 Estimate
Program by activities:		
Direct Program:		
01.000	Basic Research (6.1)	15,177
02.000	Exploratory Development (6.2)	95,323
03.000	Advanced Technology Development (6.3A)	513,515
06.000	Management Support (6.5)	2,069
	Total Direct Obligations	626,084
	Total Obligations	626,084
Financing:		
	Unobligated balance available, start of year:	
F21.020	For completion of prior year budget plans	-718,882
F22.410	Unobligated balance transferred from other account	-26,502
	Total Budget Authority	-119,300
F40.700	Reduction pursuant to P.L 104-6 (-)	-77,000
F40.710	Reduction pursuant to P.L. 104-19 (-)	-7,300
F41.220	Transferred to other accounts (-)	-35,000
	Total Budget Authority	-119,300

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide September 1995
Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

Identification code: 97-0400-DE		Obligations Fiscal Year 1995 Estimates 1995 Est.	1996 Est.
Program by activities:			
	Direct Program:		
01.000	Basic Research (6.1)	68,295	17,074
02.000	Exploratory Development (6.2)	670,211	167,553
03.000	Advanced Technology Development (6.3A)	1,140,048	285,011
06.000	Management Support (6.5)	28,026	7,007
	Total Direct Obligations	1,906,580	476,645
R01.000	Reimbursable Obligations	15,500	
	Total Obligations	1,922,080	476,645
	Financing:		
	Offsetting collections from:		
F11 010	New Federal Funds (-)	-15,500	
F14.020	New Non-Federal Sources	-4	
	Unobligated balance available, start of year:		
F21.020	For completion of prior year budget plans		-476,645
	Unobligated balance available, end of year:		
F24.020	For completion of prior year budget plans	476,645	
	Total Budget Authority	2,383,221	
	Budget authority:		
F40.010	Appropriation EN/EST	2,799,322	0
F40.700	Reduction pursuant to P.L. 104-6 (-)	-383,866	
F40.710	Reduction pursuant to P.L. 104-19 (-)	0	
F40.780	Reduction pursuant to P.L. 103-335 (-)	-68,355	
F42.000	Transferred from other accounts	36,120	
	Total Budget Authority	2,383,221	0

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide September 1995
Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

Identification code: 97-0400-DE		Obligations Fiscal Year 1996 Estimates 1996 Est.	1997 Est.
Program by activities:			
	Direct Program:		
01.000	Basic Research (6.1)	71,786	17,946
02.000	Exploratory Development (6.2)	632,870	158,218
03.000	Advanced Technology Development (6.3A)	1,376,821	344,205
06.000	Management Support (6.5)	29,910	7,478
	Total Direct Obligations	2,111,387	527,847
R01.000	Reimbursable Obligations	10,000	
	Total Obligations	2,121,387	527,847
	Financing:		
	Offsetting collections from:		
F11 010	New Federal Funds (-)	-10,000	
	Unobligated balance available, start of year:		
F21.020	For completion of prior year budget plans		-527,847
	Unobligated balance available, end of year:		
F24.020	For completion of prior year budget plans	527,847	
	Total Budget Authority	2,639,234	
	Budget authority:		
F40.010	Appropriation EN/EST	2,639,234	
F40.700	Reduction pursuant to P.L. 104-6 (-)		
F40.710	Reduction pursuant to P.L. 104-19 (-)		
F40.780	Reduction pursuant to P.L. 103-335 (-)		
F42.000	Transferred from other accounts		
	Total Budget Authority	2,639,234	

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide September 1995
Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

Identification code: 97-0400-DE		Obligations Fiscal Year 1997 Estimates 1997 Est.
Program by activities:		
	Direct Program:	
01.000	Basic Research	67,938
02.000	Exploratory Development	655,857
03.000	Advanced Technology Development	1,163,166
06.000	Management Support	32,879
	Total Direct Obligations	1,919,840
R01.000	Reimbursable Obligations	15,000
	Total Obligations	1,934,840
	Financing:	
	Offsetting collections from:	
F11.010	New Federal Funds (-)	-15,000
	Unobligated balance available, start of year:	
F21.020	For completion of prior year budget plans	
	Unobligated balance available, end of year:	
F24.020	For completion of prior year budget plans	479,960
	Total Budget Authority	2,399,800
	Budget authority:	
F40.010	Appropriation EN/EST	2,399,800
F40.700	Reduction pursuant to P.L. 104-6 (-)	
F40.710	Reduction pursuant to P.L. 104-19 (-)	
F40.780	Reduction pursuant to P.L. 103-335 (-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,399,800

Exhibit PB-2A

Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

Identification code: 97-0400-DE		Budget Plan Estimate FY 1995	Estimate FY 1996	Estimate FY 1997
Program by activities:				
	Direct Program:			
01.000	Basic Research (6.1)	85,369	89,732	84,923
02.000	Exploratory Development (6.2)	837,764	791,088	831,628
03.000	Advanced Technology Development (6.3A)	1,425,059	1,721,026	1,443,957
06.000	Management Support (6.5)	35,033	37,388	39,292
	Total Direct Program	2,383,225	2,639,234	2,399,800
R01.000	Reimbursable Program	15,500	10,000	15,000
	Total Program	2,398,725	2,649,234	2,414,800
	Financing:			
F14.020	New Non-Federal Sources	-4		
F11.010	New Federal Funds (-)	-15,500	-10,000	-15,000
	Total Budget Authority	2,383,221	2,639,234	2,399,800
	Budget authority:			
F40.010	Appropriation EN/EST	2,799,322	2,639,234	2,399,800
F40.700	Reduction pursuant to P.L. 104-6 (-)	-383,866		
F40.710	Reduction pursuant to P.L. 104-19 (-)	0		
F40.780	Reduction pursuant to P.L. 103-335 (-)	-68,355		
F42.000	Transferred from other accounts	36,120		
	Total Budget Authority	2,383,221	2,639,234	2,399,800

Exhibit PB-2A

Identification code: 97-0400-DE		Budget Plan Estimate FY 1995
Program by activities:		
	Direct Program:	
01.000	Basic Research (6.1)	85,369
02.000	Exploratory Development (6.2)	837,764
03.000	Advanced Technology Development (6.3A)	1,425,059
06.000	Management Support (6.5)	35,033
	Total Direct Program	2,383,225
R01.000	Reimbursable Program	15,500
	Total Program	2,398,725
	Financing:	
F14.020	New Non-Federal Sources	-4
F11.010	New Federal Funds (-)	-15,500
	Total Budget Authority	2,383,221
	Budget authority:	
F40.010	Appropriation EN/EST	2,799,322
F40.700	Reduction pursuant to P.L. 104-6 (-)	-383,866
F40.710	Reduction pursuant to P.L. 104-19 (-)	0
F40.780	Reduction pursuant to P.L. 103-335 (-)	-68,355
F42.000	Transferred from other accounts	36,120
	Total Budget Authority	2,383,221

Exhibit PB-2A

Identification code: 97-0400-DE		Budget Plan Estimate FY 1996
Program by activities:		
	Direct Program:	
01.000	Basic Research (6.1)	89,732
02.000	Exploratory Development (6.2)	791,088
03.000	Advanced Technology Development (6.3A)	1,721,026
06.000	Management Support (6.5)	37,388
	Total Direct Program	2,639,234
R01.000	Reimbursable Program	10,000
	Total Program	2,649,234
	Financing:	
F14.020	New Non-Federal Sources	
F11.010	New Federal Funds (-)	-10,000
	Total Budget Authority	2,639,234
	Budget authority:	
F40.010	Appropriation EN/EST	2,639,234
F40.700	Reduction pursuant to P.L. 104-6 (-)	
F40.710	Reduction pursuant to P.L. 104-19 (-)	
F40.780	Reduction pursuant to P.L. 103-335 (-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,639,234

Exhibit PB-2A

Advanced Research Projects Agency
Program and Financing
(Dollars in Thousands)

Identification code: 97-0400-DE		Budget Plan Estimate FY 1997
Program by activities:		
	Direct Program:	
01.000	Basic Research (6.1)	84,923
02.000	Exploratory Development (6.2)	831,628
03.000	Advanced Technology Development (6.3A)	1,443,957
06.000	Management Support (6.5)	39,292
	Total Direct Program	2,399,800
R01.000	Reimbursable Program	15,000
	Total Program	2,414,800
	Financing:	
F14.020	New Non-Federal Sources	
F11.010	New Federal Funds (-)	-15,000
	Total Budget Authority	2,399,800
	Budget authority:	
F40.010	Appropriation EN/EST	2,399,800
F40.700	Reduction pursuant to P.L. 104-6 (-)	
F40.710	Reduction pursuant to P.L. 104-19 (-)	
F40.780	Reduction pursuant to P.L. 103-335 (-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,399,800

Exhibit PB-2A

SECTION II

MODERNIZATION AND INVESTMENT

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Research Sciences	**85,369**	**89,480**	**84,923**	**85,936**	**86,684**	**88,374**	**88,286**	**Continuing**	**Continuing**
Information Sciences CCS-02	23,175	24,524	25,109	25,805	26,300	29,500	29,700	Continuing	Continuing
Electronic Sciences ES-01	34,401	42,600	37,967	37,578	38,009	38,778	37,533	Continuing	Continuing
Materials Sciences MS-01	27,793	22,356	21,847	22,553	22,375	20,096	21,053	Continuing	Continuing

(U) **Mission Description**: The Defense Research Sciences program element is budgeted in the Basic Research Budget Activity because it provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military, national security and commercial applications. It supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information, electronic and materials sciences.

(U) The Information Sciences project supports basic scientific study and experimentation in software technology, intelligent systems technology, human-computer interaction technology, facets of microelectronic sciences, and varied aspects of high performance computing.

(U) The Electronic Sciences project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function.

(U) The Materials Sciences project is concerned with the development and exploitation of: development of high power/energy density electrochemical power sources (batteries and fuel cells); bioremediation tools for cost effective in situ toxic waste conversion; waste source reduction for DoD-relevant manufacturing processes; and training of DoD personnel in hazardous waste management. In addition, research is focused on basic concepts for development of advanced magnetic materials for use in radiation hardened memories, and combat casualty care medical technologies.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Sciences CCS-02	23,175	24,524	25,109	25,805	26,300	29,500	29,700	Continuing	Continuing

(U) **Mission Description**: This project supports the basic scientific study and experimentation that is the basis for more advanced knowledge and understanding in information sciences technology areas such as software foundations and environments, intelligent systems, human computer interface, language technology, microelectronic science, and high performance computing related to long-term national security requirements.

(U) In the area of software technology: advanced concepts are developed for methods and tools to produce high assurance software; language concepts that facilitate the rapid specification and evolution of systems; and techniques to manage shared complex structured data objects in larger heterogeneous, distributed information systems. The intelligent systems technology focus is on advanced techniques for knowledge representation, reasoning, and machine learning, which enables computer understanding of spoken and written language and images. Also included is advanced methods for planning, scheduling, and resource allocation. The focus in the human computer interaction technology area is design methods and enabling technology for more natural interaction between people and computers. Lastly, the high performance computing (HPC) focus is on science generated concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Experimentally evaluated advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. ($5.0M)
- Developed initial tool kits for interactive, dialogue-based human computer interaction and demonstrate them in a clinical environment. ($5.5M)
- Developed initial language-based methods for image understanding, high assurance, and software engineering system composition. ($5.0M)
- Experimentally evaluated process model approaches for prototyping large-scale software environments. ($2.0M)
- Experimentally evaluated library research that supports multiple parallel architectures. ($1.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project CCS-02

- Demonstrated health information network using South Florida Clinic. ($.9M)
- Developed initial planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($3.0M)

(U) FY 1996 Program:

- Refine and enhance benchmark problems, metrics, and test data sets and conduct experimental evaluations involving multiple intelligent systems and software engineering foundations technologies, utilizing knowledge acquisition. ($6.0M)
- Enhance advanced information processing methods in spoken language understanding, written language understanding and automated planning systems. ($4.5M)
- Experimentally evaluate tool kits for interactive, dialogue-based human computer interaction. ($4.7M)
- Experimentally evaluate language-based methods for image understanding, high assurance, and software environments system composition. ($2.5M)
- Refine and begin experimental evaluation of design technology to include high performance computational prototyping of systems. ($4.5M)
- Experimentally evaluate planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($2.3M)

(U) FY 1997 Program:

- Develop initial tools and tool kits for development and evaluation of highly interactive, agent and dialogue-based human computer interactions. ($6.3M)
- Advance the capabilities of spoken and written language understanding to solve real-world problems and provide widely usable functionality. ($7.6M)
- Extend and evaluate large-scale statistical modeling, machine learning, and knowledge representation methods for spoken and written language understanding and develop hub formalization that will infuse existing programming languages with new advances in formal methods. ($1.5M)
- Continue the experimental evaluation of design technology for high performance computational prototyping of systems. ($3.6M)
- Experimentally support software evolution by integrating numerous formal and informal information sources in a "hyperweb"; enhance formal notations for software design to include both syntatic and semantic information; and demonstrate multi-language architecture definition and analysis tools. ($6.1M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project CCS-02

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	23.9	24.8	28.4
Appropriated	23.3	N/A	N/A
Current Budget	23.1	24.5	25.1

(U) **Change Summary Explanation**:

FY 1995-97 Reflects minor program repricing and PDM related reductions.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Sciences ES-01	34,401	42,600	37,967	37,578	38,009	38,778	37,533	Continuing	Continuing

(U) **Mission Description**: This project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function. Research areas include new electronic and optoelectronic device and circuit concepts, Gallium Nitride based laser development, uncooled and novel infrared detector materials, innovative optical arrayed interconnects and smart pixels, optical memory research, artificial neural network (ANN) research, low power electronics, and microelectromechanical systems (MEMS) technology. This basic research project creates the vital new concepts for advanced electronic, optoelectronic, and MEMS components to meet future DoD needs.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Initiated Phase II of the Nanoelectronics program. Thrusts will include combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($12.7M)
  - Demonstrated power reduction by a factor of five through the combination of nanoelectronics and conventional devices.
  - Explored compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrated improved process control of MBE, controlling temperature to within 2 degrees and thickness to within 1 nanometer.
  - Determined optimum materials systems for fabricating silicon-based nanoelectronics.
  - Developed chemical self-assembly techniques for electronically active materials.
  - Developed voltage measurement capability suited to nanoelectronics (better than 100 nanometer spatial resolution and 50GHz temporal resolution).
  - Explored compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrated utility of nanochannel glasses in fabricating nanoelectronic structures.
  - Utilized nanostructures for high resolution electron and ion-beam technology.
  - Demonstrated three-terminal lateral resonant tunneling transistor.
  - Demonstrated feasibility of magnetic memory with nanometer scale devices.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

- Demonstrated optical interconnects for shared memory application. ($2.5M)
- Develop low-power, high-speed analog neural network hardware for accelerating early vision processing algorithms. ($1.5M)
- Demonstrated 2-6 material with <10 power4 defects/cm2 for short wavelength emitters. Demonstrated green cw, room temperature operation of laser operational for 90 minutes. ($1.0M)
- Demonstrated cascading of second order non-linearity's as a means to achieve all-optical switching and the applications of non-linear cross phase modulation as a means to achieve very fast all-optical analog to digital sampling. ($.8M)
- Demonstrated smart pixel arrays integrating transistors with optical emitters capable of simple logic functions and provided foundry service access to custom smart pixel chips. ($2.5M)
- Demonstrated optical interconnect modules for free space optoelectronic processor applications. ($2.3M)
- Establish theoretical foundations for specific neural network architectures, and develop improved architectures for pattern recognition, temporal processing, and adaptive control applications. ($1.2M)
- Demonstrated high-yield, high-uniformity fabrication processes for microelectromechanical system (MEMS) devices and merged MEMS with related fabrication technologies in optics/optoelectronics. Initiated low-bandwidth, large-scale MEMS-based sensor networks. ($6.8M)
- Initiated low-power electronics technology programs in the areas of circuit architecture and power management techniques. ($3.1M)

(U) <u>FY 1996 Program</u>:

- Continue nanoelectronics program with emphasis on combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($13.3M)
  - Develop designs with improved power, performance, and lowered part count compared with circuits using only conventional devices.
  - Explore applications of multi-valued logic to special purpose processing.
  - Demonstrate compressed-area multi-valued logic adder with binary input and output.
  - Demonstrate functional silicon-based nanoelectronic devices.
  - Demonstrate submicron pattern transfer using low-cost elastopolymeric stamps and explore use of self-assembled monolayers for nanoelectronics and for protection of semiconductor wafers during processing.
  - Design prototype hardware and improve user interface software for MBE process control.
  - Develop methods for converting electrical designs to processing protocols.
  - Continue development of lateral patterning techniques.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

- Demonstrate materials and device designs to achieve ultra low threshold, high speed direct modulated laser and demonstrate high speed optoelectronic technologies for optical switching applications. ($4.4M)
- Demonstrate photonic device applications of non-semiconductor thin films doped with optically active ions and explore material technologies for monothically integrated optoelectronic components. ($4.0M)
- Fabricate electron-beam microcolumn. ($1.4M)
- Demonstrate development of high-density integrated electrical/mechanical systems along with requisite developments of CAD tools, materials data base, test and characterization methods, and manufacturing processes. ($7.2M)
- Initiate development of uv-blue gallium nitride based LEDs and lasers for high density memory, lightwave countermeasures, convert communications, and warfare. ($5.5M)
- Assess thermal response characteristics of thin film material for improved sensitivity uncooled infrared detectors. ($1.0M)
- Continue low-power electronics programs in the areas of circuit architecture and power management techniques. Demonstrate CAD tool for static power estimation. ($5.8M)

(U) FY 1997 Program:

- Continue the nanoelectronics program with emphasis on the following thrusts: combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($11.0M)
  - Explore concepts for ultra high density memory, design combined nanoelectronic and conventional circuits for information processing and demonstrate 20X increase in speed-power performance of mux/demux circuits.
  - Optimize silicon-based nanoelectronics fabrication and device design.
  - Demonstrate potential for chemical self-assembled films' use in nanoelectronics.
  - Demonstrate precision process control of semiconductor heterostructures for advanced nanoelectronic devices.
  - Demonstrate improved patterning with critical dimensions below 50 nanometers.
  - Demonstrate silicon-based (silicon-germanium-carbon) resonant tunneling device structures.
- Demonstrate monolithically integrated optoelectronics for information processing and demonstrate feasibility of three-dimensional optically addressed memory. ($3.4M)
- Demonstrate precision process control of semiconductor heterostructures for advanced optical devices. ($3.0M)
- Fabricate small (5 x 5) infrared sensitive arrays as verification of material properties. ($2.5M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE
Defense Research Sciences,
PE 0601101E, Project ES-01

- Develop and demonstrate efficient low-voltage conversion/distribution circuits and self-regulating, use-driven power allocation systems. ($6.8M)
- Develop and demonstrate uv pulsed laser diode operation in the gallium nitride system. Identify relationship between defect density and applicability to military applications such as lightwave countermeasures. ($5.3M)
- Continue low-power electronics programs in the areas of circuit architecture and power management techniques. Demonstrate 256 x 256 pixel image sensor with on-chip 10-bit ADC. Demonstrate adiabatically-switched and power supply. ($6.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	35.2	42.6	40.1
Appropriated	34.6	N/A	N/A
Current Budget	34.4	42.6	38.0

(U) **Change Summary Explanation**:

FY 1995-97 Minor repricing adjustments.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Sciences MS-01	27,793	22,356	21,847	22,553	22,375	20,096	21,053	Continuing	Continuing

(U) **Mission Description**: This project is concerned with the development and exploitation of: design, synthesis and production of engineered polymer molecules for counter chemical and biological warfare (BW) defense; development of magneto-resistive materials for use in radiation hardened memories and motion and position sensors; development of forward combat casualty care medical technologies; development of high power/energy density electrochemical power sources (batteries and fuel cells). Other areas of focus are research on field-driven bioremediation tools for cost-effective in situ toxic waste conversion; waste source reduction for DoD-relevant manufacturing processes, and training of DoD personnel in hazardous waste management.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Electrochemistry ($18.1M): Concentrated on use of logistic fuels (hydro-carbon based) in advanced energy sources (fuel cells) for military applications.
  - Evaluated novel logistic fuel catalysts, electrolytes, and electrodes.
  - Developed fuel cell components capable of operating on reformed logistics fuel.
  - Constructed a pilot-scale, supercritical water oxidation reactor (1 gal./min.) and began testing for the destruction of chemical warfare agent simulants, propellants and other DoD hazardous wastes.
  - Expanded support of five hazardous substance centers to develop technologies for removing DoD hazardous waste and to train DoD and DOE personnel in hazardous waste management.
- Biomedical ($9.7M): Exploited technology base developments in microelectronics, sensors, communications, imaging and simulation to enhance far-forward combat casualty care. This project provides component and modular additions to the Personnel Status Monitor (PSM) under development in PE 0602712E, project MPT-07.
  - Accelerated development of a Ranger Overwatch personnel status monitor (RO-PSM) with standard PSM configuration and added temperature and shiver sensors to detect hypothermia.
  - Developed haptic interface for virtual environments and holographic display for virtual images in simulation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project MS-01

- Developed battlefield surgical simulation for injuries to the torso.
- Continued development of virtual environment for the individual soldier in order to test and evaluate the efforts of training, equipment, etc. on the health of the soldier.
- Developed and incorporated advanced manipulation and sensory feedback into a telepresence surgery system; explored methods for diminishing latency in tele-manipulation; field testing and evaluation.

(U) FY 1996 Program:

- Electrochemistry. ($10.0M)
  - Develop a high efficiency fuel reformer for fuel cell applications to process logistic fuel.
  - Demonstrate fuel cell operation using either hydrogen or methanol with performance adequate for soldier applications.
  - Test a novel direct oxidation logistics fuel cell concept.
- Biomedical. ($1.7M)
  - Develop miniaturized, conformal design and rechargeable polymer power sources for the Personnel Status Monitor (PSM).
  - Develop pharmacologic mixture which results in suspended animation, meaningful for vital organs following battlefield trauma.
- Counter Biological Warfare. ($5.1M)
  - Demonstrate high yield synthesis of long chain heteropolymers that have specific monomeric sequences of 50-100 molecules.
  - Demonstrate computer algorithms for heteropolymer folding at fifty molecule chain length.
- Magnetic Materials and Devices. ($2.2M)
  - Enhance magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of devices.
- Cost Effective Bioremediation. ($3.4M):
  - Characterize field sites and evaluate contaminant matrix effects on biodegration rates, bioavailability and rate limiting process steps.
  - Evaluate contaminant transport interactions and determine rate of desorption from matrix; determine matrix transport parameters and process control parameters.

(U) FY 1997 Program:

- Electrochemistry. ($9.0M)
  - Develop and test a thermally integrated fuel cell stack and reformer which operates on logistics fuel.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project MS-01

- Demonstrate direct, liquid-feed methanol fuel cell stack operation with performance adequate for soldier applications.

- Biomedical. ($4.3M)
  - Develop knowledge-based control algorithms for the Personnel Status Monitor.
  - Develop "smart" catheters for battlefield blood chemistry assessments.
- Engineered Polymers. ($5.0M)
  - Initiate synthesis of sequence specific heteropolymers to construct organophosphate "sponge" (used in countering chemical warfare agents).
- Magnetic Materials and Devices. ($3.6M)
  - Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	28.5	22.4	23.9
Appropriated	27.8	N/A	N/A
Current Budget	27.8	22.4	21.8

(U) **Change Summary Explanation**:

FY 1997 Decrease reflects PDM adjustments.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Computing Systems and Communications Technology	**375.990**	**404.127**	**387.214**	**388.626**	**405.760**	**429.740**	**446.827**	**Continuing**	**Continuing**
JASON ST-01	1,227	1,195	1,196	1,190	1,200	1,200	1,200	Continuing	Continuing
Intelligent Systems & Software ST-11	72,617	97,378	106,157	113,498	116,807	111,256	117,007	Continuing	Continuing
High Performance Computing ST-19	234,316	232,709	204,494	208,829	223,557	256,481	267,192	Continuing	Continuing
Software Engineering Technology ST-22	38,424	18,483	19,037	19,609	20,196	20,803	21,428	Continuing	Continuing
Monitoring Technologies ST-23	19,529	18,851	16,330	0	0	0	0	0	103,426
Information Survivability ST-24	9,877	35,511	40,000	45,500	44,000	40,000	40,000	0	299,349

(U) **Mission Description**: This program element is budgeted in the Exploratory Development Budget Activity because it funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include:

(U) ARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies to allow computer systems to function at a trillion operations per second and a billion bits per second networking to ensure availability for future defense needs. This technology will be incorporated into advanced applications to solve critical defense problems such as distributed C^3 systems.

(U) The efforts funded in the Intelligent Systems and Software project focus on the development of new information processing technology concepts that lead to fundamentally new software and intelligent system capabilities. Emphases

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

are in intelligent systems including autonomous systems, interactive problem solving, intelligent integration of information, software development, and manufacturing automation and design engineering.

(U) The Software Engineering Technology project supports the Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS) through FY 1995. SEI works to transition state-of-the-art technology, and introduce and promulgate modern software in the defense industry.

(U) The Monitoring Technologies project provides the technology to collect and fuse surveillance sensor data, with particular focus on those technologies needed by the U.S. to support the Comprehensive Nuclear Test Ban Treaty (CTBT) negotiations which began in 1994, the Non-Proliferation Treaty conference which convenes in 1995, and the regimes established to verify these treaties.

(U) The Information Survivability project develops the technology base underlying the solutions to protecting DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high-performance computing technologies.

(U) The JASON Group supports studies for the national security community.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
JASON ST-01	1,227	1,195	1,196	1,190	1,200	1,200	1,200	Continuing	Continuing

(U) **Mission Description**: This project supports the JASONs, an independent group of distinguished scientists and technical researchers that provides analysis of critical National Security issues. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines. The JASON process ensures senior government leaders have available the full range of U.S. academic expertise on issues critical to National Security involving all classified and unclassified information.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued investigations involving: structural acoustics; advanced land combat vehicles; precision strike; ASW; nuclear weapon proliferation; counterproliferation; joint U.S.-Russian space exploration and global surveillance and communications.

(U) FY 1996 Program:

- Continue studies in: nuclear and chemical weapons proliferation, precision strike weapons, global surveillance and communications; counter drug surveillance techniques; shallow water ASW; and advanced signal processing.

(U) FY 1997 Program:

- Continue studies in: counterproliferation of nuclear, chemical and biological weapons, precision deep strike weapons, battlefield information systems, battlefield planning and control, counter drug and law enforcement surveillance techniques; advanced sensor technologies; and global surveillance and intelligence.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology,
PE 0602301E, Project ST-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	1.2	1.2	1.2
Appropriated	1.2	1.2	N/A
Current Budget	1.2	1.2	1.2

(U) **Change Summary Explanation**: No change.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Intelligent Systems and Software ST-11	72,617	97,378	106,157	113,498	116,807	111,256	117,007	Continuing	Continuing

(U) **Mission Description**: This project develops new information processing technology concepts that lead to fundamentally new software and intelligent systems capabilities. This will enable advanced information systems to more effectively accomplish decision-making tasks in stressful, time sensitive situations and create efficient software systems supporting computer and software intensive defense systems. Major areas of technical emphasis are: (a) intelligent systems (artificial intelligence) including autonomous systems, image understanding, interactive problem solving and intelligent integration of information from heterogeneous sources; (b) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototype technology, software design tools, software reuse, and advanced software engineering environments; (c) manufacturing automation and design engineering, including the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control and demonstrations; (d) Text Video Speech (TVS) program focuses on the integration and application of emerging language understanding technology for both C4I and Intelligence community needs; and (e) organizing resources to obtain access to multiple systems and decision aids that provide logistical information when it is needed and where it is needed.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Experimentally evaluated the integration of multiple advanced intelligent systems and software technologies in multiple autonomous vehicles. ($3.7M)
- Initiated transition in focus from image understanding to image exploitation for vision guided navigation, photo-intelligence, and target detection. Continue multidisciplinary vision research with Office of Naval Research. ($10.4M)
- Developed initial prototype implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($10.8M)
- Developed initial prototype implementations of advanced real-time planning and control algorithms. ($3.9M)
- Enhanced knowledge based planning and decision aids to support the rapid construction of multiple crisis action plans. ($6.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Developed initial prototype implementations of advanced intelligent integration methods for information fusion, aggregation, summarization and explanation. ($4.8M)
- Experimentally evaluated language-based methods for describing domain specific software architecture and tools that facilitate composing a software system based on a domain specific architecture. ($4.4M)
- Experimentally evaluated advanced software environment that supports composition tools for composing software, integration, and software development and testing using animation techniques. ($3.9M)
- Developed prototypes to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($4.8M)
- Enhanced intelligent product and process representations and apply to a scalable framework for large complex systems. ($1.5M)
- Developed information infrastructure services for manufacturing, including network access to engineering analysis and rapid prototyping services and experimentally evaluate agent-based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. ($8.8M)
- Initiated development of a modular testbed for human computer interaction technology insertion for testing, evaluating and demonstrating. ($4.5M)
- Supported software initiatives at the Software Institute Johnstown. ($4.2M)

(U) FY 1996 Program:

- Enhance advanced image understanding methods for vision guided navigation, cartographic modelling, and target detection and identification, and facilitate transition and adoption of the resulting technology. ($12.5M)
- Experimentally evaluate implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($10.0M)
- Experimentally evaluate implementations of advanced real-time planning and control algorithms. ($6.1M)
- Evaluate knowledge-based planning and decision aids to support the rapid construction of multiple crisis action plans in an operational exercise. ($10.4M)
- Integrate knowledge based planning, decision, and scheduling aids to support the rapid construction of multiple crisis action plans. Collaborate with Rome Labs knowledge-based planning efforts. ($2.0)
- Experimentally evaluate advanced intelligent integration methods for information fusion, aggregation, summarization, and explanation. ($9.7M)
- Experimentally evaluate prototype implementations to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($3.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Integrate Artificial Intelligence based research technologies with numerical simulations and CAD Models, and demonstrate a three fold reduction in trade-off analysis and design optimization. ($12.0M)
- Continue the human computer interaction heterogenous testbed product development and insertion. Test, evaluate and demonstrate enhancements to the user community. ($9.7M)
- Define consensus Architecture Description Language and Interactive Architecture Synthesis Tools and initiate development of tools and initiate development of tools for complex system. ($4.1M)
- Develop and demonstrate multi-echelon, collaborative logistical support tools that integrate planning, execution, monitoring and decisions support systems to achieve real time logistical reallocation and redeployments within and between commands. ($4.7M)
- Develop a software environments rapid construction facilities for robust software and intelligent systems technology prototypes. ($2.7M)
- Support software initiatives at the National Applied Software Engineering Center (NASEC), Johnstown. ($9.9M)

(U) <u>FY 1997 Program</u>:

- Continue development of human-computer interaction, heterogeneous testbed products and insertion. Test, evaluate and demonstrate enhancements to the developer and user communities. ($6.3M)
- Pursue software engineering of real-time systems that would lead to a significant reduction in development costs, and experimentally evaluate Real Time Planning and Control algorithms for multi-agent systems. ($6.1M)
- Experimentally evaluate methods for building information detection filters from text, and baseline topic concept recognition from radio news broadcasts. ($5.0M)
- Evaluate distributed design tools and demonstrate multi-agent systems for capture of design history. ($15.0M)
- Develop modular Human Language Technologies to support easy, low-cost, rapid technology transfer and application development for Document Understanding, Machine Translation, and Speech Understanding. ($6.4M)
- Develop in the Intelligent Integration of Information area, tools and techniques to enable the rapid construction of information fusion, aggregation, and summarization software. ($11.1M)
- Develop knowledge-acquisition tools for planning and decision aids systems. ($11.1M)
- Extend Architecture Description Language for complex systems to include performance and context information. ($13.6M)
- Demonstrate a software environment rapid construction facilities for robust software and intelligent systems technology prototypes. ($1.7M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Complete the experimental evaluated prototype implementations to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($1.4M)
- Support software initiatives at the NASEC, Johnstown. ($9.9M)
- Image understanding applications effort that will transition results in automatic target recognition, terrain modeling for simulation, video surveillance, image database retrieval, and integrated reconnaissance and operations planning to other DoD agencies; continue multidisciplinary vision research with Office of Naval Research. ($8.6M)
- Develop unified knowledge representations and tools for rapid construction and reuse of fast, competent knowledge bases, develop learning methods for extending knowledge-bases, and library structures for problem-solving methods. ($10.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	75.9	95.0	100.2
Appropriated	77.9	N/A	N/A
Current Budget	72.6	97.4	106.2

(U) **Change Summary Explanation**:

FY 1995 Decreased to finance TRP earmarks.
FY 1996-97 Increases due to funding of High Performance Knowledge Base program.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Performance Computing ST-19	234,316	232,709	204,494	208,829	223,557	256,481	267,192	Continuing	Continuing

(U) **Mission Description**: This project develops the computing, networking, and associated software technology base underlying the solutions to computational and information-intensive applications for future defense and federal needs. These technologies lead to successive generations of more secure, higher performance, and more cost-effective systems scalable to trillions of operations per second (teraops) and billions of bits per second (gigabits) networking, associated software technologies, advanced information infrastructure technology and prototype experimental applications critical to defense operations as well as the federal government. Each component of this program will integrate capabilities developed under the Information Survivability initiative (Project ST-24) to satisfy defense requirements for secure systems.

(U) The Defense Information Enterprise component develops underlying computing systems technology that enables applications developers to demonstrate prototype solutions to national and global-scale defense problems. These include network-based information services, application demonstrations, mobile information systems, and experimental capabilities supporting computing systems developmental efforts. The component is strongly supported across other DoD and federal agencies.

(U) The Systems Environments component develops scalable software which is tailored toward easing the use of systems by applications programmers. This includes languages, runtime services, scalable software library technologies, and experimental applications.

(U) The Networking component develops high performance networking technologies and associated capabilities. Research is coordinated with network technology and service deployments made by DoD, NASA, and other federal agencies.

(U) The Scalable Systems and Software component develops software and hardware technologies leading to a secure scalable computing and communications technology base for systems configured over a wide performance range, from mobile handheld devices to desktop workstations to the largest-scale, highest performance systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

(U) The Microsystems component develops design tools, environments, and design infrastructure to support the research and development of advanced scalable parallel computing components and embedded computing systems. Microsystems leverages the scalable computing technology base to accelerate and support the design of complex electronic systems. Microsystems also supports innovative system prototyping techniques in hardware and software as well as early small-scale architecture experiments leveraging scalable computing technology, micro-architectures, low-energy components and processes, optimization techniques, and advanced packaging technology.

(U) Defense Technology Integration and Infrastructure combines state-of-the-art computing and information technologies focused on critical defense applications. These include developing embeddable systems based upon scalable technologies, and projects which accelerate technology transition of advanced research to intelligence, command and control, and other major ARPA and DoD programs.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Defense Information Enterprise. ($29.0M)
  - Developed initial prototype of common authentication, authorization, and accounting services infrastructure based on security mechanisms in Information Survivability (Project ST-24) program.
  - Demonstrated prototypes of distributed digital library technology including techniques for scalable storage management and data repositories, persistent object bases, and multimedia objects.
  - Demonstrated copyright management system, providing proof of concept including fully electronic copyright registration, recordation, rights transfer, and management.
  - Demonstrated mobile computing system Computer Aided Design (CAD) environment through the design of early prototype, high bandwidth, pico-cellular, and wireless access points to the wireline infrastructure.
  - Demonstrated network-based access to Multichip Module fabrication services.
- Systems Environments. ($29.5M)
  - Demonstrated prototype integrated HPC programming environment for Fortran and C++ on which applications run transparently on several distinct scalable computer architectures without change.
  - Completed detailed study of I/O characteristics of scalable computers under real application load, identifying significant bottlenecks.
  - Demonstrated tools for performance tuning of application software using dynamically-collected statistics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrated portable scalable software libraries across three major computer architectures applied to semiconductors device simulation.

- Networking. ($29.0M)
  - Demonstrated bandwidth, delay, and service reservation guarantees for networks in support of real-time control and critical services.
  - Demonstrated Synchronous Optical Network (SONET) and Asynchronous Transfer Mode (ATM) encryption technologies at 155 Mbps (OC-3c).
  - Deployed small-scale, initial prototype of gigabit-per-second-class, nation-spanning infrastructure in support of high performance computing applications.
  - Demonstrated advanced network capabilities, including multicast-based services and next generation Internet protocols with improved ease of use.
- Scalable Systems and Software. ($52.9M)
  - Designed system architectures incorporating components such as programmable protocol engines to support scalability and high performance.
  - Demonstrated systems tools for on-line analysis of a real-time operating systems for scalable, distributed HPC systems.
  - Demonstrated operating system ability to confine processes to isolated domains.
  - Demonstrated first HPC single node operating at 1 Gflop.
- Microsystems. ($35.6M)
  - Demonstrated derivation of electrical parameters from 3-D process models using early computational prototyping methods.
  - Demonstrated prototype secure distributed design environment for electronic systems.
  - Initial demonstration of microarchitectures for advanced packaging and scalable units of replication.
  - Demonstrated scalable, high performance, low-latency switch technology for workstation clusters.
- Defense Technology Integration and Infrastructure. ($34.4M)
  - Demonstrated use of advanced visualization environment in a defense application.
  - Developed a set of communication benchmarks, communication protocols, and prototype for embedded, scalable military systems.
  - First Message-Passing Interface (MPI) demonstration of cross-architecture application portability.
  - Demonstrated integrated access to several different special, classified defense and intelligence information systems.
  - Demonstrated 10 gigaflops/cu.ft. militarized HPC System.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Additional FY 1995 Activities. ($23.9M)
  - The Maui HPC Center Program increased the computing power available to defense scientists/engineers by providing the key commercial application software necessary to exploit scalable computing systems.
  - The Intelligent MetaComputing Center utilized existing defense experimental testbeds and defense-related applications to demonstrate the integration of scalable computing and high performance networks.
  - The Rome Lab Demonstration integrated existing decision support technology in a distributed networking environment to demonstrate the feasibility of effective mission planning across multiple networks.
  - The Lifecycle Improvements by Networking Critical Manufacturing Technologies Program utilized commercially-available software and advanced information technology to develop intelligent agents to search multiple databases with minimal user input and guidance.

(U) <u>FY 1996 Program</u>:

- Defense Information Enterprise. ($51.3M)
  - Demonstrate prototype toolkits supporting development of applications adaptive to changes in the computing and communication environment.
  - Demonstrate prototype of information services through a testbed incorporating information management and secure transactions, including experimental charging mechanisms.
  - Initial prototype of adaptive extensions to Internet services in support of mobility.
  - Initial prototypes of untethered node hardware/software architectures for mobile computing.
  - Initial prototype of active catalogues for defense commodity electronics brokering service.
  - Demonstrate design environments supporting simulation and synthesis of wireless systems spanning integrated circuits to network applications.
  - Demonstrate initial capabilities for intelligent information services for resource description, registration, and retrieval.
  - Complete the experimental evaluation of the integration of multiple advanced intelligent systems and software technologies in autonomous applications.
- Systems Environments. ($28.2M)
  - Evaluate small-scale teraops class systems and individual gigaops processors.
  - Evaluate first generation of fully scalable OS software and programming environments on small-scale versions of teraops computing systems.
  - Define second generation of High Performance Fortran with extensions for task parallelism and support for scalable I/O.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate extensions of portable scalable libraries to incorporate object-oriented technology and a broader set of applications.
- Enhance and experimentally evaluate advanced software environment that supports composition tools for software creation, integration, development, and testing using animation techniques.

• Networking. ($31.3M)
- Demonstrate higher level communication services that coordinate distributed computing resources across the network environment.
- Prototype networks at greater than 40-gigabit-per-second speed using optical technologies and experimentally validate scalable network protocols at the higher speeds.
- Prototype secure nomadic computing architecture integrated into existing wide area networks.
- Deploy reference implementation of protocol-independent, multicast-capable infrastructure as basis for development of advanced services.
- Demonstrate robust and secure network-level infrastructure protocols to include directory services and resource allocation.
- Demonstrate technology for autonomous, node-level network management.

• Scalable Systems and Software. ($49.9M)
- Demonstrate high-availability systems scalable in performance to 1 teraflop.
- Demonstrate extensible modular operating system framework supporting real-time, distributed, and limited fault-tolerant scalable computing applications.
- Demonstrate user-extensible microkernel operating system technology, integrating compiler and run-time support services.
- Demonstrate computing node architectures that dramatically increase internal memory and communications bandwidths.
- Demonstrate I/O enhancements to a scalable operating system that overcomes identified bottlenecks leading to significant improvements in throughput.

• Microsystems. ($36.3M)
- Perform early demonstration of parallel, fully-hierarchical Automatic Test Generation for both combinational and sequential circuits.
- Demonstrate fault-tolerant and reliability design tools supporting large-scale HPC systems developments.
- Demonstrate message-passing/shared-memory hybrid architecture protocol accelerator component.
- Demonstrate distributed computing architectures based on low-cost, low-latency switching technology.
- Prototype emulation-enhanced system simulation capabilities for microsystems design.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate integrated module-level synthesis capability.

• Defense Technology Integration and Infrastructure. ($35.7M)
- Develop and provide experimental testbed services employing advanced high performance computing technologies for special defense users.
- Prototype embedded computing system modules with scalability concepts containing memory hierarchy and power on a single unit of replication.
- Perform integration tests in key defense applications such as advanced distributed simulation, advanced distributed collaboration, advanced communications and control, and advanced human computer interfaces.
- Demonstrate improved solutions to two major classified, special computational challenges.
- Demonstrate first fine-grained high performance embedded and scalable computer system.
- Demonstrate graphical program environments for embedded systems.

(U) <u>FY 1997 Program</u>:

• Defense Information Enterprise. ($40.3M)
- Demonstrate advanced software environment that supports tools for composing applications that operate over the distributed defense information infrastructure.
- Interagency demonstration of prototype national-scale distributed information management supporting multimedia objects, access control, and flexible micropayment system.
- Demonstrate bandwidth-adaptive multimedia node for mobile computing.
- Demonstrate advanced mobile networking algorithms and protocols.
- Extend capabilities of intelligent information services architecture with multiple mechanisms for describing resource capabilities and with a uniform interface to hybrid search methods for resource retrieval; demonstrate in multiple applications.

• Systems Environments. ($17.0M)
- Demonstrate optimizing compilers with 5-to-10 times runtime performance improvement through partial compilation and late optimization during program execution.
- Demonstrate High Performance C++ with extensions for both Data Parallel and Task Parallel exploitation of concurrency.
- Prototype common runtime services reducing burden on individual compiler R&D efforts.
- Provide scalable versions of widely-used commercial engineering software, including MCS NASTRAN, leveraging scalable software library technology available to the defense community.
- Evaluate prototype teraops systems using experimental defense applications in defense environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate feasibility of utilizing advanced software environment that supports composition tools for composing software, integration, and software development and testing using animation techniques in military environment.

- Networking. ($33.8M)
  - Demonstrate transport protocols for multigigabit networks.
  - Demonstrate systems for coordinating sets of workstations as a single computing system.
  - Deploy reference implementation of a common base set of network infrastructure protocols and services necessary for secure and reliable network operation.
  - Demonstrate wide-area 40-gigabit-per-second and lab-prototype 100+ gigabit-per-second electro-optical transmission and switching systems.
  - Develop advanced multicast-based services to include refinements of collaboration systems and autonomous network processes.
- Scalable Systems and Software. ($44.2M)
  - Demonstrate scalability from distributed workstation clusters to teraflop supercomputers on the identical technology base.
  - Demonstrate distributed cluster technology scalable to teraflops.
  - Demonstrate advanced object management systems integrated with operating systems and applications to achieve efficient use of memory while enhancing execution speed.
  - Demonstrate the prototype of a scalable operating system that incorporates high assurance capabilities for the Defensive Information Warfare program.
- Microsystems. ($34.0M)
  - Demonstrate high-level, portable parallel test generation system.
  - Develop fully-integrated, parameterized, constraint-driven design libraries.
  - Demonstrate initial multisite collaborative design research environment for integrated circuit process simulation and remote experimentation over the NII.
  - Demonstrate distributed shared memory components on cluster of workstations.
- Defense Technology Integration and Infrastructure. ($35.2M)
  - Complete the developments and transition of experimental testbed services employing high performance computing technologies to special defense users.
  - Demonstrate integrating testbed architecture incorporating advanced distributed simulation, advanced distributed collaboration, advanced communications and control, and advanced human computer interfaces.
  - Demonstrate enhanced feature, real-time distributed operating systems for embeddable HPC.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate 100 gigaops/cu. ft. militarized HPC.
- Develop real-time image understanding algorithms for use in image registration, target recognition, and autonomous navigation for ground level and overhead reconnaissance and surveillance.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	241.2	234.6	224.2
Appropriated	230.8	N/A	N/A
Current Budget	234.3	232.7	204.5

(U) **Change Summary Explanation**:

FY 1995 Increase due to funding TRP earmark for Lifecycle Networking Improvement.
FY 1996 Minor program repricing.
FY 1997 Program repricing and consolidation of Information Survivability in a single project, ST-24.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Software Engineering Technology ST-22	38,424	18,483	19,037	19,609	20,196	20,803	21,428	Continuing	Continuing

(U) **Mission Description**: Software is key to meeting DoD's increasing demand for quality, affordability, and timeliness of national defense systems. There is a critical need to rapidly transition state-of-art technology and best practices to improve the acquisition, engineering, fielding, and evolution of software-intensive DoD systems. This project funds the technology transition activities of the Software Engineering Institute (SEI) at Carnegie Mellon University. Through FY 95 funding for the Software Technology for Adaptable, Reliable Systems (STARS) program was included.

(U) The SEI is a Federally Funded Research and Development Center (FFRDC), established in 1984, as a part of the DoD's software initiative which, in addition, included STARS and the Ada Program. The SEI identifies high leverage technologies and practices, and establishes transition mechanisms to enable their exploitation by both "in-house" government facilities and the industrial base where the bulk of defense software is produced. The Institute works across government, industry, and academe to identify those state of the art technologies and best practices that are best suited for rapid adoption in defense systems and to determine effective means for transitioning these technologies and practices.

(U) The SEI strategy is to bring engineering discipline to software development and maintenance. The SEI focuses on software technology areas judged to be of the highest payoff in meeting defense needs. It creates projects in these selected areas to identify, evaluate, mature and transition critical technologies. Current focus areas include Software Process, Software Risk Management, Disciplined Engineering of Software-Intensive Systems, and Trustworthy Networks.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Support to Services in STARS demonstration projects. ($6.0M)
- Test and evaluation of software architectures and implementations developed using STARS technologies on demo projects. ($5.7M)
- Revised STARS concepts, processes, methods, tools based on demonstration projects results. ($4.0M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22

- Refined STARS technology transition strategies, continued support for the Technology Transition affiliates program, and continued commercialization initiatives. ($4.0M)
- Enhanced STARS ASSET operation and capabilities. ($1.7M)
- Developed and field tested techniques and tools for process maturity modeling, software process improvement, and software engineering measurement. ($4.5M)
- Developed and field tested techniques and tools for software risk management. ($2.4M)
- Initiated series technology projects focused on product line engineering, architecture-centered systems, and predictive engineering. ($7.0M)
- Developed techniques for software security incident handling, security improvements for tools, and trustworthy system technology maturation. ($.5M)
- Continued related activities for integrated transition strategies and methods, creation of software engineering professional infrastructure, and broad dissemination of knowledge to the government, industrial and academic communities. ($2.6M)

(U) FY 1996 Program:

- Extend, integrate, and evaluate software process technology including: demonstrating and evaluating support for software process definition involving integrated product teams; completing Version 2 of the Capability Maturity Model (CMM) with added guidance for higher maturity levels and harmonization with ISO 9001; developing initial CMM statistical validation. ($5.0M)
- Develop and transition risk assessment methods and tools including: Software Acquisition Capability Maturity Model (SA CMM); metrics and quantitative methods for evaluating and controlling software risks; risk management approaches for open systems. ($2.3M)
- Develop and evaluate mechanisms to support technology choices by system developers including: formalized methods for domain analysis and engineering; software understanding technology/capabilities; software engineering environments; Open Systems; best practices in evaluating software architectures. ($7.0M)
- Evaluate and transition technology and best practices related to developing trustworthy systems, including: establishing a database for vulnerability and incident analysis; developing guidelines for product security and developing improved security risk evaluation methods. ($1.2M)
- Continue activities supporting the creation of a software engineering professional structure and broad dissemination of knowledge to the government, industrial and academic communities. ($3.0M)

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E, Project ST-22

(U) FY 1997 Program:

- Integrate and enhance software process models, improvement methods, and analytical capabilities, including: developing a framework for integration of maturity models; developing and validating a method for analysis of return on investments in process improvements; establishing a repository of process-related experience. ($4.6M)
- Establish repository services for a risk management experience base; investigate groupware techniques for efficient development and capture of risk related information. ($2.6M)
- Expand and improve architecture-centered technologies for product lines and evolutionary systems, including: developing and transitioning domain engineering technologies; defining disciplined approaches to managing and evolving legacy systems; developing criteria for assessing open systems. ($6.6M)
- Study effective countermeasures for information warfare against defense software intensive systems, including: developing software security risk taxonomy and guidelines; developing security analysis toolkit; creating guidelines for the acquisition of trustworthy open systems. ($2.5M)
- Investigate team approaches to software engineering, including the evaluation of COTS products to support collaborative work, developing a human interactive capability framework and dissemination of knowledge to the government, industrial and academic communities. ($2.7M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	40.2	19.2	19.1
Appropriated	39.5	N/A	N/A
Current Budget	38.4	18.5	19.0

(U) **Change Summary Explanation**:

FY 1995-97 Adjustments reflect minor repricing to accommodate FFRDC ceiling decreases.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Monitoring Technologies ST-23	19,529	18,851	16,330	0	0	0	0	0	103,426

(U) **Mission Description**: This program provides technologies to collect and fuse surveillance sensor data, with particular focus on those technologies needed by the U.S. to support the Comprehensive Test Ban Treaty (CTBT) negotiations which began in 1994, the Non-Proliferation Treaty conference which convenes in 1995, and the regimes established to verify these treaties.

(U) The objective of the CTBT Verification Readiness effort within the Monitoring Technologies Program is to develop and demonstrate new, applied technologies for the detection, location and identification of 1 kiloton nuclear explosions. A major part of this effort is to prototype a CTBT International Data Center (IDC), which is anticipated to become central to both U.S. and international CTBT verification operations. The prototype IDC will be required to process and disseminate seismic, radionuclide, hydroacoustic and atmospheric infrasound data, with a total volume approximately ten times that of any existing nuclear test ban or earthquake monitoring system. These technologies will also be incorporated into U.S. operational systems. The IDC will have significant responsibilities in the acquisition and management of data submitted by treaty parties and collected during on-site inspections, and in the management of unattended operation of distributed sensors and international communications. For the latter, ARPA is developing techniques for the remote control and automated processing of data from sensitive particulate and gaseous radionuclide sensors. Other technically challenging requirements for the IDC include the support of open, low-cost, secure and reliable operations; the establishment of an infrastructure that can adapt to the evolving demands of the CTBT monitoring regime (e.g., new areas of interest, data sources, analysis techniques, etc.); and the development and demonstration of multi-source data fusion/correlation techniques.

(U) To meet these requirements, ARPA is leveraging the framework of its Intelligent Monitoring System (IMS), with an increased focus on data authentication, automated processing and knowledge acquisition, reliable and secure distributed processing on UNIX systems, advanced data management technologies, effective graphic user interfaces for data visualization and access, and an open and modular system architecture. This effort also includes a two-year (FY 1995 - 1996) program that will focus the research capabilities of the university and small business communities that can be directly applied to the CTBT IDC. The IDC will be the centerpiece of a Conference on Disarmament monitoring experiment (called GSETT-3) that started full-scale operations in January 1995. Much of this same system will be used at the U.S. National Data Center for GSETT-3, that will be operated by the Air Force. The U.S. has formally

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offered the product of ARPA's work to the negotiating body for use by the future international Comprehensive Test Ban Treaty (CTBT) verification organization.

(U) The objective of the Sensor Development program is to develop advanced technologies to support the detection, monitoring, and interdiction of the proliferation of nuclear, chemical, and biological weapons. The effort will develop and provide demonstration of advanced sensors, information and intelligence processing, and modeling technologies to detect and monitor signatures of nuclear, chemical, and biological weapons proliferation. This includes their development, production, deployment, and use by a proliferator. This effort is critically needed to provide decision-makers with vastly increased flexibility in dealing with potential adversaries acquiring weapons of mass destruction.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- U.S. CTBT Verification Readiness Program.
  - Began full-scale test of prototype IDC seismic system and continued warm-up exercises of the hydroacoustic, atmospheric acoustic and radionuclide systems, with continued focus on development of robust automated processing pipelines and automated knowledge acquisition tools, and new focus on multi-source data fusion. Continued technology transfer to U.S. Air Force. ($11.9M)
  - Began development of an integrated seismic event identification subsystem, with continued support for exploratory seismic research in the areas of automated seismic signal processing, global continuous threshold monitoring, network simulation, geographic information visualization, and seismic identification of small events. ($2.5M)
- Sensor Development Program.
  - Continued development of joint chemical-nuclear monitoring instrumentation projects with laboratories in former Soviet Union. ($2.0M)
  - Demonstrated the operation of particle and air sampling monitoring systems with data transfer to the International Data Center as portions of an open global CTBT monitoring system. ($2.5M)
  - Demonstrated laboratory nanoscale particle analysis techniques and prototype operation of high-resolution, room temperature radiation sensors. ($.6M)

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E, Project ST-23

(U) FY 1996 Program:

- U.S. Comprehensive Test Ban Treaty (CTBT) Verification Readiness Program.
  - Expand full-scale prototype International Data Control (IDC) testing to include integrated, fused, knowledge-based processing and analysis of seismic, hydroacoustic, atmospheric acoustic and radionuclide data, with emphasis on expanding automatically the global CTBT data fusion knowledgebase. Continue technology transfer to U.S. Air Force and begin transfer to international CTBT organization. ($15.9M)
  - Complete development and integrated of the seismic event identification subsystem, automated seismic signal processing algorithms, global continuous threshold monitoring subsystem, network simulation routines, geographic information visualization, and seismic identification of small events. ($3.0M)

(U) FY 1997 Program:

- U.S. CTBT Verification Readiness Program.
  - Assuming the successful completion of CTBT negotiations in FY 1995 or early 1996, complete full-scale testing of multi-source prototype IDC and technology transfer to U.S. Air Force and the international CTBT organization. ($16.3M)

(U) **Program Change Summary**: *(In Million)*

	FY 1995	FY 1996	FY 1997
President's Budget	20.2	18.9	15.0
Appropriated	16.9	N/A	N/A
Current Budget	19.5	18.9	16.3

(U) **Change Summary Explanation**:

FY 1995 Funding add to facilitate transition of seismic efforts to DOE.
FY 1996-97 Increase to fully fund the CTBT Verification Readiness Program.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Computing Systems and Communications Technology, PE 0602301E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Survivability ST-24	9,877	35,511	40,000	45,500	44,000	40,000	40,000	0	299,349

(U) **Mission Description**: This project develops the technology base underlying the solutions to protect DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high performance computing technologies. Technologies developed under this project will be exploited in High Performance Computing (ST-19) and other defense programs to satisfy defense requirements for secure and survivable systems. This program is an expansion of investments in information security made previously in High Performance Computing.

(U) Information Survivability focuses on early prototypes of software and hardware technologies leading to scalable protection for large-scale, heterogeneous systems usable over a wide range of performance in diverse threat environments. High assurance networking technologies will be developed consisting of security mechanisms and value-added security services for integration into network technologies, as well as robust networking protocols designed to ensure continuous operation in hostile environments. High assurance computing systems will be developed that provide modular security services and mechanisms, provide high reliability for distributed computations, and allow geographically-separated parts of an organization to interact as if they shared a common security perimeter. This also includes secure and fault-tolerant operating systems, firewalls, and system management tools. Assurance and integration tools will allow the development of high assurance and trusted systems that add expression of modular system structures, networking, and other distributed-system protocols and the ability to reason about their security and robustness properties.

(U) In later years (FY 1999 and beyond), national computing infrastructure vulnerabilities that could be exploited by an information warfare enemy will be identified and technologies developed to mitigate these vulnerabilities. Intrusion-detection systems will allow attacks on the defense infrastructure to be detected, the damage to be assessed, and appropriate response to be taken. Technologies will be developed to allow crisis-mode operation of critical infrastructure components. Key information warfare concepts will be incorporated into models and simulations for wargaming and decision-making.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-24

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- High Assurance Networking. ($7.0M)
  - Developed basic authentication and authorization mechanisms based on digital signatures, cryptography, and privacy-enhanced mail for use in a common infrastructure.
  - Began operation of certification authority supporting privacy-enhanced mail and other secure services.
  - Completed prototype implementation of digital signature hierarchy toolkit and domain-name system enhancements.
  - Demonstrated prototype signature/timestamp server with associated access tools for location-independent object security.
- High Assurance Computing Systems. ($2.9M)
  - Completed proof-of-concept Asynchronous Transfer Mode (ATM) encryption units for use in experimental ATM networks.
  - Demonstrated operating system capability for strict process separation.

(U) FY 1996 Program:

- High Assurance Networking. ($8.4M)
  - Demonstrate prototype of secured routing protocols.
  - Release initial prototype of system security checking tools for use in security monitoring and incident response.
- High Assurance Computing Systems. ($10.3M)
  - Demonstrate cryptographic-applications programming interface to allow secure applications to be built independent of the cryptography used.
  - Demonstrate high-assurance microkernel for use in secure operating systems.
- Assurance and Integration. ($5.6M)
  - Complete development of a prototype toolkit supporting secure distributed applications over a single administrative domain.
- Survivability and Vulnerabilities. ($11.2M)
  - Small-scale demonstrations of techniques for survivability and recoverability in electronic communications, and information systems of critical importance to DoD.

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(U) FY 1997 Program:

- High Assurance Networking. ($6.0M)
  - Demonstrate incident response tools to detect corrupted code and signs of penetration.
  - Integrate basic security services into critical networking protocols for enhanced infrastructure protection.
- High Assurance Computing Systems. ($8.0M)
  - Develop services for defining and enforcing configurable security policies in secure operating systems.
  - Demonstrate auditing, intrusion detection, authentication, and authorization components of firewalls.
  - Demonstrate transparent application interoperability across firewalls.
- Assurance and Integration. ($6.0M)
  - Demonstrate enhancements to secure distributed application tools to support operation across multiple administrative domains.
- Survivability and Vulnerabilities. ($20.0M)
  - Validate techniques for permitting real-time tradeoffs between security, reliability, and recoverability in critical defense experimental systems.
  - Apply assurance tools to demonstrate assurance levels for COTS products and tools.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	10.0	35.0	25.0
Appropriated	9.7	N/A	N/A
Current Budget	9.9	35.5	40.0

(U) **Change Summary Explanation**:

FY 1995-96 Increases reflect minor program repricing.
FY 1997 Increase reflects OSD-directed expansion of Defensive Information Warfare efforts.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Technology	**119,876**	**113,967**	**156,983**	**179,075**	**187,084**	**187,119**	**188,586**	**Continuing**	**Continuing**
Naval Warfare Technology TT-03	48,593	30,000	35,229	34,837	53,000	66,553	69,172	Continuing	Continuing
Advanced Land Systems Technology TT-04	28,373	33,412	39,974	46,986	57,001	55,909	56,686	Continuing	Continuing
Advanced Targeting Technology TT-05	5,623	0	0	0	0	0	0	0	308,441
Advanced Tactical Technology TT-06	37,287	40,905	64,595	58,567	60,418	57,024	62,728	Continuing	Continuing
TRANSTECH TT-10	0	9,650	17,185	38,685	16,665	7,633	0	0	99,818

(U) **Mission Description**: This program element is budgeted in the Exploratory Development Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The Tactical Technology program element funds a number of projects in the areas of Naval Warfare, Advanced Land Systems, Advanced Tactical, and Transportation technologies.

(U) The Naval Warfare Technology project is focusing on three primary areas of research: Simulation Based Design (SBD); Command, Control, Communications and Intelligence/Synthetic Environments (C3I/SE) and Ship Systems Automation (SSA). The SBD program is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems utilizing virtual prototypes in synthetic environments. In the C3I/SE program, advanced information technologies are being integrated into advanced prototype systems to provide improved battlefield awareness and dominance to mobile command centers in the field. The Ship Systems Automation program is developing a highly integrated sensor, weapons control, and battle damage suite to reduce costly shipboard manning requirements. The Simulation Based Design program will provide the tools required to integrate cost, performance and manufacturing considerations throughout the design process.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

(U) The Advanced Land Systems Technology project supports three efforts: Small Low-cost Interceptor Device (SLID); Operations-Other-Than-War (OOTW); Military Operations in Built-up Areas (MOBA); and Battle Management Architecture, Data-Base Modeling and Technology Development. The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. The OOTW program focuses on technological solutions to critical problems encountered in peacekeeping and non-combatant evacuation operations. The MOBA program will develop laboratory prototypes of a powered exoskeleton and teleoperated manipulated components for use in small-scale military operations. Battle Management Architecture, Data-Base Modeling and Technology Development address command and control problems of highly mobile, joint contingency forces in very difficult early entry scenarios.

(U) The Advanced Tactical Technology project is exploring the application of compact lasers, microwave radiation and advanced mathematical algorithms to enhance the performance of radars, sensors, communications, and electronic warfare and target recognition systems. The technologies under development will improve infrared countermeasures, enable active infrared suppression, permit faster signal processing, improve target recognition, and create smaller, more capable microwave devices.

(U) Finally, the TRANSTECH project will develop and demonstrate technologies that will make a fundamental difference in transportation and logistics planning and operations in the 21st Century. Developmental efforts will focus on establishing a board network and computer environment (TRANSWEB); transportation models and simulations; and revolutionary changes to physical systems that impact intermodal system performance and efficiency.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Naval Warfare Technology TT-03	48,593	30,000	35,229	34,837	53,000	65,553	69,172	Continuing	Continuing

(U) **Mission Description:** The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The enabling technologies include: virtual prototyping and advanced modeling to radically change the DoD acquisition process through integrated product and process design; Command, Control, Communications, and Intelligence/Synthetic Environments (C3I/SE) for littoral warfare; and integrated ship sensor, weapons and platform technologies to demonstrate the feasibility of reduced ship manning.

(U) The Simulation-based Design (SBD) area is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems. SBD will utilize virtual prototypes in synthetic environments to enable effective, integrated product and process development. The program will integrate the technologies of distributed interactive simulation, physics-based modeling, and virtual environments and apply them to the design, acquisition, and life cycle support processes of systems. Complete simulation from early in the concept formulation stage through verification of requirements to design, manufacture, operation, training, and logistics will be available prior to initiation of construction. Successful development and deployment of SBD will enable meeting the program's objective of reducing the cost and acquisition time for DoD systems. Overall product quality and capabilities will be enhanced by the timely insertion of the latest technological advances into designs as they progress through the shortened acquisition cycle. SBD will be applicable to all subsystems, from mechanical to large scale electronic, within an overall system and it will enable cost savings by reducing the need for expensive physical mockups and by eliminating many of the manufacturing inefficiencies caused by inadequate design.

(U) In the C3I/SE area, advanced information technologies are being integrated and applied to provide improved battlefield awareness and battlefield dominance to mobile command centers in the field (e.g., Fleet Commanders, Mobile Expeditionary Force (MEF) Commanders, Commander Joint Task Force (CJTF) afloat, and deployed Joint Special Operations Task Force (JSOTF) Commanders). The advanced prototype systems developed under this program integrate the latest technologies in high-bandwidth communications, object oriented information system, collaborative planning, intelligent database access, image processing, data exploitation, and high performance computing to address the unique (quick reaction and real-time execution) requirements of forward deployed, mobile commanders. The demonstration systems will include capabilities for high-bandwidth communications to ships and aircraft at sea based on capitalizing upon emerging commercial and military communications advancements. It also develops the Synthetic Test Range (STR), which in conjunction with the Simulation Based Design (SBD) development, is aimed at improving the

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acquisition process. The STR will also improve training, readiness, and operations planning and rehearsal of the maritime component of U.S. forces. The Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) Program builds upon existing ARPA-developed planning tools while identifying and incorporating other emerging C3I and information system technologies. Starting in FY 1996, the program is emphasizing pre-crisis awareness and preemption.

(U) In the Ship Systems Automation (SSA) area, advanced, highly automated sensor, weapons control, and platform systems (including damage control) are being developed and demonstrated for submarine and surface ship applications. Through evolving sequential technology demonstrations, efforts in this area will show how an integrated collection of automated systems could achieve an order of magnitude reduction in crew size. Because personnel account for a significant portion of current ships' life cycle costs, such a reduction would lead to immediate and long term cost savings for ship acquisition programs. SSA technology developments include intelligent command-level advanced reasoning components, scalable sensor integration work stations to fuse multi-source data and intelligently display the tactical situation on a tactical situation assessment system, cooperating expert agents conducting mission-context/sensor employment planning, and integrated internal condition sensor and control systems to intelligently display and control ship physical conditions on a ship's internal assessment system.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Commenced SBD prototype development and initiated applications demonstrations using the facilities of linked design centers. ($15.1M)
- Initiated creation of a virtual prototype of a large complex mechanical and electronic system for application and analysis. ($3.2M)
- Initiated demonstrations of SBD critical enabling technologies. ($5.4M)
- Conducted a demonstration of a concept for electronic commerce supporting distributed facilities manufacturing complex systems. ($1.0M)
- Demonstrated an initial integrated Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) architecture during exercise Kernel Blitz in an amphibious assault and a maritime theater-wide planning/planning assessment scenario linked to an at-sea Commander Joint Task Force (CJTF) during Joint Warfare Interoperability Demonstration (JWID-95). Conducted a mobile demonstration of advanced technology wideband satellite network communications between the Commander-in-Chief (CINC) and mobile CJTF command complexes during JWID-95. ($6.7M)

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- Expanded synthetic environment development to include a complete electromagnetic environment creating a Test Range (STR). ($2.2M)
- Conducted Ship Systems Automation (SSA) demonstrations of Intelligent Systems Interfaces Advanced Tactical Planning and Electronic Warfare Advisor in the combat systems area; demonstrated advanced sensor networks for platform monitoring and a manpower assessment tool concept. ($8.0M)
- Continued most promising ocean science efforts at the Center of Excellence for Research in Ocean Sciences (CEROS). Selected several innovative marine technology projects for initiation. ($7.0M)

(U) FY 1996 Program:

- Conduct Simulation-Based Design (SBD) prototype demonstrations on a complex application at distributed design and visualization centers linked via nationwide wideband networks; one to be a joint demonstration in support of the Defense Modeling and Simulation Office High Level Architecture. Conduct a demonstration of a virtual prototype of a ship combat system using an electronic smart product model to demonstrate functional requirements. ($12.4M)
- Conduct high fidelity radar stimulation with an operational radar system, transition to Navy users. ($2.0M)
- Package Maritime Campaign Operational Planning System for Global Command and Control System (GCCS) compatibility. ($1.7M)
- Develop concept of operations for Special Operations Forces (SOF) execution monitoring. Develop and demonstrate prototype crisis preemption system for Joint Special Operations Task Force (JSOTF) which includes real-time perspective scene generation, image change detection, critical point analysis, information retrieval, and execution monitoring. ($3.8M)
- Demonstrate advanced Ship Systems Automation (SSA) algorithm and integration verification in coordination with Navy and university laboratories. ($10.1M)

(U) FY 1997 Program:

- Conduct interim Simulation Based Design (SBD) prototype demonstrations of multi-disciplinary engineering analysis with connectivity to manufacturing. ($11.8M)
- Conduct interim demonstrations of SBD enabling critical technologies in system architecture, high performance computing, human computer interfaces, and design and manufacturing processes. ($3.6M)
- Develop integrated intelligence/operations framework utilizing high performance computing for SOF direct action operations and special reconnaissance. ($3.1M)
- Develop concepts for and demonstrate initial feasibility of SOF deployed sensors integration with national sensor information in the prototype crisis preemption system. ($3.2M)
- Demonstrate forward deployed JSOTF crisis preemption system. ($2.6M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E, Project TT-03

- Conduct an integrated, fully-reactive interactive land-based demonstration of all Ship Systems Automation (SSA) Operator/Associate pairs interacting Combat and Platform Systems in a Ship Information Center (SIC) of the future facility. ($10.9M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	49.4	39.7	55.9
Appropriated	48.8	N/A	N/A
Current Budget	48.6	30.0	35.2

(U) **Change Summary Explanation**:

FY 1995 Minor program repricing.
FY 1996-97 Decrease reflects consolidation of transportation technologies in Project TT-10.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Land Systems Technology TT-04	28,373	33,412	39,974	46,986	57,001	55,909	56,686	Continuing	Continuing

(U) **Mission Description**: This project is intended to develop technologies for contingency missions and military Operations-Other-Than-War (OOTW) to make U.S. combat forces more deployable, effective, survivable, and affordable. This project supports four main efforts: OOTW and Law Enforcement/OOTW; Battle Management Architecture, Data-Base Modeling, and Technology Development; Small Low-cost Interceptor Device (SLID); and small scale operations and Military Operations in Built-up Areas (MOBA).

(U) Military Operations-Other-Than-War (OOTW) encompass a wide range of activities where military power is used for purposes other than large scale combat. The purposes of the ARPA OOTW research and development program are to develop and demonstrate technologies that will enhance the survivability of individual soldiers and small military units engaged in OOTW. These technologies also have application to general military operations and civilian law enforcement. ARPA will focus on solutions that will improve our ability to conduct OOTW missions through affordable, advanced technologies. Technology developments are being conducted in areas such as personnel armor; limited effects technology; surveillance through walls; concealed weapons detection; automatic language interpretation/translation; geo-location, navigation, and data transfer subsystems; mine detection; and sniper/mortar detection. Those technologies that minimize response time to achieve mission goals will be emphasized. Working with the potential user, the OOTW program will exploit ARPA simulation technologies to help define technology requirements. A Memorandum of Understanding is in place with the Department of Justice for the law enforcement applications.

(U) The Battle Management Architecture, Data-Base Modeling and Technology Development program addresses command and control problems of highly mobile, joint contingency forces in very difficult early entry scenarios. First to arrive units, which are usually outnumbered, currently cannot obtain a joint relevant common picture of the battlefield and have few battle synchronization tools available. The goal of this effort is to determine the commander's information needs and to develop technologies to allow synchronized Battle Management and to improve the command and control of the maneuver, fire support, and intelligence functions. This effort will initiate the interoperability, synchronization, and battlespace expansion technology base for the Command and Control for Joint Early Entry (CCJEE) program, formerly titled the Command and Control Information Systems project, PE 0603226E, Project EE-21. The information processing and database modeling technologies will be exercised, tested, and evaluated in the Early Entry environment being developed in Project EE-37 which serves as one test and evaluation mechanism.

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Funding for this project in FY 1997 and beyond will be consolidated in Project EE-21 under the Command and Control for Joint Early Entry program.

(U) The Small Low-Cost Interceptor Device (SLID) program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. This system will detect, track and intercept these threats at a standoff distance sufficient to render them ineffective. Applications for the SLID system include: self-defense of vehicles; high value fixed sites such as command centers, parked aircraft and radars; and may be extended to low-speed aircraft.

(U) Beginning in FY 1997, the Military Operations in Built-up Areas (MOBA) program will develop laboratory prototypes of a powered exoskeleton and teleoperated manipulator components for use in small-scale military operations.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Initiated development of information processing and database modeling technology focused on maneuver, fire support and intelligence functions to support Command and Control for Joint Early Entry (CCJEE) program, in Project EE-21 and design evaluation to be conducted by the Early Entry evaluation environment funded within Project EE-37. ($1.6M)
- Completed Phase I (risk reduction) efforts in the Small Low-Cost Interceptor Device (SLID) program and performed downselection for Phase II fabrication and testing. ($8.6M)
- Operations-Other-Than-War (OOTW) ($18.1M):
  - Completed initial demonstrations of Soldier 911 systems in Macedonia and Korea.
  - Initiated concept design for Superchip.
  - Continued development and performed preliminary field test of miniature hyperspectral IR sensor for mine detection.
  - Initiated development and conducted initial demonstration of English to Korean text translation.
  - Completed phenomenology study for through-the-wall surveillance and concealed weapons detection and awarding development contracts on BAA.
  - Awarded contracts for sniper detection system.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-04

(U) FY 1996 Program:

- Continue development of information processing and database modeling technology to supportand transition technology to the Command and Control for Joint Early Entry (CCJEE) program in Project EE-21. Conduct initial demonstration of fire support (Quick Draw) in a field exercise. ($4.9M)
- Initiate SLID phase II fabrication and testing effort with remaining contractors. Perform sub-system tests leading to static system tests. ($12.6M)
- Operations-Other-Than-War (OOTW) ($15.9M):
  - Complete the Soldier 911 demonstrations in Korea and Macedonia, and the Korean/English text translator.
  - Continue modular tag concept definition phase, sniper detection developments including a quickly fieldable system demonstration, and development and evaluation of hyperspectral miniature IR mine detection system.
  - Initiate the superchip/Mini 911 development, the Korean/English speech translator, the concealed weapons system brassboard development, extremity armor, and the long term limited effects technology developments.

(U) FY 1997 Program:

- Continue Small Low-Cost Interceptor phase II effort. Conduct full system static tests and tests against slowly moving targets. Prepare for live-on-live tests. ($16.1M)
- Operations-Other-Than-War (OOTW) ($13.9M):
  - Complete the hyperspectral mine detection system and provide user demo and transition.
  - Continue the modular tag development program and provide a demonstration of an integrated system.
  - Initiate the Superchip and Mini 911 developments.
  - Continue the sniper detection brassboard and provide an evaluation in a field environment.
  - Continue the concealed weapons detection system and conduct a critical design review.
  - Continue the extremity armor development and conduct a proof of concept demonstration.
  - Initiate the multispectral mine detection system.
  - Demonstrate the Korean/English speech translation system using military situation reports, and initiate three language text and speech translation systems.
  - Demonstrate the limited effects technology quickly fieldable systems and initiate the long term development.
- Conduct preliminary design and component prototyping for highly dextrous teleoperated devices and powered exoskeleton for application in small-scale operations and Military Operations in Built-up Areas (MOBA). ($10.0M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Tactical Technology, PE 0602702E, Project TT-04

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	30.2	34.1	26.0
Appropriated	29.3	N/A	N/A
Current Budget	28.4	33.4	40.0

(U) **Change Summary Explanation:**

FY 1995-96 Minor program repricing.
FY 1997 This project incorporates programs formerly under the Advanced Ship/Sensor Systems (Project EE-36).

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Targeting Technology TT-05	5,623	0	0	0	0	0	0	0	308,441

(U) **Mission Description**: By integrating advanced algorithms (automatic target recognizers) and processing technologies with multiple imaging sensors, autonomous intelligent submunitions will enhance U.S. force projection by providing a flexible and accurate delivery of munitions on a wide range of targets. Damocles will demonstrate a lower cost, intelligent, and effective submunition against these targets. It will have the ability to cover a large footprint (greater than 1 sq. km.) once deployed from a carrier vehicle and automatically search for, detect, and recognize sparsely positioned targets such as SCUDS, SS-21s, and their support vehicles.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed Damocles experiments, tests, and analysis and transitioned program to Army. ($3.2M)
- Completed implementation and evaluation of real-time software to demonstrate algorithms and sensors in captive carried platforms. ($2.4M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	5.8	0	0
Appropriated Budget	5.7	N/A	N/A
Current Budget	5.6	0	0

(U) **Change Summary Explanation**:

FY 1995 Increase reflects minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Tactical Technology TT-06	37,287	40,905	64,595	58,567	60,418	57,024	62,728	Continuing	Continuing

(U) **Mission Description**: This project focuses on the technology and applications of compact lasers, microwave radiation sources, advanced displays and mathematical algorithms for signal and image processing and modeling and simulation of nonlinear processes to dramatically improve the performance of radar, sensors, and systems for electronic warfare, target recognition, and military communications. Eight broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasure, laser radar and sensors; (b) miniature air-launched decoy systems; (c) compact high density data storage for high bandwidth image processing; (d) high performance, pulsed radio frequency (RF) radiation sources for smaller and better microwave tubes; (e) fast computational algorithms for signal processing, target recognition and tracking, electromagnetic and acoustic propagation in nonlinear medium, materials, and microelectronics processing; (f) passive infrared signature suppression to counter air-to-air missile threats; (g) precision optics components for critical DoD applications; and (h) vectored thrust testing.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Compact Lasers ($5.0M): Demonstrated breadboard systems of compact high power lasers at a wavelength near one micron, tunable mid-infrared lasers, and aluminum free laser diode arrays.
  - Demonstrated 10 Joules of energy at 50 Hertz in 10 nanosecond pulses and at a wavelength of one micron and frequency doubled to 0.532 micron with near diffraction limited beam quality.
  - Demonstrated tunable mid infrared lasers with waveform modulation for U.S. Army advanced threat infrared countermeasures program.
  - Demonstrated aluminum free laser diodes at 0.808 microns and 0.980 microns in both continuous wave and quasi-continuous wave outputs.
- Holographic Data Storage ($6.1M): Technology demonstration of page-format, high density input and readout capability.
  - Developed systems architecture for 1 terabit capacity and fast readout of data.
- Pulsed Radio Frequency (RF) ($6.2M): Continued fabrication and integration of advanced RF amplifiers and power combining techniques.
  - Fabricated triode amplifier using mirocathode operating at 10 gigahertz (GHz).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Designed and fabricated prototype high performance 94 GHz power amplifier.
- Demonstrated a high frequency power combining technique using solid state devices operating at 44 GHz.
- Designed reconfigurable antenna using microtip and diode laser technology.

• Fast Computational Algorithms ($12.5M):
- Developed methods for multiresolution synthetic aperture radar and adaptive waveform design.
- Applied wavelet design tools to tactical communications and target recognition.
- Demonstrated image denoising and segmentation algorithms derived from nonlinear partial differential equations.
- Demonstrated fast multipole radar cross section code with an order-of-magnitude increase in capability.
- Developed simulation tools, signal processing and modern control methods for the in-situ sensing and real-time control of materials and microelectronics processing.

• Miniature Small Engine Application Program (SENGAP) turbine engine ($3.6M): Validated the miniature SENGAP engine through successful flight worthiness verification and actual flight tests.

• Advanced Infrared Signature Suppression ($1.8M):
- Phase 2:
  -- Bench tested cooling system concept, thermodynamics of the system and the absolute value of the skin temperature.
  -- Documented results in Phase 2 final report.
- Phase 3:
  -- Designed cooling panel for NASA F-15 Pod.

• Vectored Thrust ($2.1M): Initiated test efforts of cascade vectored thrust and block and turn vectored thrust lift systems for application in transport aircraft.

(U) <u>FY 1996 Program</u>:

• Compact Lasers ($7.0M): Demonstrate compact lasers and active tracking systems at mid-infrared wavelengths for IR countermeasures.
- Demonstrate mid-infrared lasers, packaged for slow motion, dynamic testing.
- Demonstrate and test a compact active tracking system brassboard for mid-infrared wavelengths.

• Holographic Data Storage ($5.9M): Technology demonstration to establish system trade-offs of various candidate materials for holographic data storage.
- Demonstrate proof-of-principle digital holographic data storage devices to establish the capability of various multiplexing methods and error detection and correction schemes.

• Fast Computational Algorithms ($14.4M):
- Demonstrate wavelet-based methods for automatic target detection and recognition.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Demonstrate multiresolution methods and adaptive waveforms for image formation and processing.
- Develop hybrid automatic target recognition strategy for synthetic aperture radar exploiting most advantageous features of both wavelets and nonlinear partial differential equation-based methods.
- Develop parallel implementation of fast multipoles for radar cross section calculations.
- Identify approaches to reducing high-order nonlinear descriptions of thin film processes to real-time sensing and control models.

• Precision Optics Technology ($5.0M): Develop conformal and off-axis optical components for next generation tactical systems using computer-aided design and manufacturing.

• Advanced Infrared Signature Suppression ($1.0M): Integrate and demonstrate (flight test) a long-wave infrared (LWIR) suppression system.

• Agile Warrior/"hybrid reality" displays ($4.7M): Develop fast, high resolution panoramic visual display medium; demonstrate high network throughput with multiple dynamic, visual entities while retaining resolution, realism and precision.

• Miniature Air-Launched Decoy (MALD) ($3.0M): Based on the successful completion of the SENGAP engine program, begin MALD system design, engineering and producibility analysis.

(U) FY 1997 Program:

• Compact Lasers ($9.7M): Demonstrate breadboard systems of compact high power tunable mid-infrared lasers, and laser diodes at mid-infrared wavelengths.
- Demonstrate breadboard tunable mid-infrared lasers with a watt output at 20 kilohertz (KHz) pulse repetition rate for ship defense.
- Demonstrate mid-infrared laser diodes.

• Holographic Data Storage ($7.9M): Technology demonstration to establish functional limits.
- Demonstrate 1 terabit storage capacity for functional evaluation of write once and read many (WORM) type storage systems.

• Fast Computational Algorithms ($24.2M): Continue transition of novel algorithms for automatic target recognition and image processing and develop associated electromagnetic and acoustic propagation models. Begin development of models of thin film processes that integrate process, sensing, and control considerations and provide understanding of critical microstructure issues needed to design high-quality and high yield manufacturing processes.
- Select automatic target recognition algorithms for system insertion demonstrations.
- Apply adaptive waveform designs to radar and communication.
- Implement a hybrid automatic target recognition strategy for synthetic aperture radar exploiting most advantageous features of wavelets and nonlinear partial differential equation-based methods.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Demonstrate orders-of-magnitude speed-up provided by parallel implementation of fast multipole to radar cross section calculations.
- Develop methods for calculating electromagnetic scattering from objects in ground clutter.
- Develop sensing and control models for thin film processes.

• Precision Optics Technology ($10.0M): Continue development of conformal and off-axis optical components for tactical systems.
- Develop magneto-rheological finishing for aspheres, toroids and cylinders.
- Model ion exchange and synthesize materials with varying index of refraction in the visible and infrared regions of the spectrum.

• Miniature Air-Launched Decoy ($12.8M): Complete design engineering and producibility analysis; conduct launch separation analysis and wind tunnel testing; initiate system fabrication and qualification testing; and begin RCS testing

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	36.2	39.4	42.8
Appropriated	35.2	N/A	N/A
Current Budget	37.3	40.9	64.6

(U) **Change Summary Explanation**:

FY 1995-96 Increases reflect minor program repricing.
FY 1997 Increase due to initiation of miniature Air-Launch Decoy (MALD) and Virtual Integrated Prototyping programs.

(U) **Other Program Funding Summary Cost**:

FY 1996 Advanced Concept Technology Demonstration Funding for MALD. PE 603757D FY 1996, $1.4 million; FY 1997 $4.0 million.

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
TRANSTECH TT-10	0	9,650*	17,185	38,685	16,665	7,633	0	0	99,818

* In addition, $4.7 million of FY 1996 funds are included in PE 0602301E, Project No. ST-11, for TransTech.

(U) **Mission Description**: TransTech will investigate and demonstrate technologies that will make a fundamental difference in DoD transportation and logistics. The TransTech project will define, develop, and demonstrate fundamental enabling technologies that will permit logistics and transportation assets to be deployed, tracked, refurbished and redeployed more efficiently than ever before. Currently, these assets are being managed using isolated, independent, and sometimes incompatible computer systems. Therefore, the very rapid planning, replanning and redirection necessary to support missions involving simultaneous local and major regional conflicts cannot be accomplished today. TransTech will enable this significant capability to be developed. In addition, the project has enormous potential for cost savings through greatly improved management of transportation and logistics assets.

(U) TransTech will develop multi-echelon, collaborative logistical/transportation support tools that will provide warfighters an unprecedented capability to monitor, rapidly replan and re-execute movement, even while enroute to the theater. TransTech will focus on three areas: 1) TransWeb--development of a computer network infrastructure that allows distributed real-time visualization and interaction with all phases, elements and components of the military and commercial transportation infrastructure; 2) Applications--providing a technology environment that allows warfighters to rapidly understand and assess the logistics and transportation implications of a crisis situation, to generate effective plan's and courses of action, to monitor a plans execution, and to use that information to re-plan; 3) Critical Transport Technologies--physical systems that will enable significant efficiency improvements in transportation and logistics, such as automatic equipment identification and tracking (tags), and improved cargo handling for Logistics Over The Shore.

(U) **Program Accomplishments and Plans**:

(U) FY 1996 Program:
- Initiate development of TransWeb, a full fidelity distributed transportation network. ($2.4M)
- Complete assessment of Logistics Over the Shore (LOS) technology opportunities. ($2.4M)
- Investigate Total Asset Visibility (TAV) technology opportunities and initiate development of advanced tagging/location systems and software. ($4.8M)

(U) FY 1997 Program:
- Continue TransWeb architecture development and demonstrate a distributed transportation network to support inland military transportation planning/replanning from origin to port. ($5.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-10

- Demonstrate technologies in the laboratory to reduce relative motion during cargo on/off load in unprotected waters during amphibious operations. ($3.0M)
- Conduct a feasibility demonstration of tag technology. ($3.6M)
- Initiate proof of principle for advanced software data collection techniques (also referred to as knowledge rovers or intelligent software agents) that roam the Global Information Infrastructure searching for relevant logistics information and data and return it to the user. Initiate development of multi-echelon collaborative logistical support tools that integrate planning, execution, monitoring and decision support systemsP for testing and deploying these tools. Develop a reusable and reconfigurable software framework, which will be known as a logistics anchor desk (LAD). ($5.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	11.3	30.9
Appropriated	0	N/A	N/A
Current Budget	0	9.7	17.2

(U) **Change Summary Explanation**:

1996-97 Reduction reflects program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Integrated Command and Control Technology, PE 0602708E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Definition Systems IC-03	79,375	48,000	45,000	45,000	45,000	45,000	45,000	Continuing	Continuing

(U) **Mission Description**: This program element is budgeted in the Exploratory Development Budget Activity because it develops the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications that involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; display architectures and processors; compression algorithms; and high speed data transmission. These efforts will establish a domestic technical capability and demonstrate the manufacturing capability of components necessary for military systems that capture, process, store, distribute and display high resolution images.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. ($36.4M)
- Continued enabling material and component technologies for performance and cost goals for liquid crystal materials, polymer electroluminescent materials, lightweight optics, color filters, flat backlights, field emitter materials and structures, and phosphors. ($12.0M)
- Developed manufacturing equipment and processes for the affordable production of high definition displays. Flat panel display manufacturing equipment have been scaled up to handle larger substrates at higher throughputs with improved process capability. ($20.0M)
- Developed displays with integrated computation and image processing and develop improved phosphor materials and deposition processes for emissive displays (electroluminescent, field emission and plasma displays). ($11.0M)

(U) FY 1996 Program:

- Continue development of flat panel and projection displays for mobile displays, and shipboard and landbased command and control centers. ($18.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E, Project IC-03

- Continue development of equipment and components to meet display cost and performance goals. This will include efforts in patterning, film deposition and annealing, and field emission display materials and assembly tools, as well as color filter materials, reflective liquid crystal materials and phosphor technology development. ($20.0M)
- Develop system prototypes which leverage earlier developed display technologies and incorporate integrated systems and intelligent interfaces. ($10.0M)

(U) FY 1997 Program:

- Continue development of reflective and emissive mobile display technologies and laser based projection systems for command and control applications. ($13.0M)
- Continue development of equipment and components to meet display cost and performance goals. This will include efforts in patterning and field emission display materials and assembly tools, as well as reflective liquid crystal materials, phosphor technology development, and support for domestic display manufacturing infrastructure. ($22.0M)
- Continue development of system prototypes which leverage earlier developed display technologies and incorporate integrated systems and intelligent interfaces. ($10.0M)

U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	81.6	48.0	67.6
Appropriated	79.8	N/A	N/A
Current Budget	79.4	48.0	45.0

(U) **Change Summary Explanation**:

FY 1995 Reflects minor program repricings.
FY 1997 Reflects reprioritization of DoD resources.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials and Electronics Technology	**262,523**	**222,132**	**240,625**	**288,950**	**303,556**	**320,325**	**352,708**	**Continuing**	**Continuing**
Materials Processing Technology MPT-01	142,593	117,404	118,938	145,414	160,191	161,550	180,327	Continuing	Continuing
Microelectronic Device Technology MPT-02	87,892	60,308	75,451	90,582	92,396	99,222	108,881	Continuing	Continuing
Cryogenic Electronics MPT-06	17,406	12,333	17,187	21,740	13,283	15,146	15,000	Continuing	Continuing
Military Medical/Trauma Care Technology MPT-07	14,632	32,087	29,049	31,214	37,686	44,407	48,500	Continuing	Continuing

(U) **Mission Description**: This program element is budgeted in the Exploratory Development Budget Activity because its objective is to develop technology related to those materials, electronics, and medical devices that make possible a wide range of new military and commercial capabilities.

(U) The Materials Processing project (MPT-01) concentrates on the development of novel materials, processing techniques, and fabrication strategies for production of higher performance advanced structural and electronic materials manufactured at a lower cost. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced control to materials processing, thin film processing, large area multichip module processing, and flexible fabrication and assembly. It includes research on composite materials, synthesis of diamond films; insertion of ceramics into military system components; flexible solid freeform fabrication; toxic waste elimination; modeling and simulation of vapor phase processing of thin film materials; cryogenic electronics; and adaptive ("smart") materials and structures.

(U) The Electronics Processing project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, and materials for optoelectronics and infrared devices. Areas of emphasis include high-performance analog-to-digital converters, military optical processors, novel optoelectronic devices, artificial neural network technology, low power electronics, non-volatile memory, and high power electronics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

(U) In the Cryogenic Electronics project (MPT-06), thin film electromagnetic material have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military applications. Thin-film high temperature superconducting components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance while reducing size and power requirements. Highly dependable and inexpensive cryocoolers are being developed for these applications, and new efforts will explore techniques to improve cryogenic performance in applications ranging from communications to computing.

(U) Military Medical/Trauma Care Technology project (MPT-07) is an initiative to significantly improve far-forward battlefield trauma care. The Advanced Biomedical Technology portion focuses on the human factors of advanced technology concepts in a front-line battlefield environment through development of body-worn monitors, field-portable digital imaging equipment, battlefield surgical simulator, and protection against biological warfare attack. The Health Care Information segment concentrates on development of physician, medic, and community information associates for utilization by both medics during combat care scenarios and physicians during patient visits.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Processing Technology MPT-01	142,593	117,404	118,938	145,414	160,191	161,550	180,327	Continuing	Continuing

(U) **Mission Description**: The major goals of this project are to develop novel affordable materials, processing techniques, and fabrication strategies for production of advanced structural, electronic and magnetic materials and components and devices for application in military platforms and systems for improved performance and at lower processing costs. This is accomplished by awards to individual companies, universities, and government laboratories, as well as by cost-shared Advanced Materials Partnerships. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced controls to materials processing, thin film processing, large area multichip module processing, and flexible fabrication and assembly. Other predominant areas include: biosensors for chemical and biological surveillance; and research on composites (metal matrix, polymer matrix, ceramic matrix, and carbon-carbon) for advanced aerospace structural materials to upgrade gas turbine engine and airframe components. Sensors and techniques will be developed for improved intelligent processing of materials.

(U) Additional areas of focus are: synthesis and production of engineered polymers for far-forward and combat casualty medical care and passive chemical and biological warfare (CBW) defense; synthesis of diamond films for thermal management in electronic packaging; high temperature semiconductors, such as silicon carbide for high power applications in aircraft and electric vehicles; insertion of state-of-the-art ceramics into military system components (bearings, gas turbine engine components); development of field oriented bioremediation tools for cost effective *in situ* hazardous waste destruction; precision machining of high strength alloys, composites, and ceramics using laser and electron beam energy sources.

(U) Flexible solid freeform fabrication capabilities are being developed for high performance structural materials (especially ceramics), which will fabricate functional components directly from Computer Aided Design (CAD) files and not require part-specific tooling or operator intervention. Research on magnetoresistive materials will enable demonstration of a non-volatile magnetic random access memory (RAM) with high density, short access time, infinite cycles, and low power. Magnetostrictive materials will provide benefits to smart materials actuator systems. Environmental research includes DoD-related toxic waste elimination and "green" manufacturing, which seeks to eliminate or minimize toxic waste produced by fabricating products relevant to the DoD.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Biotechnology ($1.9M): The basic research portion of this effort is found under PE 0601101E, Project MS-01. Completed program and transitioned to Advanced Biomedical Technology Program. (PE 0601101E, project MS-01 and 0602712E, project MPT-07).
  - Demonstrated gain of a biosensor device by modulation of intrinsic cellular amplification system (second messenger system).
- Structural Materials ($64.1M): Developed affordable composites, ceramics, and alloys using intelligent processing of materials and automated manufacturing concepts. Emphasized insertion of components into military systems.
  - Demonstrated on-line sensing of critical product and process variables and multivariable feedback control for the rapid densification manufacturing process for carbon-carbon composites.
  - Developed advanced electron beam curing process suitable for production of polymer matrix composites.
  - Developed cost effective electron beam processing technology for silicon carbide fiber reinforced titanium for turbine engine components.
  - Demonstrated the increased performance of the M1A2 tank dual-axis head mirror assembly by replacing nickel-coated beryllium metal with silicon carbide.
  - Initiated program to develop ultra lightweight structural panels for missile and aircraft construction.
  - Initiated a program to develop lightweight aluminum-beryllium aircraft and turbine engine structures.
  - Initiated nine cost-shared Advanced Materials Partnerships (consortia) in the areas of polymer composites and advanced non-destructive evaluation of structural materials.
- Material and Device Fabrication ($25.2M): Extended program to address hard and soft tooling, laser cutting and processing capabilities, large format multi-chip modules, and solid freeform fabrication.
  - Developed prototype design for adaptively-controlled machine tools, including a control scheme to correct machine errors.
  - Developed and applied sensor technologies for on-line process control of the large-format and roll-to-roll unit processing tools identified for development of multi-chip modules.
  - The laminate multichip module pilot line was installed and demonstrated all unit processes; debugging and process improvement studies are continuing.
  - Utilized selected laser sintering and 3-D printing solid free-form fabrication to demonstrate structural ceramic and metal components with strengths comparable to what can be produced using mass production methods.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Developed and applied fiber optic sensors to powder burnout and consolidation processes.

- Advanced Materials and Processing ($33.5M): Continued processing developments for affordable materials.
  - Lowered defect density in semiconducting silicon carbide bowls to optimize electrical properties and increase yield.
  - Developed computer models for plasma spraying of metal matrix composites.
  - Developed shape memory alloy and electrostrictor ceramic actuators for smart structure applications.
  - Developed integration technology to produce smart structures containing sensors, actuators, and on-board electronics for real time control of noise, vibrations, and small scale shape change.
  - Developed and demonstrated a slotted metal chamber which effectively couples Radio Frequency (RF) energy to generate plasma sheath around the wall for Chemical Vapor Deposition (CVD) diamond growth.
  - Developed theoretical and computational methods to predict structural and electro-optic properties for semiconductor superlattices.
  - Successfully reduced defect density in Gallium Nitride (GaN) material system and demonstrated the first U.S. very bright blue light emitting diodes with 1200 microwatts optical power.
- Vapor Phase Processing ($10.0M): Develop intelligent processing technologies to scale-up cost-effective production of thin film photovoltaics, multilayer turbine engine coatings, and thin film high temperature superconductor devices.
  - Demonstrated on-line sensing to measure critical process and product variables in the production of thin film functional multilayer structures.
  - Preliminary process models were constructed to demonstrate reactive co-evaporation systems and metal-organic chemical vapor deposition growth of high temperature superconducting thin films.
  - Field demonstrated with the 7th Marines a high efficiency, foldable photovoltaic power source for re-charging hand-held radio batteries.
  - Demonstrated feasibility of an on-line laser atomic adsorption spectrophotometer for sensing vapor species during electron beam physical vapor deposition production of multilayer thermal barrier coating systems.
- Environmental Sciences ($7.9M): Destroy DoD toxic waste using supercritical water oxidation (SCWO). Reduce toxic waste production as by-products of DoD-related fabrication processes ("green" manufacturing).
  - Initiated research and development of transportable supercritical water oxidation (SCWO) system capable of processing 100 lbs/hr of Navy shipboard excess hazardous materials.
  - Developed alternative electronic manufacturing processes for minimization/elimination of toxic wastes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) FY 1996 Program:

- Structural Materials. ($40.5M)
  - Demonstrate full-scale rapid densification of carbon-carbon composite components.
  - Demonstrate a five-fold improvement in the life of the roll reaction control (RRC) valve bearings on the AV-8B Harrier aircraft due to the upgrade of the metal bearings with ceramic hybrid bearings.
  - Validate the Resonant Ultrasonic Inspection technique for ceramic rolling elements through beta site testing at a commercial ball bearing finisher.
  - Demonstrate production of voided and foamed aluminum and titanium core materials for ultra lightweight panels.
  - Demonstrate reduced mean-time-between-failure (MTBF) associated with the upgrade of glass optical domes to spinal domes used in the Angle Rate Bombing Set (ARBS) of the AV-8B Harrier aircraft.
  - Initiate four new Advanced Materials Partnerships in low cost metals processing and advanced ceramics.
- Material and Device Fabrication. ($27.3M)
  - Demonstrate prototype multichip modules (MCM) with laminate technology roll to roll processing.
  - Demonstrate a prototype MCM for a missile guidance section using bare die on a laminate substrate and electronically validate performance.
  - Demonstrate the use of X-ray tomography and develop software to generate CAD files from solid objects compatible with requirements of solid freeform fabrication.
  - Develop the machine capability to produce silicon nitride components using the fused deposition method with silicon nitride powder loaded wax filaments.
  - Demonstrate the capability to fabricate molds for slip casting structural ceramics using the 3-D printing technology.
  - Demonstrate application of smart materials to reconfigurable machines and tooling hardware.
  - Demonstrate advanced polarization preserving fiber optic connector.
- Advanced Materials and processing. ($24.9M)
  - Develop a Chemical Vapor Deposition (CVD) process for the fabrication of particulate and chopped fiber reinforced composites with 10X increase in composite growth rate over normal CVD processing; and demonstrate the utility of the fabricated composites for the die casting of copper alloys.
  - Design, fabricate and evaluate fiber reinforced ceramic matrix composite fins for the Army's Line of Sight Anti-Tank (LOSAT) missile with a 50% weight savings over the current materials (steel).
  - Develop magnetoresistive materials with improved electrical resistance properties.
  - Develop simulation codes for physics of vapor deposition and validate on industrial processes.
  - Develop feedback control methods for plasma sprayed metal matrix composites.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Demonstrate process to produce elastomeric electrorheological materials for acoustic wave filtering applications.
- Demonstrate diamond manufacturing cost reduction of 1/2" X 1/2" square substrate to $5/piece.
- Demonstrate greater than 50 fold increase in CVD diamond deposition rate (from 60 mg/hr to greater than 3000 mg/hr) with a large area and high rate deposition system.
- Develop stable contacts for high temperature, high power semiconductors.
- Demonstrate material sensor and activator components manufacturability utilizing piezoelectric ceramics and electrostrictors.

• Vapor Phase Processing. ($11.6M)
- Demonstrate on line sensing and closed loop control of thin film photovoltaic processing.
- Demonstrate an order of magnitude improvement in jet engine compressor blade erosion resistance through the use of multilayer coatings.
- Demonstrate high yield large area processing of thin film high temperature superconducting devices.

• Environmental Sciences. ($11.7M)
- Design and initiate construction of a supercritical water oxidation system for shipboard waste disposal.
- Initiate risk assessment methodologies for bioremediation; develop baseline criteria and metrics for risk reduction.
- Demonstrate more environmentally sound production processes for printed wiring boards.
- Select sites for bioremediation prototype process design and demonstration.
- Initiate studies of advanced erosion/corrosion resistant thin film coating.

• Biological Warfare Defense. ($1.4M)
- Prototype biologic warfare defense technologies and applications using advanced modeling and simulation of High Intensity and Low Intensity (dismounted soldier) Conflicts.
- Develop breadboard versions of in-situ sensors which detect and identify threat microorganisms on the battlefield (specific microbial/viral agents) for both tactical surveillance and early warning. Multiple approaches will explore use of polymerase chain reaction (PCR), miniature electronic/mechanical systems (MEMS), and protein fingerprinting.

(U) <u>FY 1997 Program</u>:

• Structural Materials. ($13.0M)
- Demonstrate low cost production of high performance carbon-carbon composites.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Demonstrate a 2X increase in mean-time-between-failures (MTBF) associated with the replacement of carbon engine starter oil face seals on aircraft with ceramic face seals.
- Continue four advanced materials partnerships in structural materials: demonstrate low cost processing of ceramic composites for jet engines; demonstrate versatile process for lowering cost of hot isostatic pressing of superalloy powders.
- Demonstrate production of titanium components using laser sintering technique.
- Demonstrate low cost aluminum-beryllium aerostructure fabrication processes.
- Demonstrate secondary processing and joining of ultra lightweight panels.

• Materials and Device Manufacturing. ($26.4M)
- Demonstrate the capability to produce ceramic components with complex geometry and dimensional tolerances and mechanical properties comparable to mass manufactured advanced ceramics using the Jet Printer technology (3-D printing).
- Develop a new solid freeform build method for ceramic components based on layer-by-layer photolithography utilizing either large area liquid crystal display, or a light emitting diode display technology for electronic/programmable photomasks.
- Test reconfigurable machines and tools in shop floor beta test sites.
- Demonstrate fabrication process for microintegrated smart materials.
- Demonstrate roll-to-roll processing of laminate multichip modules.
- Initiate linkage chemistry to attach engineered polymers to fibers and resins for development of systemic toxic "sponge".

• Advanced Materials and Processing. ($35.9M)
- Determine the economic viability of Templated Grain Growth (TGG), a process by which solid phase epitaxy of crystallographical oriented seeds on near net shaped pollycrystalline components is used for growth of single crystal-like oxides.
- Determine the performance characteristics of low cost, damage tolerant fibrous monolith components in engine environments.
- Demonstrate control of plasma sprayed metal-matrix processing and extend process control models to physical vapor deposition of metal coated fibers.
- Complete development of a plasma/ion etch numerical simulation.
- Demonstrate predictive capability of high-pressure, low-order, chemical vapor deposition models and demonstrate feedback control to a desired wafer state.
- Develop manufacturable processes for large area deposition of giant magnetoresistive materials and bipolar spin transistors.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Demonstrate intelligent processing of large area chemical vapor deposition (CVD) diamond with a production cost of $1.00 per karat.
- Grow single crystal boules for three inch diameter silicon carbide semiconductor wafers by scaling up the reactor and developing larger seed crystals.
- Demonstrate vibration reduction by a factor of ten in machine tools via specially designed sensor/actuator elements to enhance machining tolerances.

• Vapor Phase Processing. ($18.9M)
- Demonstrate a 5X cost reduction in production of thin film photovoltaic modules.
- Demonstrate high yield multilayer coating of complex shape turbine engine components.
- Demonstrate high temperature superconducting technology with greater than fifteen square inch format and greater than eighty percent yield.

• Environmental Sciences. ($17.7M)
- Demonstrate a supercritical water oxidation pilot plant for the destruction of shipboard hazardous materials.
- Complete characterization of field sites and design and testing of risk assessment tools for bioremediation of DoD hazardous waste sites.
- Demonstrate novel recycling/reclamation techniques for disposal of scrap polymer matrix composites.
- Develop advanced erosion/corrosion resistant thin film coatings for military applications.

• Biological Warfare Defense. ($7.0M)
- Conduct laboratory demonstrations which validate the sensitivity (at concentrations of a few nanomoles) and selectivity (false alarm rates less than 25%) of bio-agent detectors in a realistic combat environment.
- Demonstrate efficacy of biologic warfare defense capabilities in advanced modeling and simulation of High Intensity (JCS/CINC/SC) and Low Intensity (dismounted soldier) Conflicts.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	148.6	122.7	146.3
Appropriated	149.3	N/A	N/A
Current Budget	142.6	117.4	118.9

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) **Change Summary Explanation**:

FY 1995 Decrease to fund TRP earmark.
FY 1996-97 Decreases due to transfer of magnetic materials and devices program to Project MPT-06.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microelectronic Device Technologies MPT-02	87,892	60,308	75,451	90,582	92,396	99,222	108,881	Continuing	Continuing

(U) **Mission Description**: This element develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and modules, artificial neural network technology, low power electronics, non-volatile memory, digital radar processor components, electromagnetic interference (EMI) semiconductor susceptibility, high temperature electronic devices, and high power electronics. This microelectronics development project creates the technology base for advanced electronic and optoelectronic components to meet DoD needs. In this project, the feasibility of promising research results are developed to the point where their military utility can be determined.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated and validated heterojunction bipolar transistor design and fabrication technologies in pilot production facilities for component applications in high speed systems. ($19.3M)
- Developed and demonstrated electronic neural network technologies for high performance, high bandwidth signal and image processing applications. ($8.1M)
- Established architecture, software requirements, and core supporting technologies to enable improved image processing, based on advanced neural networks. ($3.0M)
- Developed 3.3V Silicon-on-insulator technologies for low power electronics. ($12.2M)
- Developed Cadmium-Zinc-Telluride seeded growth technologies to produce large diameter, single crystal, controllable orientation materials and demonstrated large format, staring infrared focal plane arrays using seeded growth materials. ($13.3M)
- Initiated consortium to develop technologies for nanolithography, nanoelectronics, and high speed supercomputer visualization. ($9.0M)
- Developed and demonstrated fabrication of critical components for affordable optoelectronic modules, including vertical cavity surface emitting lasers (VCSEL), high bandwidth graded index plastic optical fiber, low error rate digital busses, and demonstrated component integration and insertion in electronic systems. ($23.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-02

(U) FY 1996 Program:

- Develop heterojunction bipolar transistor process, device, and design technologies for application in high-speed analog-to-digital converters, digital-to-analog converters, multiplexers, and demultiplexers. ($8.0M)
- Deliver the first-generation of hardware and software for the advanced image processing. ($8.9M)
- Complete development of advanced electronic neural network technologies for target tracking and recognition applications. ($8.2M)
- Develop critical materials, processes, and device technologies for .25µm silicon-on-insulator semiconductor fabrication. ($9.4M)
- Develop optoelectronics technologies to enable cost-effective fabrication and integration of module subassemblies for digital optoelectronic processors, bus and backplanes, and serial/parallel input/outputs. ($25.1M)
- Initiate efforts to design radio frequency photonic components for transmission of millimeter waves and microwaves. ($.7M)

(U) FY 1997 Program:

- Develop integrated CAD tool set for high speed (>1GHz) designs and initiate demonstration of high speed analog-to-digital prototype. ($7.9M)
- Complete hardware/software integration for advanced vision system, and demonstrate image recognition. ($10.2M)
- Demonstrate functionality and operation of high performance optoelectronic, digital processor prototype and develop advanced optoelectronic fabrication approaches and subassembly component technologies. ($21.7M)
- Develop component and fabrication technologies for radio frequency photonic components for application in millimeter wave and microwave transmission. ($7.8M)
- Improve silicon-on-insulator materials and device fabrication methodologies to enable a low power, radiation tolerant, 0.18µm technology generation. ($10.0M)
- Initiate efforts to develop advanced digital-based RADAR processor components based on high speed semiconductor technologies, such as heterojunction bipolar transistors. ($6.2M)
- Establish a methodology for investigating the susceptibility of new semiconductor technologies to electromagnetic interference and electrostatic discharges. ($4.2M)
- Initiate efforts to develop non-volatile memories. ($4.2M)
- Demonstrate operation of semiconductor switches, based on silicon-carbide materials, capable of sustained handling of high electric power. ($3.3M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E, Project MPT-02

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	92.9	62.2	81.9
Appropriated	84.0	N/A	N/A
Current Budget	87.9	60.3	75.5

(U) **Change Summary Explanation:**

FY 1995 Increase funds a Congressional TRP earmark in nanoelectronics.
FY 1996-97 Decreases due to a reprioritization of DoD resources.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology, PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Cryogenic Electronics MPT-06	17,406	12,333	17,187	21,740	13,283	15,146	15,000	Continuing	Continuing

(U) **Mission Description**: Thin film electromagnetic materials have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military systems. Films are deposited and patterned to form electromagnetic components in ways that are similar to, and compatible with the processes of semiconductor processing. Such electromagnetic components, as well as complementary metal oxide semiconductors (CMOS), perform best at lower temperatures, so that cryogenic packaging generally will be required. Thin-film high temperature superconducting (HTS) components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance by more than an order of magnitude while reducing size and power requirements. Particular demonstrations include an upgraded ship-defense radar (SPQ-9B) with 100X greater detectability of missiles in littoral clutter, and a switchable filterbank with 32 individually tuned high-performance filters to suppress Electronic Warfare (EW) saturation in radar warning receivers. Highly dependable and inexpensive cryocoolers are being developed for these applications, and new efforts will explore techniques to improve cryogenic performance in applications ranging from communications to computing. Research and development of thin-film magneto-resistive materials will enable the demonstration of a non-volatile, radiation hardened magnetic random access memory (MRAM) with very high density, short access time, infinite cyclability and very low power. These magneto-resistive materials also will provide benefits as sensors in smart materials actuator systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- High Temperature Superconductors/Analog and Digital Applications ($13.4M): The most promising HTS applications have been identified: (1) Cryo-radar for ship defense, (2) Switchable filterbanks for radar warning receivers, and (3) digital circuitry for signal processing. The following accomplishments have been achieved:
  - Demonstrated noise floor performance of a HTS stabilized oscillator (STALO) fully packaged with cryocooler.
  - Demonstrated the selectivity performance of a channelized filterbank for the cryo-radar receiver.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

- A tunable filter was demonstrated to function over a 10% frequency band at X-band, with resettability in less than a microsecond. The combination of tunability with switchability will enable unique capabilities for frequency hopping and distributed communications.
- Within the Consortium for Superconducting Electronics (CSE), a 9-pole high-power filter was developed for communications purposes.
- Six contracts were initiated with principal cryocooler manufacturers to demonstrate 3-year dependability and 5X price reductions of their standard products.

• High Temperature Superconductors/Cryoelectronic Modules ($4.0M): The integration of HTS devices and interconnects with cold conventional electronics has produced performance benefits, when packaged with a cryocooler. These subsystem modules can be inserted into larger computers and processors to provide 2X overall system improvement.
- A thin-film interconnect/multi-chip module has shown 2X improvement at low temperature.
- A processor module when packaged in a cryocooler has shown a performance improvement of 50% at -50C.
- Initiated effort to demonstrate a multi-Gb/s communications switch system (Tektronix), utilizing HTS, MCM and cryogenic CMOS as enabling technologies.

(U) FY 1996 Program:

• High Temperature Superconductors/Analog and Digital Applications ($4.0M): In this final year of the HTS Program, the focus will be on five insertion opportunities.
- Provide fully-integrated 32-element filterbank with refrigerator to F-15 and a 96 element filterbank to the B-1B aircraft.
- Complete evaluation of cryo-radar with HTS STALO.
- Complete development of crossbar switch and cryo-workstation.
- Complete funding for Consortium for Superconducting Electronics.
- Demonstration of a high-performance 8x8 asynchronous transfer mode (ATM) cryogenic switch in a wide area network.

• Cryogenics Technologies. ($5.5M)
- Undertake development of small/inexpensive reliable cryocoolers.
- Develop electronic devices and components optimized for cooled operation.
- Initiate applications demonstrations, with integrated cryocoolers and temperature-optimized components.

• Magnetic Materials and Devices. ($2.8M)
- Develop giant magneto-resistive (GMR) films with enhanced electrical characteristics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

- Enhance magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of devices.
- Model magnetic memory cell design.

(U) FY 1997 Program:

- Cryogenics Technologies. ($10.2M)
  - Continue fabrication of Cryo-radar, using HTS components and upgraded conventional components such as driver and active array, for final demonstration in FY98 with a simulated Naval scenario.
  - Upgrade HTS switchable filter sets with tunable filters, for simpler construction and operation into aircraft Electronic Countermeasures (ECM) suites.
  - Evaluate results of cryo-crossbar switch and ATM efforts. Determine most appropriate insertion for digital systems employing HTS devices as well as cryo-CMOS.
  - Determine most important communications application of cryo-components.
- Magnetic Materials and Devices. ($7.0M)
  - Demonstrate large area deposition of GMR materials.
  - Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.
  - Demonstrate prototype GMR magnetic memory cell and spin transistor memory cell using magnetic multilayers.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	14.2	12.0	12.2
Appropriated	17.8	N/A	N/A
Current Budget	17.4	12.3	17.2

(U) **Change Summary Explanation**:

FY 1995 Reduction to finance TRP earmark.
FY 1996 Minor program repricing.
FY 1997 Transfer of magnetic materials and devices from project MPT-01.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials & Electronics Technology,
PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Military Medical/Trauma Care Technology MPT-07	14,632	32,087	29,049	31,214	37,686	44,407	48,500	Continuing	Continuing

(U) **Mission Description**: The objective of this project is to revolutionize far-forward battlefield trauma care and provide protection against biological warfare (BW) attack. The project recognizes that planned downsizing of U.S. forces creates new pressures to ensure force readiness, skill mix, and effective joint doctrine at a time when battlefield casualties carry both strategic importance and tactical relevance. A review of combat casualty care has shown: (1) that 90% of combat deaths occur in the zone of close combat prior to medical or surgical intervention; (2) that fratricide continues at casualty rates as high as 20%-30%; (3) that casualty location is a continuing battlefield problem; and (4) that less than 5% of U.S. Army active-duty physicians have treated combat casualties.

(U) The ARPA Defense Healthcare Technologies program has two major segments: (1) Advanced Biomedical Technology and (2) Healthcare Information Infrastructure. The first segment exploits ARPA's unique leadership role in the electronics and information sciences areas to project advanced medical and surgical care into the far-forward battlefield area to effect early, successful, clinical intervention. In one thrust, this program will develop lightweight personnel status monitors (PSMs) permitting remote non-invasive clinical diagnosis, casualty localization, and friend-foe identification. The PSM, which would be worn by all soldiers as part of their combat uniforms, is further augmented with low power, secure, wireless communications and Global Positioning Satellite system (GPS). The PSM would monitor the soldiers' clinical vital signs continuously, but would remain otherwise passive unless either queried by an operational commander or the soldiers' vital signs departed from established clinical norms.

(U) In a second thrust, this program will develop the technology base for early far-forward medical/surgical intervention. The goal is to preserve critical organ system function, prevent exsanguination, reverse systemic shock, and prevent hypoxia by use of automatically controlled devices to provide immediate mechanical or pharmacologic therapy. Once pharmacologic or early surgical stabilization has been achieved, the patient will be evacuated in a critical care life support pod (LSTAT) which will function like an autonomous single-patient hospital intensive care unit.

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(U) In a third thrust, workers will develop and exploit advanced simulation technology to improve the training of battlefield health care providers and to ensure skill currency. The objectives of this effort are to provide for the virtual representation of human structure and function; ensure near-seamless transition from training to clinical practice; and to permit simulation of combat-casualty medical care within the framework of operational battlefield requirements. The broader impact of whole-body virtual simulation on undergraduate and continuing medical education programs will allow military medical students to integrate traditionally separate academic disciplines and dramatically reduce the need for human cadavers. Virtual prototyping is provided of medical environments such as mobile operating rooms, critical care life support pod (LSTAT) and instruments/equipment inserted by casualty care simulations. New technologies for presenting information and training scenarios will be developed using human interface technologies.

(U) A fourth thrust will develop high-fidelity diagnostic imaging, particularly in biomedical applications of Computed Tomography (CT), ultrasound, infrared (IR), and conventional X-rays. For example the particular problem that is encountered in ultrasound imaging is that the medium (i.e., human) tissue is inhomogeneous and scatters the signal, which blurs the image. The process for developing high-resolution imaging will build upon the emerging technology of adaptive acoustics, the displays of which are intuitive and easily interpreted by the combat medic and physician.

(U) A fifth thrust provides "proof of concept" demonstration for the development of powerful generalizable methodologies leading to vaccines, prophylactics and therapeutics effective against broad classes of biological warfare (BW) threat agents. Specific targets include bacterial, viral and bio-engineered threat organisms.

(U) In the other segment of the Defense Healthcare Technologies program, the development of an advanced health care information infrastructure supports the entire trauma care technology base. Medical information must flow seamlessly and transparently on all levels of patient care. For this to occur, a platform-independent medical record system, such as the battlefield electronic patient record (BEPR), will ensure immediate continuity, distribution, and accessibility of medical information from the forward battlefield to the rear echelon support in U.S. based medical centers. This information will be achieved in multimedia heterogeneous databases of laboratory studies, radiologic and pathologic images, inpatient medical records, and be available over a world wide telecommunication system for real-time interactive collaboration among physicians. In addition, the infrastructure will provide a clinical associate system which is an intelligent system that assists physicians, nurses, corpsmen and paramedics in assessing and treating patients.

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(U) This work does not duplicate any efforts of the Military Services or the National Institutes of Health. A Memorandum of Agreement exists between the Army Medical Department and ARPA.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Advanced Biomedical Technology ($5.5M): The basic research portion of this effort is in PE 0601101E, Project MS-01.
  - Demonstrated working prototype of Personnel Status Monitor (PSM) with geolocation, communication and vital signs (pulse rate, Electrocardiogram (EKG), respiratory rate), prototype medic hand held unit with locator and reception of vital signs.
  - Demonstrated 2nd generation telesurgical system with two robotic arms, 5 degrees of freedom (DOF), mounted in an armored vehicle (M577).
  - Demonstrated completed shell of life support for trauma and transport (LSTAT) with full integration of NATO stretcher and functional demonstration of respirator, vital signs monitor.
  - Demonstrated 1st generation (tissue deformation) of simulated combat wound (to replace animal wounding for combat medic training) with gunshot wound to the mid thigh derived from the National Library of Medicine (NLM) Visible Human dataset.
  - Demonstrated insertion of dismounted warrior into the virtual battlefield using 1st generation I-Port device and JACK figure (the simulated human dismounted combatant) over a Defense Information System (DIS) compatible network.
- Health Care Information Infrastructure. ($9.1M)
  - Developed software architecture for a user-oriented associate system that captures ambulatory care data directly from physicians during patient visits.
  - Developed associate system that provides trauma guidelines directly to medics during emergencies and combat care scenarios.
  - Demonstrated shared electronic, graphic based planning and collaboration tools for multiple users in a distributed health and human services associate system.

(U) FY 1996 Program:

- Advanced Biomedical Technology. ($15.4M)
  - Integrate into the Personnel Status Monitor (PSM) closed-loop control algorithms for fluid infusion and mechanical ventilation support. Design probable conformal versions of soldier-worn units.

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- Incorporate trauma mimicry into the trauma extremity simulator.
- Integrate haptic feedback and orbital lag-time solutions into Remote Telepresence Surgery.
- Develop basic design of critical care pod.
- Continue development of blood chemistry parameter analytic modules into portable Stat-Lab.

• Health Care Information Infrastructure. ($10.2M)
- Integrate models of combat doctrine and knowledge-based decision support tools (combat casualty protocols and guidelines) in support of combat medics and physicians.
- Demonstrate hands-free capture of patient data under battlefield conditions.
- Create reference architecture for generalized associate system.
- Demonstrate integration of battlefield electronic patient record with peacetime care systems.

• 3-D Ultrasound Technologies. ($3.5M)
- Develop battlefield/trauma ultrasonic imaging technology for 3D interpretation of body structures.
- Examine Synthetic Aperitive Radar processing techniques to determine those features which are pertinent to the ultrasonic imaging problem; begin testing algorithms which could mitigate the contribution of multiple scattering sites to image degradation.

• Biological Warfare Defense. ($3.0M)
- Characterize immune response to sonicate inoculation in a total of 6 bacterial, viral and bio-engineered threat species.
- Demonstrate immunoprotection in laboratory animals.

(U) FY 1997 Program:

• Advanced Biomedical Technology. ($19.6M)
- Incorporate miniaturized Global Positioning Satellite (GPS) chip into PSM for the transmission of vital sign and situational awareness data to battalion level command.
- Incorporate trauma mimicry and morphing of the axial trunk musculosketetal and organ system into surgical simulation.
- Develop surgical tools for remote telepresence, robotically controlled, and coupled in force-feedback loops for enhanced operational dexterity.
- Begin develop of pharmacologic hibernant sensor-based administration device for drug cocktail injection for the individual combatant.
- Extend the development of portable digital X-ray to 20 x 20 cm detector array, for field use.

• Health Care Information Infrastructure. ($6.0M)
- Demonstrate feasibility of protocol based care in all outpatient clinics.
- Demonstrate performance gains of advanced software engineering collaborators.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07

- 3-D Ultrasound Technologies. ($1.5M)
  - Continue to develop and implement the techniques of adaptive acoustics to ultrasonic imaging, utilizing 2-D sensor arrays and image processing.
- Biological Warfare (BW) Defense. ($2.0M)
  - Identify multiple protective antigens (for 2 key threat agents). This provides basis for development of recombinant vaccines, prophylactics and therapeutics able to overcome "resistant" strains of BW threat agents.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	14.9	29.1	29.3
Appropriated	14.6	N/A	N/A
Current Budget	14.6	32.1	29.0

(U) **Change Summary Explanation**:

FY 1996-97 Increase/decrease reflects minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Experimental Evaluation of Major Innovative Technologies	**581,818**	**619,535**	**619,322**	**627,876**	**652,011**	**733,213**	**751,757**	**Continuing**	**Continuing**
Command & Control Information Systems EE-21	51,099	63,508	89,179	126,300	131,000	139,169	139,034	Continuing	Continuing
Advanced Space Technology EE-27	8,381	0	0	0	0	0	0	0	181,489
Guidance Technology Program EE-34	9,114	25,888	29,673	25,000	21,600	21,000	20,000	Continuing	Continuing
Advanced Ship-Sensor Systems EE-36	32,368	16,561	28,605	31,910	65,508	87,816	99,696	Continuing	Continuing
Advanced Simulation EE-37	74,148	75,489	48,419	42,279	45,698	62,948	65,353	Continuing	Continuing
Unmanned Undersea Vehicle Systems EE-39	34,339	15,116	0	0	0	0	0	0	107,854
Critical Mobile Targets Systems EE-40	109,771	123,364	0	0	0	0	0	0	385,311
Air Defense Initiative EE-41	34,281	23,476	21,777	28,579	30,479	25,690	25,690	Continuing	Continuing
Global Grid Communications EE-45	43,289	45,108	42,024	48,392	33,916	32,750	39,549	Continuing	Continuing
Defense Simulation Internet EE-46	14,737	27,239	39,675	3,000	0	0	0	0	116,268

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Fast Ship/Future Ship EE-47	0	0	16,382	25,000	25,000	0	0	0	66,382
Combat Hybrid Power System EE-48	0	0	15,000	20,000	20,000	10,000	0	0	65,000
Tier III Minus UAV EE-49	*(57,221)	24,675	14,749	5,000	0	0	0	0	44,424
Battlefield Awareness EE-50	0	0	95,201	109,866	113,155	124,400	126,787	Continuing	Continuing
Classified Programs EE-CLS	170,291	179,111	178,638	162,550	165,655	229,440	235,648	Continuing	Continuing

*FY95 was appropriated to the Defense Airborne Reconnaissance Program in PE 0305154D.

(U) **Mission Description**: This program element is budgeted in the Advanced Development Budget Activity because its purpose is to demonstrate and evaluate advanced research and development concepts. Funding for nine projects are requested in FY 1997 within this program element such as the Air Defense Initiative, Command and Control Information Systems, Advanced Simulation, and Global Grid Communications projects. A number of advanced concept technology demonstrations are funded within these activities and several projects have dual-use applications. A discussion of the most significant projects follows.

(U) The Air Defense Initiative (ADI) is examining innovative technologies to counter the airborne threat posed by cruise missiles and manned aircraft. Technologies under evaluation include sensor upgrades, data integration and identification improvements, and radar-absorbent materials research. Advanced infrared measurement and high resolution digital imagery systems are also under development, and a simulation and modelling effort is included to test and demonstrate ADI concepts.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

(U) Advanced Simulation efforts will provide a distributed, scalable seamless warfighting environment at the weapon level of detail that will ultimately provide a massive synthetic theater of war capable of supporting such requirements as readiness training, doctrine refinement, requirements analysis, battle management simulation, and contingency planning. Communications and data infrastructures, range instrumentation and computer image generation are just a few of the developmental activities funded in the Advanced Simulation program.

(U) The Global Grid Communication project will develop and demonstrate advanced communications technologies needed for defense and intelligence operations for the 21st century. The ultimate goal is deployment of a gigabit network that will be interoperable with commercial, optical and secure wireless networks.

(U) The Advanced Ship-Sensor Systems project develops and demonstrates advancements in a wide range of technologies used in ship sensor, signal processing mechanical systems and advanced maritime platforms to significantly enhance the capabilities of naval and maritime forces.

(U) This program element also includes efforts in Command and Control Information Systems, advanced Guidance/Targeting technologies, and the Defense Simulation Internet.

(U) Four new projects have been initiated: 1) Fast Ship/Future Ship (EE-47) is developing new ship designs capable of high speeds and naval battle support; 2) Combat Hybrid Power Systems (EE-48) efforts will develop a hybrid electric power system to power combat vehicles; 3) Tier III Minus UAV program (EE-49) will develop and demonstrate a Low Observable High Altitude Endurance Unmanned Air Vehicle System capable of providing the war fighter with the near real time ability to assess battlefield situations synaptically; and 4) Battlefield Awareness (EE-50) is addressing imagery data collection processing capabilities by developing a Semi-Automated Imagery Processing advanced concept technology demonstration to enhance battlefield situational awareness. This effort embodies sensor assets, exploitation of sensor products, and integration of sensor exploitation products with other intelligence data.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Command Control Information Systems EE-21	51,099	63,508**	89,179	126,300	131,000	139,169	139,034	Continuing	Continuing

* Total does not include $9.925 million for IMPACT, which was funded in PE 0603226E (EE-27) in FY 1995.

** Total does not include $19.2 million for the Joint Execution and Targeting Architecture (JETA) program which was funded in Project EE-40 in FY 1996 and is integrated into the Joint Forces Air Component Commander (JFACC) Initiatives program in this project for FY 1997 and the outyears.

(U) **Mission Description**: Recent military operations, e.g., Desert Storm and Haiti, demonstrated that current theater command, control, communications, intelligence/information systems, planning and rehearsal systems, and non-lethal weapons capabilities lack the ability to support effective operations in diverse new arenas and scenarios ranging from desert heavy battle to urban areas with large civilian populations. Current capabilities do not provide critical interoperable wide-area communications and fail to provide real-time situational awareness, decentralized battle planning, rehearsal and execution capability, and flexible interfaces. The goal of the programs in this project, described individually below, is to enhance information processing, dissemination and presentation capabilities by inclusion of information concerning enemy and friendly forces, providing a joint situational awareness picture (through the Joint Forces Air Component Commander (JFACC) Initiatives, Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) and the Advanced Joint Planning (AJP) ACTD); providing multi-media information interfaces to on-the-move users (through the Unmanned Aerial Vehicle (UAV) Communications Node (UCN) and the Speakeasy programs); and providing other battlefield synchronization tools (using as testbeds the Command and Control for Joint Early Entry (CCJEE) and Commercial Communications Technology Testbed (C2T2)).

(U) The Joint Forces Air Component Commander (JFACC) Initiatives program seeks to develop key advanced technologies that will markedly improve the commander's ability to conduct air operations effectively and efficiently. Key technologies include: centrally managed, multi-stage, concurrent plan generation; intelligent strike resource scheduling techniques; dynamic resource reallocation algorithms; adaptive cueing tools; automated information routers; and information tailoring tools. These technologies will be applied to requirements that include: continuous mission planning processes which quickly anticipate and react to emerging targets; full integration of intelligence and operational activities to support strike operations and prioritized target nomination; empowerment of cross functional product teams to quickly respond to changes; and proper battlefield knowledge to support activities and decisions at multiple echelons.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) Emerging technologies in Command and Control planning promise significant enhancements in operational readiness, planning and crisis response. The Advanced Joint Planning (AJP) ACTD seeks to integrate and install selected advanced planning tools, in a distributed collaborative environment at US Atlantic Command (USACOM), to evaluate the potential for enhancing Battle Staff Command and Control capabilities. Based on the evaluation results of this selected subset of planning tools, a full set of tools will be integrated into the USACOM Battle Staff Planning System. This "leave behind" system will form the model for upgrades to other CINC's Planning Systems.

(U) The objective of the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) is to deliver a synchronized, consistent description of the battlefield, allowing the field commander to design or adapt his command and control system to mission needs for effective application of force. The description of the battlefield provided to the warfighters under this ACTD will be tailored to their mission needs by intelligent selection of information to be broadcast and intelligent request (pull) and filtering at the warfighter workstation so that needed information is available. The ACTD focusses on the dissemination of the data required to present a consistent description of the battlefield and will provide the required infrastructure, information management capabilities, user applications and interfaces to intelligently manipulate data products, apply commercial direct broadcast technology for wide-band, low-cost dissemination of multi-media information and provide tactical internet services for two-way communications. A set of applications will be included in the ACTD to support the warfighter in the extraction of information about threats and other important aspects of the battlefield from nearby and remote real-time sensor data streams, intelligence sources and stored data bases. BADD will be evaluated through participation in exercises, demonstrations and ongoing pilot services.

(U) The Unmanned Aerial Vehicle (UAV) Communications Node (UCN) will develop a communications payload for UAVs that will provide robust gateway, bridging, routing and multimedia communication services for Joint Task Force (JTF) early entry forces and mobile warfighters deployed beyond fixed tactical communication infrastructures. UCN will support information transport requirements, providing situation awareness, planning and rehearsal and JTF coordination.

(U) Speakeasy will develop modules of a multiband, multimode, programmable, digital radio capable of communicating with a wide variety of existing military and civilian radios. Improved data flow within and across Services will result in long-term cost savings through a common, interoperable tri-Service radio. Speakeasy will be interoperable with all elements of the Command and Control for Joint Early Entry (CCJEE), as well as with legacy systems, providing enhanced connectivity and communications service in situations where commercial communications may be inadequate, or specialized communications, such as anti-jam or low-probability of intercept capabilities are needed.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) The Command and Control for Joint Early Entry (CCJEE) program (formerly called the Command and Control Information Systems) will develop techniques for joint battlespace interoperability and synchronization of maneuver, fire support and intelligence functions, employing technologies that will enhance lethality and survivability of Early Entry Forces in joint operations. CCJEE will develop modular software that turns Early Entry data into relevant information/knowledge generating force multipliers to enhance battlespace synchronization while addressing varying timeliness and resolution requirements at different echelons. CCJEE serves as the integrating concept and mechanism for the functional and communications capabilities being developed in C2T2 and Speakeasy.

(U) The Commercial Communications Technology Testbed (C2T2) will extend the commander-level information processing and rehearsal capabilities developed in CCJEE down to individual dismounted soldiers. C2T2 will focus on providing local coordination and targeting information as well as a system/process for evaluating commercial communications products for dismounted applications through a "plug and play" interface. The system will provide dismounted soldiers with a wearable system, including heads-up displays and micro-processors to provide position/location and image transfer capabilities. Because the system will have both short and long-range communications, it will be used in conjunction with the Army's Advanced Warfighting Exercise JRTC 96-02 to evaluate multi-squad coordination, soldier interactions with remote sensors and weapons, and special situations such as air/ground data transfer for rapid-response coordinated attacks on snipers, mortars, and ambush teams.

(U) Military Operations in a Built-up Area (MOBA) will develop an integrated set of advanced technologies designed to provide timely and accurate operational awareness to significantly enhance force effectiveness in an urban environment. MOBA will enhance and supplement technology, equipment and systems which address the unique capabilities required to support military operations within the urban environment.

(U) Under the Joint Casting program, current casting process emissions are being characterized and new casting practices developed to reduce the emissions of foundries in anticipation of Clean Air Act standards for volatile organic compounds and other pollutants.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- CCJEE: Initiated evaluation of Army Deep Operations Center System (ADOCS) for adaptation to an Early Entry battle management system capability; effort started to investigate/design inference engine to provide

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monitors/triggers events for real-time situational awareness; began development of rehearsal capability through extension of simulation technology. ($2.2M)

- Speakeasy: Completed Phase I interoperability and programmability demonstration with GFE Single-Channel Ground and Airborne Radio System (SINCGARS), Have Quick and HF radios; demonstrated advanced bridging functionality between SINCGARS, Have Quick and police in Joint Warrior Interoperability Demonstration (JWID) '95; awarded Phase II contract. ($6.0M)
- Commercial Communications Technology Testbed (C2T2): Conducted squad, platoon and company level demonstrations of leveraged advanced civilian personal communications and computation technology for dismounted soldiers and vehicles, in military operational training/test environment. Linked situation awareness and intelligence to ground soldiers. ($8.8M)
- SECURES initiated development of a deployable urban environment gunshot detection sensor grid. ($1.5M)
- Operations-Other-Than-War (OOTW): Issued BAA for contracts to develop covert tags using a family of small modular low power devices to perform functions of sensing, navigation, and communications; and unobtrusive antennas. Developed and demonstrated quick reaction body armor inserts to replace current Ranger vest; conducted materials assessment demonstration for advanced materials for helmets and covert armor; and released BAA for improved torso armor development. Prepared program plans to demonstrate connectivity of multi-user private wireless connectivity to databases and decision support tools and for telemedicine demonstration with military and civilian facilities. ($17.1M)
- Advance Joint Planning (AJP) ACTD: Initiated the development of metrics for and integration, demonstration and installation of selected advanced technology planning tools in a distributed collaborative environment with the United States Atlantic Command (USACOM) operational sponsorship to support readiness, planning and crisis response. ($4.9M)
- Joint Casting: Focus to date has been on metals and processes used in the automotive industry and not the high-end alloys used primarily in aerospace (funding provided via other PEs). Beginning in mid-FY 1995 the program began to investigate aerospace alloy casting emissions and other DoD relevant foundry operations. ($10.6M)

(U) <u>FY 1996 Program</u>:

- CCJEE: Design, develop and integrate real-time battle management system, integrate friendly semi-automated forces (SAFORs) and interface for live data feeds. In conjunction with Army Battle Command System, RFPI ACTD and USMC Joint C4I Technology Demonstration/Regimental Combat Operations Center programs, evaluate

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component concept demonstrations with early entry scenarios at the operational level. Design and plan demonstration of integrated CCJEE, Speakeasy and C2T2. ($2.5M)

- Speakeasy: Continue the development of advanced technologies for the Speakeasy multiband, multimode modules and hold first of four model year demonstrations to allow incremental user evaluation and feedback. ($16.3M)
- Demonstrate C2T2 in the integrated demonstration provided by the Advanced Warfighting Experiment JRTC 96-02. Evaluate C2T2 impact on integrated execution of Special Operations Forces (SOF) and tactical operations for efficiency of concurrent operations and fratricide avoidance. Develop and demonstrate improved, reduced cost communication system based on emerging technologies. ($7.6M)
- MOBA: Develop an integrated set of advanced technologies to provide operational awareness to enhance force effectiveness and synthetic environment to address the unique set of functionality required to support activities ranging from architecture assessment to individual training that support improved operations in an urban environment. Finalize the formulation of an architecture for Military Operations in a Built-up Area (MOBA) to provide the focus for the assessment of the contributions of technology alternatives to the enhancement of military operations in an urban environment. ($17.8M)
- Advanced Joint Planning ACTD: Evaluate metrics of installed planning tools. Based on the results from previously installed planning tools, integrate and demonstrate additional planning tools which will result in a completed integration of planning tools at United States Atlantic Command (USACOM). Expand the functionality of systems to crisis response; and evaluate the installed planning tools and associated metrics under operational conditions for future design incorporation. ($15.0M)
- Battlefield Awareness and Data Dissemination (BADD) ACTD: Demonstrate initial capability in JWID 96 and deliver to 2nd Armored Division. Demonstrated Warfighter Associate functions will include: local databases, filtering on tags, profiles, requests, static/dynamic visualization, and video interaction. Demonstrated Information Dissemination Manager functions will include: repository, object tagging, and video/data broadcast. ($4.3M)

(U) FY 1997 Program:

- CCJEE: Design, develop and integrate enemy SAFORs, embedded knowledge acquisition systems and robust C4I distributed architecture. ($10.4M)
- Speakeasy: Continue development of hardware and software technology for the Speakeasy demonstration radio and conduct Model Year 2 demonstration. Transition technology. ($5.2M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

- UCN: Design a UCN relay payload, establish a UCN ACTD, develop test and begin demonstrations in a system integration laboratory environment. ($10.0M)
- Commercial Communications Technology Testbed (C2T2): Complete integration of C2T2 with other Service systems, demonstrate improved system in a warfighting exercise, and transfer stand-alone technology. ($2.4M)
- Advanced Joint Planning ACTD: Based on prior year evaluation, complete the design, accomplish modifications and installation of a "leave behind" operational system, which can then be replicated for other CINCs. ($9.0M)
- Battlefield Awareness and Data Dissemination (BADD) ACTD: Participate and be evaluated in Force XXI Army Warfighting Experiment. Capabilities and Services to be evaluated include: Information Dissemination Manager node at ADJPO, IPL at USACOM, leased GBS commercial satellite, fused red and blue ground-order-of-battle picture, and integrated image, video, signals intelligence, terrain, Global Command and Control System and Maneuver Control System data. ($32.2M)
- Joint Forces Air Component Commander (JFACC) Initiative: Initiate the development of a prototype system consisting of a continuous planning and execution infrastructure, integrated surveillance and strike planning tools, and optimized scheduler algorithms. Select campaign plan comparison techniques and initiate plan visualization and evaluation technologies. ($20.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	55.6	61.4	38.6
Appropriated	45.3	N/A	N/A
Current Budget	51.1	63.5	89.2

(U) **Change Summary Explanation**:

FY 1995 Increase reflects initiation of Advanced Joint Planning ACTD.
FY 1996-97 Increases reflect funding of the Battlefield Awareness and Data Dissemination (BADD) ACTD.

(U) **Other Program Funding Summary Cost**: N/A

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(U) **Schedule Profile**:

Plan	Milestones
Oct-Dec 95	Soldier testing of commercial communications system for dismounted operations and assessment of alternative missions.
Jan 96	Review Speakeasy Phase II system design.
Feb 96	Complete the integration of AJP-ACTD planning tools at USACOM.
Jun 96	Complete initial architecture for CCJEE.
Jun 96	Initial BADD capability to 2nd AD.
Jul 96	Expand the AJP-ACTD functionality of systems to crisis response.
Aug 96	Demonstrate Speakeasy Model Year 1 initial capability.
Sep 96	Evaluate the installed AJP-ACTD planning tools and associated metrics under operations conditions.
Sep 96	Demonstrate CCJEE real-time battle management system proof-of-concept.
Sep 96	Demonstrate BADD capability in JWID 96.
Sep 96	Initiate JFACC Initiatives Program.
Oct 96	Develop Program Plan for UCN ACTD.
Feb 97	Demonstrate novel advanced warfighting concepts using the improved commercial communications testbed.
Feb 97	Demonstrate friendly SAFORs and CCJEE battle management system.
Feb 97	Support Task Force XXI Advanced Warfighting Experiment.
Apr 97	Demonstrate a prototype simulation environment capable of: representing Urban Warfare; conducting analysis of MOBA technology approaches; and evaluation of the contributions of MOBA technologies to operational effectiveness.
Aug 97	Demonstrate Speakeasy Model Year 2 open system architecture.
Sep 97	Conduct a UCN system integration laboratory demonstration.
Sep 97	Complete the design, accomplish modifications and installation of a "Leave behind" an AJP-ACTD operational systems.
Jan 98	Begin UCN integration onboard airborne platform.
Feb 98	Demonstrate enemy SAFORs, embedded knowledge acquisition system and distributed C4I architecture in CCJEE.
Apr 98	Demonstrate early entry Brigade command entity.

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Apr 98	Demonstrate early entry Brigade command entity.
Jun 98	Demonstrate automated COA development and analysis, mission review/rehearsal and knowledge discovery in CCJEE.
Jun 98	Demonstrate prototype JFACC planning and execution infrastructure/tools.
Aug 98	Integrate Speakeasy into SICPS and participate in CECOM DBC ATD.
Sep 98	Deliver BADD pilot service OONUS.
Jan 99	Demonstrate real-time situational awareness, "what if" analysis for COA refinement, operational and tactical level rehearsal, transparent access to data and real-time analysis of heterogeneous databases in CCJEE.
Mar 00	Demonstrate CCJEE with Army/Marine forces in a joint CONUS exercise.
Sep 00	Complete BADD transition to DISA, GBS JPO and Services.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Space Technology System EE-27	8,381	0*	0	0	0	0	0	0	181,489

*In FY 1996 and subsequent years the IMPACT Program is funded in PE 0603226E, project EE-21.

(U) **Mission Description**: The Advanced Space Technology Program (ASTP) was aimed at achieving an affordability breakthrough in the development, launch and operation of satellite systems. To date, the goals have been to demonstrate low cost access to space with small launch vehicles; reduce the size, weight, power and cost of satellite components; and demonstrate first-generation lightweight satellite capabilities. This phase has formed a prerequisite technology foundation and has produced two new launch vehicles (the Pegasus Air-Launched Vehicle and the Taurus Standard Small Launch Vehicle), 10 small satellites and numerous advanced, miniaturized components. This phase of the program concluded with the launch of Taurus, on-orbit demonstration of DARPASAT and completion of the remaining technology projects.

(U) IMPACT is a multidisciplinary development program aimed at leveraging advanced technologies to reduce the life-cycle costs of all military satellite communications (MILSATCOM) terminals with associated reductions in size, weight and power consumption of MILSATCOM terminals and increased performance, reliability and capability. The program addresses broad technology efforts that span all MILSATCOM terminal programs with technology initiatives in support of next-generation terminals. Beginning in FY 1996, the IMPACT program is funded in Project EE-21.

(U) The Congressionally directed Large Millimeter Wave Telescope is a potential joint United States/Mexico program to build and operate an adaptive, high precision, wide bandwidth, 50-meter aperture millimeter wave radio telescope. The sites being considered in Mexico offer low humidity and ability to view both northern and southern skies. This telescope is being designed for a 1 arcsec pointing accuracy, which, if achieved, would better the current state-of-the-art for radio telescopes.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed technology developments for IMPACT; conducted technology design reviews. ($4.4M)
- Awarded contract to design and fabricate the large radome for the Large Millimeter Wave Telescope program. ($4.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-27

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	5.9	0	0
Appropriated	8.4	0	0
Current Budget	8.4	0	0

(U) **Change Summary Explanation**: N/A

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Guidance Technology EE-34	9,114	25,888	29,673	25,000	21,600	21,000	20,000	Continuing	Continuing

(U) **Mission Description**: Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively and with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geo-locate targets accurately in the same coordinate system (i.e. WGS-84) in which the weapon system navigates; (2) the weapon system has a precision navigation and guidance system on-board, plus weapons with effective endgame seekers; and (3) navigation and target location systems cooperate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. The advanced navigation and guidance technologies being developed in support of this goal are the Global Positioning System (GPS) Guidance Package (GGP), Sharpshooter, and technologies for direct acquisitions of the encrypted GPS precision position code. Both GGP and Sharpshooter technologies are applicable for both new or retrofit guidance/navigation packages for aircraft and weapons.

(U) GGP is the core component of the guidance technology project. It tightly integrates a miniature GPS receiver and an all solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a low cost ($15,000), precision navigation system. GGP Phase I addressed the technology issues involved in: (1) miniaturizing inertial grade inertial measurement units (IMUs) into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics receiver. A Memorandum of Agreement (MOA) has been signed and implemented to demonstrate a Phase 1 unit on an Army Bradley Fire Support Team Vehicle (FIST-V). GGP Phase 2 requirements place more stressing demands on performance of MIMU components and call for further reductions in size, power and weight. An MOA has been signed with the Navy designating GGP Phase 2 as the Navy's Advanced Integrated Navigation and Control Package. This project also encompasses development of miniature, highly accurate clocks and receiver upgrades to enable direct acquisition of the encrypted GPS precision positioning code. Payoffs include immediate acquisition of the encrypted GPS code (e.g., by a missile after launch) or reacquisition of the code after temporary loss of GPS signals.

(U) Sharpshooter will demonstrate an integrated, advanced technology, precision strike capability. The importance of minimizing collateral damage and fratricide, as well as coping with the adverse effects of weather, was

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dramatically illustrated in Desert Storm and other more recent operations. The high cost of today's guided weapons is largely driven by the need for complex, expensive seekers to compensate for weapon navigation system inaccuracies, target location uncertainties and poor weather conditions. These seekers need to operate at long-ranges with wide search areas and large processing loads. Accurate navigation and guidance, using Global Positioning System (GPS) and solid state inertial navigation technologies, and precision, low power clocks with associated GPS receiver upgrades will enable more accurate target location and provide seeker operations at shorter ranges with smaller search areas and smaller processing loads. Sharpshooter will incorporate accurate navigation and guidance by integrating and demonstrating use of GPS Guidance Package (GGP) units on an air-to-surface weapon. GGP reduces the weapon's midcourse errors and the resultant target location errors for which weapon seekers must compensate. Sharpshooter payoff will be the demonstration of range-invariant, 3-meter circular error of probability (CEP) guidance accuracy in integrated carrier platform, weapon and seeker configurations. Technologies will be integrated and exploited to demonstrate the simplest, most affordable terminal seekers to satisfy the 3-meter CEP demonstration goals.

(U) **Program Accomplishments and Plans**

(U) FY 1995 Accomplishments:

- Delivered Phase 1 Guidance Package (GGP) brassboards for testing GGP. ($.5M)
- Completed test and demonstration of GGP on the Army FIST-V. ($.4M)
- Initiated Government laboratory and field evaluations of GGP Phase 1 brassboards. ($.6M)
- Initiated two competing GGP Phase 2 designs. ($2.1M)
- MSAG - designed and developed a 100-tile test array which will demonstrate an active conformal array for full duplex operation in a satellite link for testing on a Medium Altitude UAV. ($5.5M)

(U) FY 1996 Program:

- Continue Global Positioning System (GPS) Guidance Package (GGP) Phase 2 designs. ($12.2M)
- Initiate Sharpshooter flyable, integrated seeker brassboard design. ($8.0M)
- Initiate Sharpshooter user GPS receiver upgrades to provide improved location accuracies and improved transfer alignment to precision weapons. ($2.7M)
- Refine and evaluate components for the accurate, low power clock. ($3.0M)

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(U) FY 1997 Program:

- Complete GPS GGP Phase 2 designs and begin fabrication of two competitive GGP units. ($17.0M)
- Develop user GPS receiver upgrade components to provide positional coordination among surveillance and strike platforms and to provide improved accuracies. ($1.7M)
- Evaluate completed, packaged, low power clock units. ($1.0M)
- Reserve for reprogramming for ACTDs. ($10.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	10.1	26.2	29.7
Appropriated	9.1	N/A	N/A
Current Budget	9.1	25.9	29.7

(U) **Change Summary Explanation**:

FY 1996 Reflects minor repricing of GGP Phase 2 designs.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Feb 96	Complete Government evaluation of Phase 1 units.
Mar 96	Initiate Sharpshooter flyable brassboard design.
Dec 96	GGP Phase 2 critical design review.
Oct 98	Complete GGP Phase 2 contractor testing.
Dec 98	Develop integrated direct P(y) code GPS receivers for real time demonstration.

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COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost

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COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Ship-Sensor Systems EE-36	32,368*	16,561*	28,605	31,910	65,508	87,816	99,696	Continuing	Continuing

*This project incorporates programs under PE 063226E, Project EE-39 and PE 0603569E, Project AS-01.

Project EE-39	(34,339)	(15,116)
Project AS-01	(31,575)	(9,501)

(U) **Mission Description**: The objectives of this project are to develop and demonstrate advanced systems concepts and to pursue critical enabling technologies for maritime systems that will counter the threat created by the world-wide spread of increasingly sophisticated military technology. The evolving threat of quiet diesel submarines, the proliferation of sophisticated submarine and weapons capabilities, and the growing stockpile of underwater mines available to third world countries necessitates the development of far-term solutions for increasing ship affordability and enhancing our operating capabilities in the littoral. This project will provide advanced technologies to enhance the capabilities of naval forces to more effectively operate "...forward from the sea" in a broader range of tactical environments.

(U) The Advanced Ship-Sensor Systems Program includes Sonar Technology, Advanced Ship Mechanical Systems, and Advanced Maritime Platforms. In the Sonar Technology area, applications of advanced object detection, classification, and localization technologies using High Performance Computing (HPC) are demonstrated. Active and passive sonar techniques are applied, using advanced sources and sonar systems built from distributed elements or concentrated arrays. Advanced signal processing techniques to integrate real-time information and background intelligence into the operational situation is also included. These applications will result in enhanced Anti-Submarine Warfare (ASW) capability against diesel-electric submarines operating in shallow water. In the Advanced Ship Mechanical Systems area, technologies such as precision active structural controls, actuator and sensor systems and high speed digital signal processing are being developed. These technologies will result in reduced ship acoustic signatures, high performance/high reliability propulsion systems, and increase ship system affordability. Advanced Maritime Platforms focuses on the technologies for large offshore structures, innovative ships and ship systems to provide the multi-mission, sustained presence capability required for joint operations associated with future regional conflicts.

(U) Commencing in FY 1997, this project will incorporate programs formerly under the Submarine Technologies Project (AS-01) and the Unmanned Undersea Vehicle (UUV) Project (EE-39). These projects are reported separately in their

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respective Budget Item Justification Sheets for FY 1995 and FY 1996. Innovative technologies to significantly enhance submarine stealth and survivability including hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables will continue to be developed and demonstrated. They form the basis for efforts addressing affordability through improvements in structural acoustic design capabilities, innovative machinery mounting systems and high reliability propulsion systems. The Supercavitation Technology Program will continue to address the physics of launching and propelling underwater bodies at velocities approaching the speed of sound in water and demonstrate the capability to destroy underwater targets. Unmanned Undersea Vehicle (UUV) technologies under development include a Synthetic Aperture Sonar (SAS) system to increase underwater search rates; advanced acoustic communications that will enable tether-free control of minehunting UUVs; a micro-miniaturized tactical weather station able to scavenge energy from the environment and provide needed meteorological/oceanographic measurements; small autonomous taskable machines for mine neutralization in, and near, the surf zone; and a clandestine surveillance system employing autonomous taskable machines.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued development and testing of autonomous multistatic active technologies for shallow water environment tactical sonars. ($4.1M)
- Conducted proof-of-concept tests and provided initial assessment of multistatic shallow water active surveillance. Conducted at-sea ASW technology demonstration in Korean Strait. ($3.8M)
- Accelerated development of autonomous diesel electric submarine detection and classification technologies and conducted laboratory demonstration of candidate systems. ($3.0M)
- Restructured scene management to accommodate autonomous detection effort. Demonstrated high frequency tactical active sonar processing and scene generation capability. ($1.7M)
- Completed development and testing of polymer transducer array modules. ($.7M)
- Continued development of impulsive sources by extending capability to very shallow water and environmental adaptability. ($1.7M)
- Initiated development of technology for a small craft that would be reconfigurable for different missions in support of operations in shallow, littoral waters. ($1.8M)
- Initiated preliminary design for a Mobile Offshore Base. Completed preliminary design of the Landing Ship/Causeway (LSQ/C) concept. Prepared preliminary and sub- and full-scale demonstrations of critical technologies. ($14.1M)

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- Developed capability to assess alternatives for collection and relocation of coastal and harbor sediments (deep ocean relocation) using advanced interactive modeling/simulation. ($1.5M)

(U) FY 1996 Program:

- Complete development of multistatic active adaptive processing and impulsive sources for shallow water tactical sonars. Complete assessment of potential of multistatic active adaptive technology. Conduct fleet Anti-Submarine Warfare (ASW) demonstration of multistatic active tactical processor. ($5.8M)
- Initiate development of Automated Multi-static Active/Passive Receiver System (AMARS) ($4.2M)
- Accelerate autonomous ASW detection effort and extend to multi-targets and broader application to fleet systems. Deploy and evaluate initial (one class) autonomous submarine detection technology package. ($4.0M)
- Initiate planning for integrated ASW scene demonstrations. ($2.6M)

(U) FY 1997 Program:

- Conduct final at-sea ASW demonstration of environmentally adaptive shallow water active sonar technology in conjunction with single/few platform scene generation capability. ($2.3M)
- Experimentally validate the physics of supercavitation and perform preliminary designs of hypervelocity gun and high speed torpedo. ($3.1M)
- Complete proof-of-concept system of Automated Multi-static Active/Passive Receiver System (AMARS) and plan for FY 1998 basic concept demonstrations. ($4.2M)
- Continue development of autonomous ASW multi-target detection technology. Prepare for sea test and demonstration. ($3.9M)
- Fabricate and test a prototype active transmission vibration isolation mount. ($4.0M)
- Continue development of a clandestine system of taskable machines to neutralize mines, clear obstacles, and mark safe areas in the surf zone and shallow waters. ($.8M)
- Continue development and testing of high-speed, long range, robust, and compact underwater acoustic communications. ($2.5M)
- Conduct at-sea testing of high resolution long range 2D synthetic aperture sonar. Design and analyze 3D algorithms. ($2.3M)
- Deploy and demonstrate prototype micro weather system for tactical meteorology (METOC). ($3.4M)
- Conduct at-sea demonstration of drag reduction, maneuvering control, and signature control using Electromagnetic Turbulence Control (EMTC) on a large scale vehicle. ($2.1M)

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(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	34.3	16.5	33.5
Appropriated	32.6	N/A	N/A
Current Budget	32.4	16.6	28.6

(U) **Change Summary Explanation**:

FY 1995-1996 Reflects minor program repricings.

FY 1997 This project incorporates programs formerly under the Submarine Technologies Project (AS-01) and the Unmanned Undersea Vehicle Project (EE-39). Reflects PDM change (FY 1997) and the transfer of the Military Operations in Build-up Areas (MOBA) program to the Advanced Land Systems Technology Project TT-04 in PE 0602702E.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
2QFY96	Deploy basic version of autonomous diesel electric submarine detection and classification technology.
4QFY96	Complete development of multistatic active adaptive processing for shallow water tactical sonars.
4QFY96	Complete Large-Scale Demonstration of advanced Aeroderivative Engine active control technology.
4QFY96	Conduct at-sea demonstration of an active tactical acoustic system for shallow water environment.
4QFY96	Complete preliminary design for a Mobile Offshore Base (MOB) concept.
4QFY96	Demonstrate simulation and visualization techniques of dredged material isolation process.
1QFY97	Begin selected Critical Feasibility Demonstration Experiments for Mechanical Technology Initiative.
1QFY97	Conduct high resolution long range Synthetic Aperture Sonar (SAS) at-sea testing.
1QFY97	Complete active transmission vibration isolation mount prototype test.
2QFY97	Demonstrate Electromagnetic Turbulence Control (EMTC) at-sea on a full scale marine vehicle for acoustic quieting, drag reduction, and signature control.

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2QFY97	Demonstrate breadboard system design of micro weather system/buoy.
4QFY97	Complete proof-of-concept of automated multi-array processing system.
4QFY97	Complete preliminary designs of supercavitation projectile, launcher, and high speed torpedo technology demonstrators.
4QFY97	Demonstrate prototype active transmission vibration isolation mount.
1QFY98	Conduct Anti-Submarine Warfare (ASW) autonomous multi-target detection capable technology at-sea demonstrations.
1QFY98	Complete airframe shake test of active transmission vibration isolation mount.
2QFY98	Conduct ASW Automated Multi-static Active/Passive Receiver System (AMARS) demonstrations.
2QFY98	Conduct at-sea demonstration of deployed micro weather station.
4QFY98	Demonstrate high-speed, long range, compact acoustic communications system.

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COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Simulation EE-37	74,148	75,489	48,419	42,279	45,698	62,948	65,353	Continuing	Continuing

(U) **Mission Description**: The strategic environment in which the United States operates places emphasis on joint crisis response and requires coordinated joint and Service training programs to ensure readiness. Resources will continue to shrink, requiring the Department to search for the most cost effective ways to address the threat across the full spectrum of military activity. To support the new National Military Strategy, the Advanced Distributed Simulation program is developing advanced interoperable technologies to effectively and efficiently construct a robust variety of synthetic battlespaces that will enable fundamental changes in how mainline defense functions are accomplished in the post Year 2000 timeframe. The ultimate goal is to provide cost effective tools and standards necessary to create seamless warfighting simulation battlespace, with resolution at the weapons system level of detail and capable of representations of a theater of war supporting the following functions: joint/service readiness training; joint/service doctrine refinement and development; requirements analysis; design, prototyping and manufacturing; and contingency planning, operations, after action review, early entry command and control information system for battle management and historical analysis. Specific efforts being undertaken as part of this project include the Synthetic Environment development, Synthetic Forces development, Networking and Information transfer development, Early Entry Command and Control Information Systems Technology Development, Integrated Product & Process Development, and the Synthetic Theater of War (STOW). As technologies mature, they will be integrated, tested and demonstrated in exercises of increasing size, complexity and utility.

(U) The Synthetic Environment program concentrates on the creation of synthetic environments for simulation including representation of static and dynamic terrain, weather and environmental phenomena, and diurnal variations. The Synthetic Forces Program creates a scalable, computer-generated military force that is representative and behaviorally accurate with resolution of battle outcomes at the weapon system level of detail. The Networking and Information Transfer Program investigates and develops the communication, networking and information transfer battlespace technologies necessary to take full advantage of capabilities offered by the next generation communication networks. These technologies facilitate efficient and cost effective utilization of evolving network infrastructure while supporting the requirement to represent 100,000 entities interoperating over the network in perceptible real time. The Early Entry Command and Control Information Systems technology program relates to development of a robust simulation environment capable of situational representations facilitating evaluations of a multi-level, joint battle management system. The Integrated Product and Process Development simulation provides a

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distributed toolbox of simulation tools linking concurrent engineering of land vehicles with the warfighting environment for the purpose of test and evaluation. The Advanced Simulation Technology Program focuses research and development efforts on creating a battlefield situational awareness simulation capability integrated with real world C4I systems.

(U) The Synthetic Theater of War (STOW) program is an integral element of the Advanced Simulation Technology Program, and has been designated an Advance Concept Technology Demonstration (ACTD) by the Deputy Under Secretary of Defense for Advanced Technology. STOW integrates simulation technology developments to create a seamless synthetic battlespace to support joint training and mission rehearsal.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated unique solutions for an advanced technological network accommodating the unique demands of 5,000 interactive, dynamic entities interacting in a coherent manner across distributed local, (metropolitan), and wide area networks. Provided technical solutions enabling networking of heterogeneous simulations, simulators, and operational equipment. ($4.9M)
- Continued development of an environmental sub-architecture consistent with advanced distributed simulation development; demonstrated prototype environmental representations integrated with semi-automated forces; prototyped high fidelity terrain database in an operational scenario; continued environmental representation development focused on dynamic environmental effects, dynamic terrain representation and weather effects; continued development of synthetic battlefield data bases to support the Synthetic Theater of War (STOW) 1997 exercise. ($8.3M)
- Continued development and demonstrated prototype synthetic forces architecture and creation of baseline intelligent software command entities within that architecture. Developed and demonstrated increasingly more capable Synthetic Forces representing a wider range of combat forces and characterized by more accurate behavioral representation. ($20.0M)
- Continued development of a capability to support seamless land/sea/air warfighting simulation environment representing 15,000 entities operating with a high degree of realism, fully integrated and supportive of service and joint operational concepts. ($14.2M)
- Initiated development of advanced simulation technologies to provide improved capability to the post STOW-97 objective system. These included advances in software development techniques, architecture analysis and tools for the ADS programs. ($4.4M)

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- Continued to develop and integrate advanced distributed simulation technologies designed to support this optimum mix of training aids, devices, simulations, simulators and field training to intensify conventional training methods for an armored brigade. ($16.7M)
- Initiated design of components for an early entry command and control information systems environment capable of situational representations facilitating evaluations of battle management concept. ($1.1M)
- Validated performance of high-fidelity engineering work stations and motion-based simulator by comparing simulations with actual land vehicle tests. This experiment demonstrated technology developed in PE 0602702E, TT-04. ($4.6M)

(U) FY 1996 Program:

- Continue to develop and demonstrate expanded network and computer technologies supporting interaction of as many as 10,000 entities on the synthetic battlefield in a coordinated exercise, networking platform level synthetic forces with company/battalion level synthetic command entities. ($5.0M)
- Continue to improve and demonstrate the technology necessary to represent a synthetic battlespace to include increased fidelity of terrain and environmental effects (e.g. fog, smoke, haze, diurnal effects, etc.); continue development of terrain and environmental data bases to support Synthetic Theater of War (STOW) 1997. ($6.3M)
- Continue development of synthetic forces command entities; expand development of synthetic forces to include representations of additional battlespace entities for all services, continue to improve functionality of other synthetic forces. Develop and test a set of standard interface specifications capable of accommodating a variety of technical architectures which represent service unique command and operational features. ($25.4M)
- Continue development of simulation operating systems, testing and integration of technologies, and development of the STOW Advance Concept Technical Demonstration (ACTD) simulation system to support the STOW-97 ACTD. ($22.1M)
- Continue development of advanced simulation technologies to include improved synthetic forces functionality, faster-than-realtime simulation, and improved efficiencies for synthetic generating simulations. ($7.9M)
- Develop component of an early entry command and control information system capable of situational representations facilitating evaluations of battle management concepts. ($4.1M)
- Develop the capability to utilize concurrent-engineering tools for land vehicle design, link to synthetic battlefield environments, and tie requirements to design through virtual prototypes. ($4.7M)

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(U) FY 1997 Program:

- Integrate and test expanded network and information transfer technologies supporting bandwidth demands created by an exercise of greater than 50,000 entities operating in a coherent, coordinated manner the synthetic battlespace. Integrate and demonstrate these technologies for the STOW 1997 ACTD. ($1.5M)
- Continue to develop and transition an improved synthetic environment sub-architecture capable of supporting advanced distributed simulation exercises; continue development of environmental technologies capable of supporting an environmentally robust battlespace to include interactive terrain, fog, haze, battlefield obscurant, diurnal effects. Integrate, and transition synthetic environment technologies to Synthetic Theater of War (STOW)-1997 Advance Concept Technology Demonstration (ACTD). Finalize STOW 1997 ACTD Terrain data base. ($5.3M)
- Continue to develop and transition a broad range of Synthetic Forces representing combat elements; integrate with a simulation architecture supporting a distributed command and control structure portraying in simulation the influence of one command level on the actions of the subordinate synthetic formations. Continue to develop and demonstrate increasingly more sophisticated behaviors representing an extended set of battlespace reactions such as situational awareness, reaction to the environment and tactical planning. Integrate, and transition synthetic forces technologies in STOW-97 ACTD. ($13.7M)
- Demonstrate and transition to the ACTD a prototype Joint Synthetic Theater of War prototype system supporting a seamless land/sea/air warfighting simulation environment capable of representing greater than 50,000 entities with a high degree of realism, supporting service and joint operational training while retaining the arbitration of battle outcomes at the entity level of detail. ($12.3M)
- Continue development of advanced simulation technologies. Integrate realworld information with simulation; prototype Faster-than-Realtime simulation based on entity level resolution; develop more behaviorally accurate and intelligent semi-automated forces; develop multi-dimensional analysis tools. ($15.6M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	82.7	79.1	44.3
Appropriated	78.7	N/A	N/A
Current Budget	74.1	75.5	48.4

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(U) **Change Summary Explanation**:

FY 1995 Decrease reflects Congressional reduction and a reduction in developmental effort for the early entry command and control information system and the concurrent engineering initiatives for land vehicle design concepts.

FY 1996 Decrease due to downscoping of the Synthetic Theater of War (STOW) program.

FY 1997 Increases reflect enhancement of STOW technology development required to meet STOW Advance Concept Technology Demonstration (ACTD) Management Plan.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 95	Conduct technical Engineering Demonstration #1 of integrated Synthetic Theater of War (STOW) technologies.
Sep 96	Demonstrate and assess the capability of concurrent-engineering tools for land vehicle design using engineering work stations, the driving simulator, and the synthetic battlefield.
Apr 96	Conduct technical Engineering Demonstration #2 of integrated STOW technologies.
Nov 97	Demonstrate ICW USACOM the STOW-97 Advance Concept Technology Demonstration (ACTD) Synthetic Theater of War capable of representing a JTF through a combination of virtual and constructive simulation with a high degree of realism and with outcomes arbitrated at the entity level of detail, for the purpose of mission rehearsal and training.

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COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Unmanned Undersea Vehicle Systems (UUV) EE-39	34,339	15,116	0	0	0	0	0	0	107,854

(U) **Mission Description**: The growing stockpile of underwater mines and the proliferation of weapons of mass destruction worldwide present a threat in both littoral warfare and strategic warfare situations. The objective of this project is to develop and demonstrate autonomous maritime systems and technologies to counter these threats. The Unmanned Undersea Vehicle (UUV) Program includes efforts in mine countermeasures (MCM) and enabling technologies for autonomous vehicles. In the MCM area, the Autonomous Minehunting and Mapping Technology (AMMT) Program is developing technologies to support Navy clandestine mine warfare requirements that will enable the autonomous location and classification of mines with sufficient precision for detailed minefield mapping and subsequent reacquisition by a neutralization system. The program is also developing Synthetic Aperture Sonar (SAS) to increase underwater search rates; small autonomous taskable machines for mine neutralization in, and near, the surf zone; advanced acoustic communications that will enable tether-free control of minehunting UUVs; electromagnetic communications for use in shallow water; atomic interferometers for precision navigation, and a high energy density power system to provide the range and endurance required for longer UUV missions. These efforts are coordinated with and support the long-range goals of the Navy UUV Program Plan. In FY 1997, this Project is merged with EE-36, Advanced Ship/Sensor Systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Configured Unmanned Undersea Vehicle (UUV) for at-sea testing; conducted modeling/simulation analysis. ($2.3M)
- Continued Autonomous Minehunting and Mapping Technologies (AMMT) development; prepared for at-sea demonstration of mine detection, classification, identification and mapping; tested small taskable machines for mine neutralization. ($6.1M)
- Developed Synthetic Aperture Sonar (SAS) algorithms and models to increase minehunting area search rates. Conducted proof-of-principle demonstration. ($2.3M)
- Completed construction and started full scale testing of a high energy-density aluminum-oxygen semi-cell UUV power system. ($3.0M)

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- Continued advanced acoustic communications development. Developed interference suppressor and message routing software for acoustic local area network and tested first modems with 360 Megaflop processing power. ($1.3M)
- Conducted at-sea test of prototype magnetic communication system. ($.2M)
- Continued development of atomic interferometer inertial sensor. ($.2M)
- Developed and demonstrated remote miniature tactical weather station. ($.9M)
- Examined concepts for maritime counterproliferation, including clandestine underwater chemical sampling system. ($.4M)
- Started development of methanol-fed fuel cell system for transit buses. (Congressional addition of $11.1M)
- Completed proof of principle demonstration of thermophotovoltaic (TPV) power system using a narrow-band emitter. Initiated program to demonstrate a portable TPV power system. (Congressional addition of $1.9M)
- Continued DoD tasks within the DoE 2 MW molten carbonate fuel cell improvement program. (Congressional addition of $4.6M)

(U) FY 1996 Program:

- Complete at-sea testing of Autonomous Minehunting and Mapping Technology (AMMT), including navigation and mapping, imaging, acoustic communications and mission control. ($5.5M)
- Continue development and testing of high-speed, long-range, robust, and compact underwater acoustic communications. ($1.0M)
- Complete design and fabrication of high resolution long range Synthetic Aperture Sonar (SAS). ($5.6M)
- Complete full scale testing of the high energy-density aluminum-oxygen semi-cell UUV power system. ($1.0M)
- Demonstrate breadboard prototype micro weather system, including sensors, for tactical meteorology and oceanography. ($2.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	17.8	16.8	17.5
Appropriated	33.3	N/A	N/A
Current Budget	34.3	15.1	0

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-39

(U) **Change Summary Explanation**:

FY 1995-96 Reflects minor repricing.
FY 1997 This project merged with EE-36, Advanced Ship/Sensor Systems.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Dec 95	Begin Autonomous Minehunting Mapping Technology (AMMT) at-sea testing.
Feb 96	Demonstrate 10 node shallow water acoustic communications network.
Apr 96	Complete full scale testing of aluminum-oxygen semi-cell power system.
May 96	Complete demonstration of small autonomous prototype legged taskable machine in surf environment.
Sep 96	Demonstrate environmental profiling microsensor; demonstrate technologies for scavenging power from the environment.

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Critical Mobile Targets (WAR BREAKER) EE-40	109,771	123,364	0*	0	0	0	0	0	385,311

*Programs continue in budget Projects EE-21 and EE-40.

(U) **Mission Description**: Prosecution of time-critical fixed and mobile targets has long been a concern of the Services as evidenced by past efforts in the areas of Strategic Relocatable Targets and Smart Weapons. Experience in Desert Storm dramatically demonstrated our inability to prosecute these targets, particularly Tactical Ballistic Missile (TBM) launchers. ARPA's WAR BREAKER program has served to develop advanced technology and systems that enable the detection, identification and prosecution of a wide range of high value, time-critical fixed and mobile targets, and has served as the framework for maturing and integrating these technologies for demonstration of systems concepts supporting the prosecution of these targets.

(U) Recently, ARPA has become increasingly active in Advanced Concept Technology Demonstrations (ACTDs) that relate to Battlefield Dominance; that is, providing the field commanders with a comprehensive awareness of the surrounding battlespace and the ability to exploit that information so that force can be brought to bear where it is needed. To enhance the achievement of these capabilities, a major portion of ARPA's efforts, including WAR BREAKER, are being refocused. Through this refocussing, the elements of WAR BREAKER will be transitioned to programs contributing to Battlefield-Dominance, including: 1) Maturing battle management, execution and information distribution technologies will form the foundation for enhancement of joint force air operations described as Joint Forces Air Component Commander (JFAAC) Initiatives in Project EE-21; 2) Correlation, fusion and infrastructure technologies that enable battlefield awareness is transitioned to the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) described in Project EE-21; 3) Advanced automatic target detection and recognition, automated imagery exploitation, and force recognition efforts are incorporated in the Semi-Automated Imagery Processing ACTD described in Project EE-50; and 4) The systems engineering and simulation projects are transitioned to Project EE-50 to support battlefield awareness specific simulations. Refocusing of these WAR BREAKER elements will occur in FY 1996, with complete transition in FY 1997.

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(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed Korean, and initiated Iraq Major Regional Conflict (MRC) scenario developments and validations, setting a new standard within CIO, DIA and other government agencies for analysis and simulation.
- Completed SimCore framework release and initiated effort to populate the framework with entity models.
- Conducted virtual and constructive analysis in support of Tier II+ and III- UAVs, automatic target recognition programs, and air-to-ground prosecution of time critical targets. ($15.4M)
- Continued development of Intelligence Correlation (IC) technologies, components and systems to include a natural language processor, force/target tracker, and force status assessor. Completed development, evaluation, and installation of a Signals Intelligence Correlator at a classified site. Demonstrated force/target tracker in support of the Combat Intelligence Center (CIC) targeting function during a field training exercise. ($16.6M)
- Continued development of Local Attack Controller (LAC) components. Demonstrated initial integration of dynamic intelligence processor and battle management decision aids in the Roving Sands exercise. Demonstrated distributed target execution concept within the CIC, and provided systems' interoperability at key Joint and Service command nodes through use of the Automated Deep Operations Coordination System in Roving Sands. ($11.9M)
- Continued development and test, and began integration of the Multiple Access Intelligence and Nomination System (MAINS). Delivered a prototype intelligence fusion tool to operational intelligence center for use and evaluation. ($9.3M)
- Integrated the Terrain and Features Generation (TFG) testbed for end-to-end evaluation, database development and user assessment. Demonstrated generation of terrain database at Roving Sands for multiple participant use. ($7.3M)
- Continued to apply advanced fusion and vision algorithms on high performance processors for National Technical Means exploitation (TOPSIGHT). Integrated search, automatic target recognition and imagery exploitation system capabilities. Demonstrated TOPSIGHT ability to process U-2 ASARS II real time data to detect units and single large vehicles in Roving Sands exercise, resulting in generation of 52 reconnaissance exploitation reports. ($8.4M)
- Continued development and evaluation of enabling technologies for the Internetted Unattended Ground Sensors (IUGS). Demonstrated high fidelity location, identification, and vector capability at Roving Sands using brassboard systems. ($4.5M)

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- Continued evaluation of rapid three-dimensional (3-D) digital terrain elevation data using interferometric synthetic aperture radar (IFSAR) and initiated transition to users. ($3.2M)
- Continued development of the congressionally directed GEOSAR program utilizing low frequency IFSAR to develop terrain and potential target profiles under foliage. ($7.0M)
- Completed partial test and evaluation of Multi-Sensor Target Recognition System (MUSTRS) technology using a helicopter testbed. Terminated program due to lack of progress with the Synthetic Aperture Radar sensor and lack of service customer sponsorship. ($2.9M)
- Continued development of Automatic Target Recognition/Detection (ATD/R) technology components needed for automatic target detection, recognition, and classification, through the initiation of a Moving and Stationary Target Acquisition and Recognition (MSTAR) Program, emphasizing a model-driven reasoning approach to support partially occluded, articulated or modified targets. The focus is on SAR with applications to Laser radar (LADAR) and multispectral sensors. ($9.9M)
- Continued 'DRAGNET' application development of Moving Target Indicator (MTI) radar and inverse synthetic aperture radar (ISAR) for detecting, recognizing and tracking high-value moving targets while they are actively moving in traffic, thus avoiding high revisit rates of SAR-imaging platforms. ($5.1M)
- Continued development of 'Monitor'. Successfully demonstrated an interactive ATR system for detection and discrimination of targets during the Gold Pan '95 (Roving Sands) exercise, achieving significant ATR gains using SAR imagery. ($4.0M)
- Continued development of 'Clipping Service' to automatically screen synthetic aperture radar (SAR) imagery and crop high-information content portions of images for transmission to ground stations at reduced datalink throughput rates to avoid dramatic data communications system costs. ($1.0M)
- Continued data analysis and assessment of the performance of advanced algorithms for detecting targets in foliage from high-resolution high frequency/ultra-high frequency (HF/UHF) ultra-wideband foliage penetrating (FOPEN) Synthetic Aperture Radar (SAR) data. ($2.7M)
- Conducted a demonstration of the 'Expose' algorithm with integrated FOPEN components. ($.6M)

(U) <u>FY 1996 Program</u>:

- Conduct distributed simulation analysis and modeling of two nearly simultaneous Major Regional Conflicts (MRCs) incorporating current and newly developed Services' capabilities. Complete TIER II+ and III- analyses. Complete analyses processes and simulation development; transition to Joint Precision Strike Demonstration (JPSD) and other government/FFRDC sites for force-on-force analysis in support of system(s) acquisition. ($10.0M)

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- Continue development, test, integration and demonstration of Intelligence Correlation (IC) technologies, components, and systems. Initiate integration of the natural language processor with intelligence correlators, and the target tracker with the force status assessor. Transition technology to enable information integration in the Battlefield Awareness and Data Dissemination (BADD) and Semi-Automated Imagery Processing (SAIP) ACTD. ($18.9M)
- Continue development, test and integration of JETA components for transition to JFACC Initiative. Deliver and transition UNIX version of Army Deep Operations System to Army and Marines. Continue development of advanced capabilities, with emphasis on interoperability, for incorporation into new and existing Air Force systems. Enhance distributed situation object technology and targeting functions to support multimedia databases and target systems analysis. Continue development of intelligence fusion tools. ($19.2M)
- Continue development, test and integration of the Terrain and Feature Generator (TFG) system for rapid processing of spatial data. Continue testbed technology insertion and evaluation. Transfer technology to SAIP ACTD to support terrain analysis and to BADD ACTD to provide foundation for common picture and warfighter visualization. ($3.5M)
- Continue TOPSIGHT development to apply advanced fusion and vision algorithms on high performance processors for National Technical Means exploitation and integrate technology into SAIP ACTD. ($2.0M)
- Demonstrate Internetted Unattended Ground Sensors (IUGS) component technologies to determine the performance gains in target classification and identification and the potential for an internetted system. ($4.6M)
- Continue development of MSTAR infrastructure and baseline algorithm suite for an increased number of targets modeled and hide states. ($16.6M)
- Complete algorithm development and hardware modifications for 'Dragnet' moving target classification application demonstration. ($6.6M)
- Continue development of 'Clipping Service' application in cooperation with the DARO and the High Altitude Endurance (HAE) Unmanned Aerial Vehicle (UAV) program. Transition to the SAIP ACTD. ($1.5M)
- Conduct detailed tradeoffs on ATR performance as a function of sensor performance upgrades, continue assessment of 'Expose' capabilities consistent with Foliage Penetration (FOPEN) objective, and complete characterization of FOPEN environment and predicted system performance. ($4.1M)
- Initiate the Semi Automated Imagery Exploitation (SAIP) ACTD by integrating technologies developed under MONITOR, TOPSIGHT, Clipping Service, Terrain Feature Generation, Intelligence Correlation, and RADIUS (ST-11) into a system of semi-automated image analyst tools with the capability to process SAR and other image types more completely and correctly, perform wide area search for GOB and MOB targets, perform rapid site

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monitoring and modeling, and produce target reports in near real time. A baseline system will be demonstrated at Beale AFB using ASARS data. ($36.4M)

(U) FY 1997 Program:

- Description of former WAR BREAKER efforts can be found in: JFACC Initiative, Project EE-21; BADD ACT, Project EE-21; and SAIP ACTD, Project EE-50.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	117.4	117.8	112.8
Appropriated	110.7	N/A	N/A
Current Budget	109.8	123.4	0

(U) **Change Summary Explanation**:

FY 1995 Adjustments reflect minor repricing.
FY 1996 Adjustment reflects funds added for the SAIP ACTD.
FY 1997 Adjustments reflect transition of WAR BREAKER efforts to other related programs as described above.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Jun 96	Complete SIMCOR simulation analysis tool.
Aug 96	Realtime demonstration, using infrared, of Forces Wide Area Search Component of TOPSIGHT.
Sep 96	Integrated Tracker-Kinematic Intelligence Processor demonstration for Army-USMC Battle Management. (JETA)
Sep 96	Completion of transition of War Breaker elements to other projects. FY 1997 and out milestones appear in recipient projects.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Air Defense Initiative EE-41	34,281	23,476	21,777	28,579	30,479	25,690	25,690	Continuing	Continuing

(U) **Mission Description**: Air Defense Initiative (ADI) programs form a critical part of the Advanced Research Project Agency's (ARPA) program to ensure defense against cruise missiles and manned aircraft. The programs also complement systems being pursued by other program offices to counter theater ballistic missiles. The rapid evolution and spread of cruise missile systems and related threats require new approaches and technologies to ensure effective countering of future breathing threats.

(U) The Mountain Top Program objective is to provide a cost effective ground-based radar system for evaluation and advancement of concepts and technologies required for future airborne surveillance radars. Through intense data collection campaigns, the Mountain Top Project identifies and quantifies natural and man-made phenomenology that may limit airborne early warning (AEW) system performance. Central to this activity is the Radar Surveillance Technology Experimental Radar (RSTER), located at the Pacific Missile Range Facility (PMRF), Kauai, Hawaii. In FY 1996, the Mountain Top Project segregates the RSTER hardware program segment from the signal processing and analysis effort to form two distinct programs; Mountain Top and Advanced Signal Processing. The RSTER system will continue to serve as the focal point for the Mountain Top Program and will concentrate on joint testing and integration activities to effect a successful infrastructure transition to the Services by FY 1998. The signal processing and analysis work has been re-designated the Advanced Signal Processing Program.

(U) The Advanced Signal Processing Program elements include Space Time Adaptive Processing (STAP), phenomenology data collection, and university/industry/DoD development and testing of advanced radar signal processing algorithms for: (1) detection and post detection processing in STAP-based surveillance radar systems; (2) use of Frequency Jump Burst (FJB) waveforms to increase range resolution for surveillance radars employing STAP; and (3) hot clutter mitigation at UHF for low and medium range resolution waveforms. Program activities will include continued database development and support, phenomenology studies, and algorithm trade studies and experiments.

(U) HAVE DUNGEON enhances the capability to provide data integration and identification techniques for aerospace defense. Advanced hardware and software is developed to exploit data provided by intelligence sensors and collateral surveillance systems to provide near-real-time warning, attack assessment, and track history for the engagement of hostile targets. The program completes in FY 1995.

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(U) The Simulation and Modeling Program performs dynamic analyses of new Air Defense technologies and concepts, and the effects of their integration into theater force structure. It emphasizes and illustrates concepts to counter the cruise missile and other breathing threats. Additionally, the Operator-in-the Loop exercises allow the opportunity for warfighters to test and evaluate advanced technology concepts and operations. The program has established interconnectivity to the Air Force Theater Air Command and Control Simulator Facility (TACCSF) and will investigate the value of similar interconnectivity with like simulation sites.

(U) The Airborne Infrared Measurement System (AIRMS) program will provide improved scientific understanding of the fundamental limits of infrared technologies and will develop analytical tools, models, design methodologies, and associated signal processing algorithms/architectures. The program employs the existing AIRMS testbed airborne infrared imaging sensor and aircraft to collect high resolution digital imagery of airborne vehicles, background clutter, clouds, and other phenomenology.

(U) The Advanced Target Identification (ID) Program objective is to provide high confidence target identification at long range. The program will enable the Air-Directed Surface-to-Air Missile (ADSAM) concept to exploit the kinematic range of the missile. The program will modify existing sensors with new target identification modes and develop data fusion and decision logic to exploit the synergism between information provided by multispectral sensors and that from other sources such as electronic support measures (ESM). Techniques under consideration include high range resolution target profiling, inverse synthetic aperture radar (ISAR) and SAR imaging, and phase imaging of moving structures within the target.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- The Mountain Top Program successfully integrated the RSTER system at the Makaha Ridge site at PMRF and completed a littoral data collection campaign to support investigations of: STAP processing of clutter discrete; bistatic scattering from the sea; height estimates from sea scattered multipath; low altitude propagation and target detection; range profiling; length estimates from wideband signature data; and doppler signatures from helicopters, propeller, and jet aircraft. The established Mountain Top database continued to be distributed to the user community for development and evaluation of advanced adaptive processing techniques. ($12.9M)

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- The Maui High Performance Computing Center (MHPCC) initiated host activities for the Mountain Top database and the CREST shell. ($1.5M)
- HAVE DUNGEON completed scenario development and development of supporting technical data, and the basic tracker device was developed. ($.6M)
- The Simulation and Modeling Program (SMP) completed integration of various high fidelity Air Defense models into a dynamic simulation, the Extended Air Defense Simulation (EADSIM). Applications of these capabilities focused on investigations of Service Air Defense architectures, support to various OSD and Service studies and analyses, and OSD sponsored wargame activities. Establishment of interconnectivity to other simulation sites nationwide, such as the Air Force Theater Air Command and Control Simulator Facility, was accomplished via a "trusted interface". ($6.2M)
- The Airborne Infrared Measurement System (AIRMS) program completed ground and airborne sensor acceptance tests and characterization flights. It conducted initial flight tests, and began evaluation of operational algorithms for target detection and tracking. ($13.1M)

(U) <u>FY 1996 Program</u>:

- The Mountain Top Program will continue to support Joint Testing activities including the Navy Wide Area Defense over-the-horizon detection and track capability demonstration, and the Cruise Missile Defense (CMD) Advanced Concept Technology Demonstration (ACTD) Phase I. The program will pursue technology investigations and experiments to foster transition of the RSTER asset. ($5.0M)
- The Advanced Signal Processing Program will carry forward and perform the signal processing and analysis activities of the Mountain Top effort. The Advanced Signal Processing Program will perform phenomelogical studies, evaluate and manipulate a diverse RSTER database, and define Measures Of Effectiveness for a focused data set to test and evaluate candidate algorithms. ($6.6M)
- The Simulation and Modeling Program (SMP) will continue Air Defense Service architecture evaluations. Support of OSD and Service studies and analyses will continue and wider Distributed Interactive Simulation (DIS) network interconnectivity will be designed with the Joint Warfare Center (JWC), the Air Force Theater Battle Arena (TBA), and the National Test Facility (NTF). ($6.8M)
- The Airborne Infrared Measurement System (AIRMS) will complete flight tests, employ the data in the evaluation of algorithms, and perform near real time demonstrations with operational algorithms. Additionally, AIRMS will support service technology transition efforts by providing data to support various

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Service demonstrations, and providing support to numerous special research activities (ship self defense, countermine detection and nonacoustic ASW) in order to demonstrate the system's utility to other services. ($5.1M)

(U) FY 1997 Program:

- The Mountain Top Program will focus on ultra-high frequency (UHF) AEW radar technology component upgrades, integration, and demonstration activities. The RSTER will transition to the Services by the end of FY 1997. ($5.0M)
- The Advanced Signal Processing Program will complete refinement of the focused data set, and evaluate candidate algorithms for integration into defined and/or evolving STAP systems. Resultant program recommendations and a final report will be submitted to appropriate Service Program Offices (i.e., E-2C, AWACS). ($8.3M)
- The Simulation and Modeling Program will continue analysis support to Service transition activities such as Advanced Concept Technology Demonstrations. Interconnectivity will be established with other nationwide simulation sites such as the Joint Warfare Center and National Test Facility. ($7.0M)
- The Airborne Infrared Measurement System (AIRMS) will continue to support service technology transition efforts, complete all data analyses, clutter characterization and model validation. ($1.5M)
- The Advanced Target ID Program will begin a wide-ranging exploratory assessment of potential identification signatures. Those assessed to have the most potential will be identified for further investigation. ($1.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	36.4	23.5	24.8
Appropriated	35.1	N/A	N/A
Current Budget	34.3	23.5	21.8

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(U) **Change Summary Explanation**:

FY 1995 Decrease reflects completion of the HAVE DUNGEON program at a lower than anticipated cost.
FY 1997 Changes reflect the transition of the AIRMS aircraft and anticipated competition of ASTB.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mountain Top Program:	
Oct 96	Integrate RSTER at Kokee Site, PMRF.
Oct 97	Employ RSTER in Navy AEW Demonstrations.
Sep 97	Transition RSTER Asset to Services.
Advanced Signal Processing Program:	
Oct 95	Release RLSTAP Alpha Build 1.
Nov 95	Release RLSTAP Beta Build 1.
Jan 96	Place RLSTAP General Release Build 1 On-line at MHPCC.
Dec 96	Complete Establishment of Focused Data Sets.
Jun 97	Complete Candidate Algorithm Test and Evaluation.
Oct 97	Deliver Suite of Sensor Compatible Algorithms.
Jun 98	Simulate Coherent Repeater Signal with RLSTAP.
Sep 98	Complete PMRF site modifications for ADSAM test.
Simulation and Modeling Program:	
Oct 95	Integrated JUDY Dynamic Simulation.
Dec 95	Complete Architecture Shell.
Mar 96	Participate in OSD/Net Assessment Seminar Wargame.
Jun 96	Participate in OSD/Net Assessment Seminar Wargame.
Jan 97	Apply M&S Capability to ACTD Planning.
Jul 98	Commence CMD ACTD Distributed Simulation.

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Airborne Infrared Measurement System Program:

Sep 95	Completed initial flight tests, began evaluating operational algorithms, collected imagery of breathing targets, ballistic missiles, and various kinds of clutter.
Mar 96	Phenomenology Investigations Complete.
Sep 97	Data Analysis Complete.

Advanced Target ID Program:

Oct 96	Initiate Assessments of ID Signatures.
Apr 97	Complete Initial Assessment of ID Signatures.
Aug 97	Complete Plan for Further Investigations.
Apr 98	Submit Interim Report on ID Signatures.
Sep 98	Complete Sensor Modification Plan.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Global Grid Communications EE-45	43,289	45,108	42,024	48,392	33,916	32,750	39,549	Continuing	Continuing

(U) **Mission Description**: This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and demonstrated to be applicable to advanced, high performance networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technologies developed elsewhere. The key elements are: 1) Applications such as intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action; 2) Advanced services such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level; 3) Demonstration networks that validate the research and development and enable early application development and technology transition into DoD efforts such as Defense Information System Networks; 4) Develop network controls pertaining to management, and security software technologies to enable sensor-to-shooter applications combining all network media; and 5) Develop advanced optoelectronic network component technology and network architecture for scalable and modular networks. The aggregate network bandwidth will be in the range of terabits per second and the network will handle multi media service for both digital and analog signals.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Designed and conducted initial assessments of information services for the defense internet; evaluated prototype software components in a software engineering testbed and during an operational exercise. ($18.6M)
- Utilizing planning and decision developed aids, supported the rapid construction of multiple crisis action plans. ($1.8M)
- Integrated DoD and commercial networks and demonstrate services and network management in support of DoD experimental application with military attributes such as crypto surge capability. ($5.3M)
- Developed optoelectronic components for optical network. ($6.9M)

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- Modeled multi-wavelength reconfigurable network architecture and initiated cost analyses and tradeoffs. ($5.8M)
- Developed optical network management software and control algorithms. ($4.9M)

(U) FY 1996 Program:

- Demonstrate evolving software development practices and the migration of software applications and information services to higher bandwidth networks in an operational exercise involving multiple JTFs. ($18.8M)
- Demonstrate integration on a CONUS/International scale of all networks and demonstrate end-to-end secure transmission and signaling at gigabit rates. ($5.0M)
- Demonstrate high bandwidth operation of critical multi-wavelength components. ($7.5M)
- Field test local area network application of multi-wavelength analog and digital signal transmission. ($8.3M)
- Continue to develop multi-wavelength network management software and control algorithms. ($5.5M)

(U) FY 1997 Program:

- Identify control and protocol issues for operation of multi-wavelength networks. ($4.2M)
- Demonstrate advance integrated optoelectronic network component operations. ($9.4M)
- Complete multi-wavelength network architecture and control planning; and initiate field-trial network deployment for long-distance and wide area applications. ($14.4M)
- Demonstrate integration with advanced optical testbeds; large scale planning demonstrations; and deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces). ($14.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	44.0	45.2	44.6
Appropriated	44.7	N/A	N/A
Current Budget	43.3	45.1	42.0

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(U) **Change Summary Explanation**:

FY 1995-97 Decreases reflect minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Planned	Milestones
May 96	Demonstrate network combining crypto, commercial communications, and defense secure wireless, satellite.
May 97	Demonstrate integration with advanced optical testbeds. Conduct large scale planning demonstrations.
Jul 97	Complete deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces).
May 98	Complete cross-country demonstration of optical and advanced network management.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Simulation Internet (DSI) EE-46	14,737	27,239	39,675	3,000	0	0	0	0	116,268

(U) **Mission Description**: The goal of the Defense Simulation Internet (DSI) program is to research, develop and test at scale (worldwide), a network infrastructure capable of enabling distributed, real-time, multi-media (video, voice, shared data and work spaces) simulation that will seamlessly integrate all simulation, modeling, command and control functions from early design to battle rehearsal enroute to the conflict. The DSI meets DoD security requirements by commercial-off-the-shelf (COTS) encryption device (INES). The communications needs of the distributed, real-time, multi-media modeling and simulation community cannot be met with any other available technology. Also, commercial vendors are pursuing some of the required technologies, but development is too slow and unfocused to accommodate the immediacy of the Department of Defense's simulation requirements. The DSI program is therefore accelerating the commercial development of the technologies needed by the simulation community for distributed work environments worldwide. Over 100 nodes currently extend the DSI to each of the Services, most of the Commanders-in-Chief (CINCs), some of our allies and other Government affiliated sites. These locations constitute the network's user sites; they provide valuable feedback on the technologies and methodologies being pursued and critical capability for both ongoing and major modeling and simulation events. A key mission of the DSI is to provide real-time infrastructure for the Synthetic Theater of War (STOW) 97. A major program goal is to transition the DSI into the Defense Information Systems Agency (DISA) Defense Information Systems Network (DISN) by the end of FY 1997. The transition of the DSI into the DISN provides affordability through consolidation of the costs required to operate multiple networks while continuing to support modeling and simulation requirements.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishment:

- Provided network operations and user services: an increase of 25% in user sites during FY 1995. Operations included management of the 24 hours per day/7 days per week Network Operations Center (NOC), network security, exercise/event planning and management, and a 24 hours per day/7 days per week Help Desk at the DSI Customer Service Center (CSC). ($8.3M)
- Procured telecommunication circuits; Phase I backbone (4 X T1), CONUS Phase II Backbone (T3 upgrade starting in July), Tail Circuits to user sites. ($3.9M)

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- Upgraded network: Completed Phase I Cutover, increasing bandwidth capacity from T1 to 4 X T1. Upgraded European and Pacific locations, replacing legacy routers with high-speed commercial-off-the-shelf (COTS) routers. Initiated testing and installation of Asynchronous Mode Transfer (AMT) switches into the DISN Leading Edge Services (LES) backbone and implemented initial installation of the Phase II (AMT/T3) backbone upgrade, the first step of DSI infrastructure transition into DISN LES. Provided automated scheduling services to user control and improved network management and interoperability. ($2.0M)
- Initiated Defense Information Systems Agency (DISA) migration planning process and installed a network management viewport. ($.5M)

(U) FY 1996 Program:

- Provide network operations and user services. It is expected that the DSI will become a virtual network of DISN LES during the 3Q FY 1996. This will contain an estimated 30% more user sites. Operations will include the 24 hours per day/7 days per week NOC, network security, exercise/event planning and management, and the 24 hours per day/7 days per week CSC Help Desk. ($8.7M)
- Procure telecommunication circuits: International circuits (T1 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade select high use Synthetic Theater of War (STOW) sites to T3 tail circuit 4Q FY96. ($13.0M)
- Upgrade network: Initiate upgrade which provides AMT switches and end-to-end encryption for the wide area network interface to the sites and the edge devices which provide the local area interface with the workstation for STOW 97 (30 Sites). Upgrade to commercial standard desktop VTC. Integrate systems management to provide control of end node workstations. ($5.5M)

(U) FY 1997 Program:

- Provide network operations and user services. As a subnet of DISN LES, it is expected that by the end of FY 1997 the subnet work will contain an estimated 30% more user sites. Operations include the 24 hours per day/7 days per week NOC, network security, exercise/event planning, management and the 24 hours per day/7 days per week CSC Help Desk. ($10.0M)
- Procure telecommunication circuits: International circuits (T3 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade high use STOW sites to high capacity tail circuits. ($17.0M)
- Upgrade network: Complete deployment of service upgrade which provides AMT switches, end-to-end encryption and the edge devices to sites which require this upgraded capability (70 Sites). Automate network management to provide real-time management of high speed high bandwidth requirements. Provide resource

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reservation at the application level. Complete migration of Defense Simulation Internet (DSI) network operations and maintenance to Defense Information Systems Network (DISN). ($10.2M)

- Transition management: Provide programmatic integration management and engineering support through the ARPA/DISA (Advanced Information Technology Systems (AITS)) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. ($2.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	16.6	27.5	37.2
Appropriated	15.9	N/A	N/A
Current Budget	14.7	27.2	39.7

(U) **Change Summary Explanation**:

FY 1995 Decrease reflects reprogramming to satisfy higher priority requirements.
FY 1996-97 Adjustments reflect minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Feb 94	Doubled DSI Backbone capacity (3 Mbps).
May 94	Completed Interim Backbone upgrade (6 Mbps).
Feb 95	Completed Phase I Backbone Cutover (T1).
Sep 95	Initiated AMT T3 Backbone upgrade (45 Mbps).
Jun 95	European and Pacific Theater Phase I backbone hardware upgrades.
Sep 96	Complete Phase II Backbone Cutover (T3/AMT).
Sep 96	DISA Network operations center fully functional.

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Sep 96	Fully integrate an automated network and life cycle management.
Sep 96	Deploy AMT switches to select STOW 97 sites.
Jun 97	Deploy AMT switches to sites and end to end encryption to sites.
Sep 97	Complete network services transition to DISA.

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RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Fast Ship/Future Ship EE-47	0	0	16,382	25,000	25,000	0	0	0	66,382

(U) **Mission Description**: The objectives of this new project are to develop and demonstrate advanced maritime technologies for future ship concepts to include new hull forms for high speeds and a next generation ship to support a naval battle group in a variety of missions.

(U) The Fast Ship Program will develop and demonstrate advanced maritime technologies and integrate the highest value concepts into a single preliminary ship design. Technology developments will be focused in three areas: Naval Architecture, Fluid Dynamics, and Propulsion. The goal of the Fast Ship Program is to demonstrate technology supporting development of a 100 knot ship capable of performing maritime missions ranging from peacetime humanitarian to full scale war. Spanning the entire mission range is the U.S. capability to conduct lift operations in support of vital interests around the world. This lift capability is a joint forces requirement and must simultaneously encompass moving large amounts of forces and their equipment from the continental U.S. to the area of concern as quickly as possible. Currently, the U.S. does not possess this strategic mobility capability. This capability would not only fulfill this requirement, but create a paradigm shift in the DoD Investment Strategy by altering the current force packaging and prepositioning necessary to effectively respond to crises.

(U) The next generation ship is a concept for supporting battle group operations that will drastically increase the firepower brought to bear during a regional conflict. Technological advances in long range precision munitions will enable this ship to directly influence the outcome of the ground campaign by efficiently destroying enemy armored vehicles and halting the advance of the enemy early in the conflict. The project will develop conceptual designs and assess the feasibility of developing a container-type vessel that is nominally outfitted with 500 weapon launchers. The vessel will be designed to carry operational and planned naval missiles and traditional artillery munitions to support a variety of mission requirements. Anticipated mission support includes tactical and strategic strike, theater ballistic missile defense, battle group air defense, and in-shore fire support. The weapon systems will be capable of remote command, control and launch by a battle group or on-scene commander aboard another vessel. Remote targeting and launch will also be possible from cruise missile capable submarines and forward observers targeting in-shore fire support. Manning reduction will be a critical design element through systems automation for operations and damage control.

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(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- Conduct feasibility and analysis supporting the developments of 100 knot-capable ships; develop enabling technologies, in the areas of advanced hydrodynamics, propulsion and structures, utilizing advanced design and analysis codes and limited small-scale experimental demonstration. ($14.4M)
- Initiate conceptual design and feasibility studies supporting Navy interest in next generation ship development. Focus on feasibility of building a prototype ship and identifying technology show-stoppers. ($2.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	0
Current Budget	0	0	16.4

(U) **Change Summary Explanation**:

FY 1997 New start.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mar 97	Complete fast ship feasibility study.
Sep 98	Complete next generation ship conceptual design and feasibility studies.
Dec 98	Complete demonstration of fast ship critical enabling technologies.

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R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Combat Hybrid Power Systems EE-48	0	0	15,000	20,000	20,000	10,000	0	0	65,000

(U) **Mission Description**: Essential requirements for U.S. Cavalry/Scout ground units are to acquire threat information, locate targets, communicate, reduce signatures, and be more mobile and survivable. The cavalry/scout vehicle must be air deployable which dictates weight and volume constraints. The military is developing an array of subsystems to support the cavalry/scout mission that include: advanced sensor suites and communication equipment, active suspension and electric propulsion systems, signature management suites, countermeasures, active defense, and directed energy weapons. These subsystems require either continuous or pulsed electric power and a dedicated electrical power supply has been developed for each subsystem. Integration of multiple power supplies into a vehicle is not feasible due to space constraints, cost, and efficiency.

(U) The objective of this program is to develop enabling technology and conduct a laboratory demonstration of hybrid electric power systems which provide power and energy management for all of the subsystems throughout the cavalry/scout vehicle. The hybrid electric power system will consist of an integrated engine/alternator sized for average power demand, energy storage and power averaging components, distribution network, subsystem control and power conditioning devices. Vehicles will be simulated to evaluate subsystem requirements, topologies, and military utility. The program is closely coordinated with the U.S. Army and the Marine Corps.

(U) Hybrid electric power is an enabling technology for the cavalry/scout and other future combat vehicles if electrically powered subsystems are to be implemented. The vehicles will have greatly reduced noise and thermal signatures; and improved mobility, survivability, lethality, and fuel economy. By eliminating rigid connections between components, interior layout can be optimized, significantly reducing volumetric constraints. These advantages will result in a deployable, affordable calvary/scout vehicle that meets mission requirements.

(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- Establish subsystem requirements, evaluate military utility, and support hybrid electric power system technology development. ($1.5M)
- Complete detail design of hybrid electric power system demonstration. ($1.0M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-48

- Complete design and technology development of engine/alternator, power averaging, power conditioning, and power distribution and control component options and downselect for fabrication and demonstration. ($12.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	N/A	N/A
Current Budget	0	0	15.0

(U) **Change Summary Explanation**:

FY 1997 Reflects program new start.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Aug 97	Establish subsystem requirements, evaluate military utility, and support hybrid electric power system technology development using integrated, hybrid electric powered scout vehicle virtual prototypes.
Dec 97	Complete detail design of hybrid electric power system demonstration.
Dec 97	Complete design and technology development of engine/alternator, power averaging, power conditioning, and power distribution and control subsystems and downselect for fabrication and demonstration.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tier III Minus UAV EE-49	(57,221)*	24,675	14,749	5,000	0	0	0	0	44,424

* FY95 was appropriated to the Defense Airborne Reconnaissance Program, PE 0305154D, Project Name/No. LO-HAE UAV/P527.*

(U) **Mission Description**: The objective of this program is to develop and demonstrate a Low Observable High Altitude Endurance Unmanned Air Vehicle (LO HAE UAV) system, including a ground segment, capable of providing the war fighter with the near real time ability to assess battlefield situations. This system will provide continuous, all weather, day/night, wide area reconnaissance and surveillance in direct support of the Joint Forces Commander. It will consist of aircraft, sensors, communications and interfaces to theater systems in support of tactical warfighters at various levels of command. The LO HAE UAV will provide wide area search (over 15,000 sq nm per mission) with either an Electro-Optical (EO) or Synthetic Aperture Radar (SAR) system at 1m resolution. In addition, it will provide 600 spot images per mission with either sensor at 0.3m resolution. The search and spot modes can be interleaved with attendant reductions in the overall coverage. The system will support a targeting accuracy of at least 20m CEP.

(U) The detection capabilities of the LO HAE UAV will allow the system to operate in high threat environments where manned reconnaissance or other operational assets are not viable options.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed all tooling. ($2.0M)
- Completed design and fabrication of Vehicles #1 and #2. ($23.2M)
- Rollout and begin integration of Vehicles #1 and #2. ($10.0M)
- Completed system integration and ground testing. ($15.0M)
- Conducted flight test planning and complete flight test readiness review. ($1.0M)
- Designed, develop, and integrate the processing and display system (PDS). ($6.0M)

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(U) FY 1996 Program:
- Complete system integration and conduct Phase II flight test. ($19.7M)
- Complete integration and provide support to system flight test (PDS). ($5.0M)

(U) FY 1997 Program:
- Begin development of Vehicles #3 and #4. ($14.7M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	N/A	24.7	14.7
Appropriated	N/A	N/A	N/A
Current Budget	N/A	24.7	14.7

(U) **Change Summary Explanation**: N/A

(U) **Other Program Funding Summary Cost**:

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Related RDT&E PE0305154D	57.2	73.0	55.0	23.0	13.0	0	0	0	N/A

(U) **Schedule Profile**:

Plan	Milestones
Dec 95	Complete system integration and conduct Phase II flight test.
Dec 95	Complete integration and provide support to system flight test (PDS).
Mar 96	Complete and test EO and SAR payloads.
Mar 96	Conduct static and dynamic observable testing.
Jun 96	Complete integration and initial flight test of Vehicle #2.
Sep 96	Conduct initial Phase III user assessment flight testing.
Oct 96	Begin development of Vehicles #3 and #4.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Battlefield Awareness EE-50	*	*	95,201	109,866	113,155	124,400	126,787	Continuing	Continuing

* Programs included in this project were previously funded under Project EE-40 except for the Joint Execution and Targeting Architecture (JETA) program which transferred to EE-21.

(U) **Mission Description**: This project represents a refocusing and transition of pertinent elements of the Critical Mobile Targets (WAR BREAKER) project (EE-40) into a concentrated effort to empower the battle commander with comprehensive battlefield situational awareness. This effort embodies sensor assets, exploitation of sensor products, and integration of sensor exploitation products with other intelligence information. Current imagery collection systems produce far more data than imagery analysts (IA) are able to exploit. This results in: unexploited and under-exploited data; few reports on deployed forces; reporting on only a limited number of facilities; very long periods between updating of terrain and feature data derived from imagery; and manually generated reports which are generally late. The decrease in the IA population and the increase in collection capability with modern systems exacerbate this situation, especially when the collector is a Synthetic Aperture Radar (SAR). While SAR's day/night, all-weather capabilities mean it is often preferred over other sensor types, it is also the most difficult for humans to exploit, especially in low to medium resolution broad area search mode.

(U) The focus of this project is the Semi-Automated Imagery Processing (SAIP) Advanced Concept Technology Demonstration (ACTD), that will address these problems. This ACTD will develop, test and transition to the operational user, automated algorithms and semi-automated tools that enhance IA capability to: process SAR and other image types more completely; conduct wide-area search for Ground Order of Battle (GOB) and Missile Order of Battle (MOB) targets; perform rapid site-monitoring and site modeling; and produce target reports in near real-time (< five minutes). SAIP will consist of a baseline, enhanced, and transition systems. Goals for the baseline system are: automatic target cuing and classification for a limited set of vehicles; object level change detection; force recognition to the company level; and interactive tools including model-based target recognition. Additional goals for the enhanced system are: site modeling and monitoring with EO; addition of SIGINT cuing; and on-the-fly training for algorithms. Goals for the transition system are to add the following to the enhanced system: Enhanced automatic target recognition (ATR) (30 targets); force recognition to the regiment level; site modeling and monitoring with SAR data; and, rapid target insertion.

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(U) The Semi-Automated Imagery Processing (SAIP) is built on, will leverage, and, as appropriate for an Advanced Concept Technology Demonstration (ACTD), integrate program products that are being refocused and transitioned from the WAR BREAKER Program: Monitor, which is developing template-based automatic target recognition (ATR) capability; MSTAR, which uses a model-based approach to target recognition in Synthetic Aperture Radar (SAR); Topsight, which reasons about detections in low and medium resolution imagery, terrain, doctrine and other sources of intelligence to identify units.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:
- See Project EE-40 for FY 1995 Accomplishments.

(U) FY 1996 Program:
- See Project EE-40 for FY 1996 Program.

(U) FY 1997 Program:
- Transition of all component projects into the SAIP ACTD will be completed and integration continued to achieve enhanced system objectives. The site modeling and monitoring component will be integrated, additional Missile Order of Battle (MOB) and Ground Order of Battle (GOB) models and algorithms inserted, and the system ported to a High Performance Computer architecture. Tests will be done on system performance with Tier III- and national imagery and the enhanced SAIP system will be available to the Battlefield Awareness and Data Dissemination ACTD to serve as its imagery processor. A test at an overseas operational unit will be initiated. ($35.0M)
- Conduct a ground demonstration of Expose/FOPEN ATD/C processor. ($7.0M)
- Conduct IC demonstration and evaluate integrated system for a limited set of targets at ROVING SANDS 97. Initiate development of a wide area tracker/correlator. ($13.0M)
- Evaluate the performance of an Internetted Unattended Ground Sensor (IUGS) system at ROVING SANDS 97. ($3.0M)
- Field an initial operational capability configuration of TFG at ROVING SANDS 97 exercise. ($3.5M)
- Demonstrate TOPSIGHT regional analysis/movement capability at ROVING SANDS 97 exercise. ($1.0M)
- Implement Clipping Service multi-scale architecture and conduct laboratory demonstration. ($2.0M)

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- Continue MONITOR development of super resolution techniques for target identification as SAIP upgrade. ($1.0M)
- Conduct airborne demonstration of Dragnet capability to ID and track moving target in traffic. ($4.5M)
- Demonstrate MSTAR recognition of 10 target set in open with limited obscuration. ($16.7M)
- Conduct design trade simulations for Battlefield Assessment and Data Dissemination (BADD) to establish Warfighter Associate requirements; evaluate the human-computer interface designs for Semi-Automatic Imagery Processing (SAIP), and the synergistic effects of SAR/MTI sensors in the discrimination of both fixed and moving targets. ($8.0M)
- Initiate planning and system requirements definition for a Synergistic SAR/MTI System Demonstration. ($.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	N/A	N/A	N/A
Current Budget	0	0	95.2

(U) **Change Summary Explanation**: Funding transferred from EE-40.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan Milestones
(See Project EE-40 for prior milestones.)
Nov 96 Demonstrate and test baseline Semi-Automated Imagery Processing (SAIP) system with ASARS at Beale AFB.
Dec 96 Test SAIP with Tier III- imagery.
Jan 97 Port SAIP to High Performance Computer.
Jun 97 Test SAIP with national product.
Oct 97 Install and test SAIP at operational OCONUS site.

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Mar 98 Airborne demo of FOPEN target detection.
Mar 98 Begin testing of SAIP with Tier II+ imagery.
Apr 98 Provide SAIP code to Army for STARLOS hardware implementation.
Jun 98 Operational demo of Dragnet on JSTARS.
Jul 98 Initiate SAIP transition to USACOM.
Sep 99 Complete SAIP transition.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Submarine Technology, PE 0603569E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Subtech AS-01	31,575	9,501	0*	0	0	0	0	0	N/A

*FY 1997 and subsequent years efforts are funded in PE0603226E, Project EE-36.

(U) **Mission Description**: The objectives of this project are to develop and demonstrate advanced concepts and to pursue critical enabling technologies for future ship classes. The evolving worldwide threat of quiet diesel submarines and the proliferation of sophisticated submarine and weapons capabilities available to third world countries necessitates that the U.S. continue to maintain a superior submarine force. U.S. submarine technologies must keep pace with changing threats and remain immune to technological surprises, but declining resource availability mandates that this be done affordably. Therefore, the main thrust of this project is to provide far-term solutions for both increasing ship affordability and enhancing our operating capabilities in the littorals.

(U) This project continues to develop and demonstrate innovative technologies initiated under hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables. These technologies will significantly enhance submarine stealth and survivability. They form the basis for efforts addressing affordability through improvements in structural acoustic design capabilities, innovative machinery mounting systems and high reliability propulsion systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Developed and tested active shock attenuation techniques. Initiated design of a thermally-boosted acoustic source for stealth applications. ($2.5M)
- Demonstrated active compliant structural control concepts at laboratory scales. ($1.4M)
- Completed transfer of Magnetic Levitation Technology from GEC Marconi, Great Britain, UK to the United States. ($2.0M)
- Completed design and fabrication of 1/4-scale model for lightweight structures and complete truss testing and numerical simulations. ($5.0M)
- Continued fabrication, assembly and test of thick composites components and a cylinder with embedded sensors, and refinement of sensor demodulation and non-destructive evaluation (NDE) methods. ($.4M)

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- Conducted phenomenology testing and technology optimization on several Electromagnetic Turbulence Control (EMTC) panels. Developed preliminary simulation and performance prediction tools. ($3.7M)
- Conducted initial demonstrations of submarine signature reduction and management technologies for submarines enhanced for littoral warfare operations. ($4.3M)
- The following activities relating to Advanced Submarine Technology were funded by Congressional additions to the FY 1995 President's Budget.
  - Demonstrated automated welding techniques. ($.7M)
  - Performed a concept demonstration of a subsurface topographical navigation system aid integrating own-ship sensing and maneuvering systems. ($1.0M)
  - Conducted a full scale demonstration of Active Structural Control (ASC) for turning and boring applications. ($3.8M)
  - Demonstrated initial active structural control concepts for suppression of blade resonance and turbine external components. ($3.8M)
  - Investigated advanced manufacturing techniques for affordable acquisition of large quantities of EMTC material and evaluated the multiple commercial applications of this technology including non-marine applications. ($3.0M)

(U) <u>FY 1996 Program</u>:

- Demonstrate ASC shock attenuation techniques on full-scale platform. Demonstrate an acoustic sound cancellation system for stealth applications. ($1.5M)
- Conduct initial design, prototype development and test of active transmission vibration isolation mount components. ($1.4M)
- Integrate truss and hull structure at 1/4-scale. Test with magnetic levitation technology in submerged 1/4-scale model. ($2.4M)
- Conduct a demonstration of drag reduction and maneuvering control using EMTC on a Mk 48 torpedo in the Langley Tow Tank Facility. ($3.2M)
- Conduct supercavitation weapon technology proof-of-principle tests. ($1.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Submarine Technology, PE 0603569E, Project AS-01

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	32.4	7.5	9.9
Appropriated	31.6	N/A	N/A
Current Budget	31.6	9.5	0

(U) **Change Summary Explanation:**

FY 1996 Increase due to augmentation of funds for Active Structural Control Technology.
FY 1997 Decrease reflects the transfer of funding to PE 0603226E, Project EE-36, Advanced Ship/Sensor Systems to facilitate wider application of the technologies.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan	Milestones
Sep 95	Concept feasibility demonstration of active control of turbine blade resonance vibrations.
Sep 95	Completion of feasibility assessment of individual stealth technologies in submarine design concepts optimized for littoral operations.
Sep 95	Complete high speed laboratory testing of optimized Electromagnetic Turbulence Control (EMTC) tiles.
Feb 96	Demonstration of EMTC in a high speed water tunnel on a Mk-48 torpedo for drag reduction and control authority.
Feb 96	Full-scale demonstration of active shock attenuation system.
Jun 96	Testing of integrated 1/4-scale lightweight truss structures with magnetic levitation technologies in submerged model.
Jul 96	Concept feasibility demonstration of thermoacoustic source noise cancellation system.
Aug 96	Full-scale demonstration of active control of turbine blade resonance vibration.
Aug 96	Demonstrations of selected mission enhancements and signature reduction/management technologies in submarine design concepts.
Sep 96	Complete supercavitation projectile proof-of-principle test.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Defense Reinvestment, PE 0603570E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Reinvestment	208,067	500,000	0	0	0	0	0	0	N/A

(U) **Mission Description**: The purpose of the Defense Reinvestment program is to enhance the technological superiority and affordability of U.S. military technology through dual-use projects designed to directly improve military capabilities while also having potential pay-offs in the commercial sector. Key to meeting the program objectives is the selection of particular technology areas which can serve both a military and a commercial market, thereby encouraging a partnership and cost sharing between commercial industry and the Department of Defense.

(U) The initial competition held in FY 1993/1994 resulted in the selection of 212 proposed partnerships. Lessons learned from this competition were shared with potential future partners through nationwide multi-city outreach seminars. These lessons are analyzed and applied, as appropriate, to enhance the program each year.

(U) The FY 1995 program is soliciting proposals in a general competition with emphasis on developing dual-use technologies. Due to the FY 1995 congressional recission, only Technology Development will be completed. Changes in authorization language will be implemented to provide additional assistance for small businesses and increased, formal participation by the military services.

(U) The FY 1996 program will continue to develop and deploy promising new technologies with competitions planned for each year. The majority of the initial partnerships will have concluded their first phase by this time and studies will be initiated to analyze the success/results of these first efforts. At a minimum, the studies will search for strengths/weaknesses of each partnership and an overall assessment on the progress of the program.

(U) Funding for the Small Business Innovation Research (SBIR) Program is included within this Program Element to strengthen the role of small business in meeting dual-use research and development for both military and commercial applications.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Defense Reinvestment,
PE 0603570E

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:
- Signed agreements with partners selected under focused competition.
- Conducted out-reach seminars to assist potential partners in responding to general competition announced in FY 1994.
- Executed FY 1995 options on successful partnerships begun in FY 1993 and FY 1994.
- Selected and establish new partnerships resulting from the general competition announced in late FY 1994.
- Prepared and provided a report to Congress on program activities.

(U) FY 1996 Program:
- Initiate the FY 1996 competition.
- Execute FY 1996 options on partnerships begun in FY 1995 and prior years.
- Conduct additional out-reach seminars to discuss lessons learned from previous competitions.
- Complete selection process and identify new partnerships.
- Conduct formal assessment of FY 1993 program results.
- Sign agreements with partners selected under the FY 1996 competition.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	625.0	500.0	400.0
Appropriated	208.1	N/A	N/A
Current Budget	208.1	500.0	0.0

(U) **Change Summary Explanation**:

FY 1997 Program refocussed and elements transferred to PE 0603805E.

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Defense Reinvestment, PE 0603570E

(U) **Schedule Profile**:

Plan	Milestones
1st Qtr FY 95	Sign agreements with partners selected under focused competition.
3rd Qtr FY 95	Select and establish new partnerships identified during the general competition announced in late FY 1994.
1st Qtr FY 96	Initiate the FY 1996 competition.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Advanced Electronics Technologies,
PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Electronics Technologies	**409.763**	**419.863**	**443.458**	**446.910**	**435.469**	**470.081**	**527.446**	**Continuing**	**Continuing**
Distributed Sensor System MT-01	0	1,907	50,000	50,000	50,000	50,000	50,000	Continuing	Continuing
MIMIC MT-02	20,472	0	0	0	0	0	0	0	267,206
IR Focal Plane Array (IRFPA) MT-03	42,979	36,744	44,772	19,000	14,000	0	0	0	251,203
Electronic Module Technology MT-04	113,540	103,482	64,929	71,804	134,823	164,783	183,034	Continuing	Continuing
Tactical Information Systems MT-05	14,033	22,064	17,721	22,784	21,646	23,000	27,500	Continuing	Continuing
Microwave and Analog Front End Technology (MAFET) MT-06	19,475	48,841	47,921	59,114	58,201	17,467	27,811	Continuing	Continuing
Centers of Excellence MT-07	35,786	22,142	0	0	0	0	0	0	109,402
Manufacturing Technology Applications MT-08	47,798	78,942	63,850	33,455	23,000	9,951	0	0	264,174
Advanced Lithography MT-10	56,321	39,003	51,404	40,000	40,000	40,000	40,000	Continuing	Continuing

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Computer-aided Acquisition and Logistics Support MT-11	33,755	34,247	10,604	0	0	0	0	0	121,606
Microelectromechanical Systems (MEMS) MT-12	0	30,991	42,800	47,060	48,549	24,281	0	0	193,681

(U) **Mission Description**: The Advanced Electronics Technology program element is budgeted in the Advanced Development Budget Activity because it seeks to design and demonstrate state-of-the-art manufacturing and process technologies for the production of various electronics and microelectronic devices, sensor systems, actuators, gear drives that have both commercial and military applications. Introduction of advanced product design capability and flexible, scalable manufacturing techniques will enable the commercial sector to rapidly and cost-effectively satisfy military requirements and enhance the U.S. industrial base.

(U) This project addresses the special needs of distributed sensor systems which will be used to maintain battlefield information dominance and technological leadership in a wide range of military applications. Applications include spaceborne sensing systems, environmental monitoring systems, engine and process control systems, hand-held or portable cameras and range finding devices, portable data recorders, and implanted medical devices. These applications all require the integration of sensing, computing, and communicating into compact form-factors that will often have to survive in harsh environments.

(U) The IR Focal Plane Array project focuses on the establishment of a manufacturing capability for advanced infrared sensor arrays for major weapons systems. This industrial base will allow the systems to meet specification requirements at approximately 1% of the current cost.

(U) The goal of the Electronic Module Technology project is to allow for the timely insertion and rapid acquisition of state-of-the-art microsensors and actuators, conformal electronics and affordable, high performance application specific electronic module (ASEM), components into major military systems. These systems include automatic target

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recognition, electronic countermeasures and Signal Intelligence (SIGINT). This project includes Advanced Technology Demonstrations in ASEM and Rapid Prototyping of Application Specific Signal Processor.

(U) Tactical Information Systems project contains two major programs: Head Mounted Displays and the Tactical Information Assistants. These programs demonstrate high definition miniature displays to provide visual information to individual combatants and small groups who are remotely located from conventional visual information sources.

(U) The Centers of Excellence program finances demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life-cycle costs while improving quality.

(U) The goal of the Manufacturing Technology Applications program is to reduce the cost and acquisition leadtime of future military systems by integrating manufacturing process considerations during the product design phase, and by demonstrating high efficiency multi-product prototype factories. This program will also enable manufacturers to economically produce military variants of their commercial products in limited quantities through the introduction of flexible process technologies.

(U) Advanced Lithography technology has enabled the dramatic growth of integrated circuit capability. Advances have led directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability.

(U) The mission of the Computer-aided Acquisition and Logistic Support program is the transfer of Electronic Commerce (EC) technologies to small- and medium-size enterprises through a network of regional deployment centers.

(U) The Microelectromechanical Systems (MEMS) project is a broad and cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems.

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Distributed Sensor Systems MT-01	0	1,907	50,000	50,000	50,000	50,000	50,000	Continuing	Continuing

(U) **Mission Description**: This project addresses the special needs of distributed sensor systems which will be used to maintain situational awareness and battlefield information dominance. Distributed sensor systems applications include remote sensing systems, environmental monitoring systems, engine and process control systems, portable image acquisition systems, mobile data recording systems, and implanted medical sensors. These applications all require and are enabled by the integration of sensing, computation and communication into compact form-factors that will often have to survive in harsh environments.

(U) The project has the following major elements: 1) High Temperature Electronic Devices; 2) On-Chip Molecular Processing; 3) Radiation Tolerant Electronics; 4) Materials for Distributed Systems; and 5) Physical 3-D Packaging. The Physical 3-D Packaging element will develop new technologies for the assembly of compact, high-performance, electronic and electromechanical systems. The On-Chip Molecular Processing element will integrate advances in electromechanical fluid-handling systems with new devices and materials to develop and demonstrate chip-based control and detection of molecular reactions and products. The Materials for Distributed Systems element will integrate situational awareness sensor networks with tactical information systems to develop and demonstrate monitoring and control of battlefield environments. High Temperature Electronics and Radiation Tolerant Electronics will develop and demonstrate electronics devices and materials suitable for long-term operation in harsh environmental conditions.

(U) **Program Accomplishments and Plans**:

(U) FY 1996 Program:

- Initiate efforts to develop electronic components and assembly technologies to support distributed sensing, computing, and communicating applications. ($1.9M)

(U) FY 1997 Program:

- Develop fabrication process for high power, high temperature (200°C) silicon carbide switches. ($4.0M)
- Initiate program to develop on-chip integrated microfluidic systems for improved detection and control of molecular reactions with emphasis on the development of new materials and control of reactions. ($16.6M)
- Develop physical 3-D packaging technologies which will lower systems costs, shorten manufacturing cycles and enable error-free transitions to manufacturing. ($10.0M)

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Advanced Electronics Technologies,
PE 0603739E, Project MT-01

- Initiate Radiation Tolerant Electronics program to address the needs of tactical and distributed sensor systems. ($10.0M)
- Initiate Materials for Distributed Systems program with laboratory demonstrations to validate sensitivities and selectivities in a harsh environment and integrate results with high-fidelity models and simulations of battlefield situations. ($9.4M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	1.9	26.5
Appropriated	0	N/A	N/A
Current Budget	0	1.9	50.0

(U) **Change Summary Explanation**:

FY 1997 Increased to support the development of microelectronics for distributed sensor systems to support DoD needs.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 96	Initiate efforts to develop innovative materials, devices, and processes for cost-effective radiation tolerant electronics.
Feb 97	Initiate component assembly technology development.
Sep 97	Demonstrate prototype high-power switches at 200°C.
Oct 97	Initiate efforts to develop on-chip integrated molecular processing.
Sep 98	Demonstrate molecular reaction detection and control.
Oct 98	Demonstrate paperless transfer of assembly/packaging design to manufacturing.
Dec 98	Demonstrate integrated electronic circuits which meet the radiation tolerance requirements for distributed sensing applications.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
MIMIC MT-02	20,472	0	0	0	0	0	0	0	267,206

(U) **Mission Description**: This project provided for the acceleration of development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (ICs). The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program provided previously unavailable microwave and millimeter-wave integrated circuits to enable DoD systems to meet size, weight and power constraints at the lowest possible cost. Its primary thrust was to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations was accelerated and, thus provided the United States with a technological lead in deploying MIMIC-based military systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completion of program including delivery of MIMIC chips, modules and brassboards and demonstrations of advanced technology and hardware. ($20.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	25.2	0	0
Appropriated Budget	24.3	N/A	N/A
Current Budget	20.5	0	0

(U) **Change Summary Explanation**:

FY 1995 Reduction reflects completion of program.

(U) **Schedule Profile**: N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
IR Focal Plane Array MT-03	42,979	36,744	44,772	19,000	14,000	0	0	0	251,203

(U) **Mission Description**: The Infrared Focal Plane Array project addresses the technology necessary to produce affordable, infrared (IR) sensor arrays, essential to major weapon systems. The focal plane array consists of a two dimensional detector array sensitive in a broad spectral range, integrated with unique signal processing to enhance performance and provide more efficient utilization of the information. The critical elements of the technology addressed in this program include the infrared material, detector array fabrication, read-out electronics, cryogenic packaging and testing, and module assembly. Processing and fabrication techniques focus on the production of affordable arrays, at low volume, in the configurations required by weapon systems. Performance enhancements in uncooled infrared and near-infrared sensors are also being addressed to provide an integrated, broadband two dimensional sensor array without the cryogenic package usually associated with infrared sensors. Elimination of the cryogenic package dramatically reduces the cost of the sensor module, and provides a sensor package compatible with a wide range of system applications, including navigation, targeting and manportable systems. The solid state integrated sensor also solves the problem of blooming in the presence of high intensity sources, which is encountered with current low light level visible and near infrared sensors. Arrays will be built in the configuration required for missile seekers; target acquisition and navigational platforms; search and track; and threat warning systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated state of the art 240 x 2 and 480 x 4 focal plane arrays built at one hundred times less cost than at the initiation of the program. ($9.7M)
- Integrated dry processing into infrared detector fabrication, and produced 480 x 4 arrays meeting system screening criteria. ($7.0M)
- Developed cluster tool compatible infrared detector processes, and demonstrated 480 x 4 arrays, meeting system field requirements. ($18.3M)
- Produced 128 x 128 infrared focal plane arrays with four times greater sensitivity than current missile seeker requirements. ($5.0M)
- Demonstrated wafer level cold probe of infrared focal plane arrays and integrated capability into fabrication lines. ($3.0M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-03

(U) FY 1996 Program:

- Complete development of standard electronic cells for rapid design and fabrication of infrared read-out circuits. ($8.0M)
- Demonstrate uncooled focal plane arrays hybridized to low noise analog readout circuits. ($4.7M)
- Demonstrate focal plane array fabrication using four inch diameter silicon wafers. ($14.0M)
- Verify computer aided design tool for infrared sensors; including cryogenic packaging. ($10.0M)

(U) FY 1997 Program:

- Demonstrate 480 x 640 uncooled infrared sensor with 0.1 degree thermal sensitivity. ($7.5M)
- Demonstrate the capability to rapidly design and fabricate cryogenic packages for a wide range of system applications. ($8.3M)
- Complete infrared focal plane array flexible manufacturing capability, including staring arrays employing 0.8 micron analog CMOS process. ($11.0M)
- Evaluate laboratory performance of uncooled solid state sensor with anti-blooming and on-chip pixel gain. ($18.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	44.1	36.7	19.3
Appropriated	43.0	N/A	N/A
Current Budget	43.0	36.7	44.8

(U) **Change Summary Explanation**:

FY 1997 The increase to the program addresses an accelerated effort in uncooled sensors with broad spectral response. Elimination of the cryogenic package represents a major step toward reducing the cost of sensor module and providing sensors compatible with a wide range of systems.

(U) **Other Program Funding Summary Cost**: N/A

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-03

(U) **Schedule Profile**:

Plan	Milestones
Jan 96	Demonstrate process module concept for multipurpose scanning arrays.
Jun 96	Demonstrate equipment with flexibility to produce various infrared focal plane array configurations on the same line.
Sep 96	Demonstrate large-area staring and scanning array for search and track, target acquisition, and missile seeker systems.
Mar 97	Demonstrate gain stage integrated into the pixel unit cell.
Jul 97	Evaluation of high performance uncooled sensor array.
Sep 97	Demonstrate high-yield infrared focal plane array manufacturing facility capable of varying production rates from small lots to high throughput rates.
Dec 97	Completion of modular infrared focal plane array final assembly, integration and test capability, scalable from low volume (single wafer processing) to higher production volume (ten wafer lots @ over 10,000 wafers per year); with single wafer cycle time of ten days.
Dec 97	Demonstrate anti-blooming capability of solid state sensor array.
Mar 98	Field evaluation of large area uncooled sensor with less than 0.1 degree thermal sensitivity.
Jun 98	Evaluation of integrated sensor with broad band infrared response.
Dec 98	Demonstrate solid state sensor with improved anti-blooming performance.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Module Technology MT-04	113,540	103,482	64,929	71,804	134,823	164,783	183,034	Continuing	Continuing

(U) **Mission Description**: The Electronic Module Technology Project is a broad initiative to substantially decrease the cost and increase the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the design and fabrication of various types of digital, analog, and mixed signal modules consisting of electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards and emerging technologies such as high density Multichip Modules (MCMs).

(U) The project has five major objectives: (1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; (2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; (3) provide a robust manufacturing infrastructure for electronic modules; and (4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs).

(U) The project has the following major elements: (1) Application Specific Electronic Modules (ASEM); (2) Multichip Integration (MCI); (3) Rapid Prototyping of Application Specific Signal Processors (RASSP); (4) High Density Microwave Packaging (HDMP); and (5) Electronic System Manufacturing (ESM). ASEM will reduce the non-recurring engineering time and cost for designing and inserting complex electronic modules. MCI will produce order of magnitude reductions in manufacturing cost and accelerate the acceptance and insertion of Multichip Integration technologies. RASSP is a major ARPA/tri-Service initiative which seeks to dramatically reduce the development time and life cycle cost of advanced signal processing capability while ensuring state of the art performance when the processor is fielded, not just when it is first defined. HDMP is developing microwave frequency, thin, lightweight multichip packages for use in applications such as active scanned arrays. It is expected to result in cost reductions of up to 75% compared to present approaches with excellent performance. The ESM program will develop new technologies for the assembly of compact, high-performance, electronic and electro-mechanical systems. The programs leverage related efforts developing component technologies such as semiconductors, displays, MCMs, and Microelectromechanical Systems (MEMS), as well as physical Computer Aided Design (CAD) tools in order to achieve a dramatic reduction in system assembly cost.

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(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Developed microwave frequency multichip module housings, internal packaging interconnections, array interconnect technology, module assembly and integration and Computer Aided Design (CAD) tools and databases. Perform tests on modules to assess performance; assess projected per unit cost savings. ($5.2M)
- Continued the Application Specific Electronic Modules (ASEM) program with heightened emphasis on mixed signal modules and application demonstrations. Delivered new software tools to streamline the error-free design of Multichip Modules (MCMs). ($23.8M)
- Continued the Multichip Integration (MCI) program with further development of manufacturing equipment, with a focus on the delivery of production modules for military aircraft and other dual-use applications. Demonstrated pilot production line for roll-to-roll fabrication of high density laminate MCMs. ($24.6M)
- Demonstrated improved signal processor design environment incorporating advanced CAD technology, VHDL extensions, and new signal processing algorithms. Completed first Rapid Prototyping of Application Specific Signal Processors (RASSP) system demonstration prototypes and delivered preliminary RASSP benchmark evaluations. Initiated technology transition activities. ($42.8M)
- Demonstrated and multi-site evaluated a sensor cluster for environmental monitoring; multi-device chip run with over twenty different devices (including accelerometers, gyroscopes, flow-sensors, and resonators) fabricated from a single, common, high-volume surface micromachining process of successful operation of a vertical-wall silicon carbide reactor to deposit sensor-grade films over multiple, 100 mm wafers; inserted and tested Microelectromechanical Systems (MEMS) inertial measurement devices in projectile munitions. ($10.2M)
- Demonstrated single-crystal, micromachined tunneling tips with integrated, three-dimensional positioning actuators; prototype multiple-component conformal MEMS sensing and actuating arrays applied to delta-wing model and operated in wind-tunnel tests; demonstrated organization and processing of signals from sensors distributed across control surfaces of underwater vehicles. ($4.4M)
- Disseminated and continued development of a multi-use design library for MEMS devices and systems; dissemination of CAD tools that are coupled to shared fabrication services; completion and continued offering of ninth shared surface micromachining fabrication run reaching over 350 users in the government, industry and academia. ($2.5M)

(U) FY 1996 Program:

- Complete development of required microwave packaging approaches and interconnection circuitry; produce and demonstrate required multichip microwave assemblies. Reassess projected per unit cost savings. ($9.1M)

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- Demonstrate complete end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) design framework with additional demonstration hardware and benchmark evaluations. Develop accelerated framework standards, improved Computer Aided Design (CAD) technology for system testing, and VHDL reuse libraries. Accelerate technology transfer activities. ($38.1M)
- Continue Application Specific Electronic Modules (ASEM) program to reach one month turn-around time and $25K NRE cost for digital Multichip Modules (MCMs). Demonstrate high volume production technology for producing known-good die. ($28.2M)
- Continue Multichip Integration (MCI) program with the delivery of high volume/low cost laminate MCM technology and develop optimized modules and mixed signal applications. ($25.1M)
- Initiate the Electronic Systems Manufacturing (ESM) program by identifying breakthrough technologies to lower system assembly costs, shorten manufacturing cycles, and enable error free transitions to manufacturing. ($3.0M)

(U) FY 1997 Program:

- Demonstrate microwave packaging array performance of advanced multichip assemblies; establish robust manufacturing approach resulting in significant cost savings; deliver all required hardware and program documentation. ($9.2M)
- Demonstrate final end-to-end RASSP signal processor design environment. Complete technology insertion demonstrations, benchmarking analysis, and technology transition activities. ($7.5M)
- Continue ASEM program and demonstrate new ASEM foundry capability for flexible production of modules with board-level integration. ($18.9M)
- Continue Multichip Integration program to demonstrate order of magnitude reductions in MCM manufacturing costs and MCM technology insertions. Continue insertion of MCM technology into dual-use products such as workstations, engine control and wireless communications. ($25.3M)
- Initiate program to demonstrate new paradigms for integrating electronic, electromechanical, and electro-optical components to enable small, lightweight, battlefield information systems. ($4.0M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	119.1	134.5	133.8
Appropriated	117.8	N/A	N/A
Current Budget	113.5	103.5	64.9

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-04

(U) **Change Summary Explanation**:

FY 1995 Reduction due to below threshold reprogramming to finance a TRP earmark.
FY 1996-97 Adjustments reflect reprioritization of DoD resources to fully fund approved programs. Microelectromechanical Systems (MEMS) program transferred to MT-12 in FY 1996 and beyond.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Sep 95	Complete High Density Microwave Packaging (HDMP) initial development of housings, inter-chip and inter-layer interconnections and testing.
Sep 95	Complete HDMP developments of initial versions of specialized microwave packaging Computer Aided Design (CAD) tools and databases.
Mar 96	Demonstrate improved versions of Rapid Prototyping of Application Specific Signal Processors (RASSP) design environment.
Mar 96	Demonstrate Multichip Modules (MCM) insertions in OH-58D Image Processor.
Jun 96	Complete high density microwave packaging (HDMP) final development of housings, interconnect approaches and perform initial module testing.
Jul 96	Demonstrate Application Specific Electronic Modules (ASEM) Technology for assuring known-good die.
Aug 96	Begin assembly of HDMP brassboard array and perform initial testing.
Sep 96	Deliver Multichip Integration (MCI) Manufacturing Technology to the dual-use market.
Jun 97	Demonstrate final end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) signal processor design.
Jul 97	Demonstrate microwave packaging array performance.
Sep 97	Demonstrate new mixed signal ASEM foundry capability.
Jun 98	Demonstrate efficient 3-D electromagnetic modeling capability.
Sep 98	Demonstrate MCM substrates with integrated passive components.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Information Systems MT-05	14,033	22,064	17,721	22,784	21,646	23,000	27,500	Continuing	Continuing

(U) **Mission Description**: This project is a major DoD effort to develop the technology for displays and portable information systems for use in a variety of military systems. The project has two major programs: Head Mounted Displays (HMDs) and Tactical Information Assistants (TIAs). The Head Mounted Display program is developing world-class miniature displays and integrating these displays into head and helmet mounted configurations for use by pilots, combat vehicle crews and individual warriors as well as for virtual environments and simulation. It is expected that by the year 2000, the military will use more miniature displays for head mounted applications than the cumulative total of all other types of flat panel displays. This is the only DoD program addressing this need. The TIA program will develop portable information systems that combine communication, computation, and navigation for use by individual warriors. The systems will use state-of-the-art displays, multichip modules, microelectromechanical devices, global positioning chips, low power electronics, and efficient energy sources. Emphasis is on augmenting things already carried or worn by warriors (weapons, clothing, binoculars, rangefinders, radios, etc.) with high information content components. Resulting systems will promote enhanced vertical and horizontal battlefield information infrastructures.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Head Mounted Displays - Completed circuit designs for 12 micron pixel and integrated display drivers for 2560 x 2048 pixel display in both liquid crystal and electroluminescent technologies. Completed system tradeoff studies for integrating a 1280 x 1024 pixel electroluminescent display into a medical head mounted display system. Completed ride motion simulation and SIMNET evaluations of the Combat Vehicle Crew head mounted display. ($8.6M)
- Tactical Information Assistants - Initiated four projects including: Technology Advanced Mini Eysafe Rangefinder (TAMER), VuMan TIA, Maintenance and Repair Support System (MARSS), and VoiceMap. First phase of TAMER and VuMan TIA have been demonstrated in field exercises with US Army 2nd Armored Division and 1st Marine Expeditionary Forces, respectively. Initial architecture designs for MARSS and Voice Map have been completed. ($5.4M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E, Project MT-05

(U) FY 1996 Program:

- Head Mounted Displays - Emphasis will be on continuing the development of 2560 x 2048 liquid crystal and electroluminescent displays, significantly decreasing the voltage requirements for electroluminescent displays and demonstrating a high-resolution head mounted display for aircrew pilots, combat vehicle crews, individual soldier and simulation applications. ($11.1M)
- Tactical Information Assistants (TIA) - Emphasis will be on demonstration of four systems for use by individuals remotely located from conventional information sources. Initiate two additional TIA developments to address combat information connectivity with individual warriors. ($11.0M)

(U) FY 1997 Program:

- Head Mounted Displays - Complete development of 2560 x 2048 pixel displays and demonstrate in a military head mounted application. ($6.2M)
- Tactical Information Assistants - Two previously developed TIAs will be significantly reduced in size, weight and power over a 2 year period. A goal is to provide increased functionality in a pager sized device operating on commercially available batteries. These devices will be built using Shape Deposition Manufacturing processes to demonstrate rapid cost effective prototyping. ($11.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	14.7	20.2	17.7
Appropriated	15.5	N/A	N/A
Current Budget	14.0	22.1	17.7

(U) **Change Summary Explanation**:

FY 1996 Increase reflects minor repricing for head mounted displays.

(U) **Other Program Funding Summary Cost**: N/A

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-05

(U) **Schedule Profile**:

Plan	Milestones
Oct 95	256 x 256 pixel displays demonstrated.
Oct 95	Maintenance and Repair Support System (MARSS) prototype.
Jul 96	Complete low voltage electroluminescent (EL) project.
Nov 96	2560 x 2048 pixel displays demonstrated.
Jan 97	Integrate CCD, memory, wireless interface in Technology Advanced Mini Eysafe Rangefinder (TAMER).
Feb 98	Demonstrate low power display.
Mar 98	Demonstrate air combat air controller Tactical Information Assistant (TIA).

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microwave and Analog Front End Technology MT-06	19,475	48,841	47,921	59,114	58,201	17,467	27,811	Continuing	Continuing

(U) **Mission Description**: Microwave and millimeter wave frequency technology for DoD electronic weapon systems is at a critical crossroads. Great progress was been made under the microwave and millimeter wave integrated circuit (MIMIC) program in terms of maturing the gallium arsenide industrial community. The DoD is now far ahead of the commercial world in microwave and millimeter wave technology in terms of performance characteristics. However, in many cases, radio frequency (RF) system costs are still a major impediment to fielding cost effective DoD weapon systems. Material, processes and design technology advances must be undertaken to sustain an effective defense capability and to maintain U.S. dominance in this critical technology area. The Microwave and Analog Front End Technology (MAFET) program is the only DoD effort directed at significantly reducing non-recurring costs for military microwave/millimeter wave sensor systems through improved computer aided design capabilities. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave components. The MAFET program addresses the essential foundation for all DoD systems and programs making use of microwave and millimeter wave solid state technology.

(U) Specifically, the MAFET program will provide the DoD with the state-of-the-art electronic systems that it needs to maintain its force multiplying capability. The program will: (1) reduce design time and cost for every RF system being developed or upgraded through an improved microwave/millimeter wave design environment; (2) break the very expensive and time-consuming current practice of design-build-test--redesign-rebuild-retest; (3) put in place repeatable, robust processes to produce high frequency components; and (4) make strategic investments in critical passive, packaging and integrated circuits devices needed for millimeter wave systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Begin implementation of microwave/millimeter wave computer aided design (CAD) environment that will reduce non-recurring chip/module/system costs by providing improved design, simulation capabilities. This task includes enhancement of CAD tools specifically needed for microwave and millimeter wave circuit use (not digital circuit design tools which are different), tool set integration, needed circuit and module model development, and work on the needed Microwave Hardware Description Language (MHDL). ($9.5M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-06

- Initiated advanced sensor technology development programs in the areas of fabrication technology, devices and circuits, packaging and passive components, millimeter wave test, and multichip assembly (MCA) foundries. ($10.0M)

(U) FY 1996 Program:

- Continue microwave/millimeter wave computer aided design (CAD) environment with quantitative demonstration of ability to reduce time and cost of producing microwave and millimeter wave products. Continue development and implementation of Microwave Hardware Description Language (MHDL). ($14.2M)
- Continue development of advanced sensor technology with demonstrations of improved performance coupled with cost savings. Demonstrate state-of-the-art millimeter wave probes. ($29.5M)
- Select most appropriate system application areas and begin demonstration tasks that will allow quantitative assessment of subsystem and system performance improvements and cost savings resulting from Microwave and Analog Front End Technology (MAFET) activities. Begin benchmark development and assessment of design tool advances. ($5.1M)

(U) FY 1997 Program:

- Continue microwave/millimeter wave computer aided design environment development with implementation of advanced microwave/millimeter wave CAD tools and integrated tool sets and implementation of improved models. Conduct assessment and demonstration of design environment effectiveness through quantitative assessment of benchmarking metrics. Continue development and implementation of MHDL. ($18.4M)
- Complete advanced sensor technology developments in the area of millimeter wave test. In addition demonstrate: (1) millimeter wave InP high electron mobility transistor (HEMT) monolithic microwave integrated circuits (MMICs) with high yield; (2) low cost, high Indium-content field effect transistor (FET) materials on gallium arsenide; (3) microwave and millimeter wave device arrays; (4) advanced mixed signal chips for highly integrated frequency synthesizers; (5) low cost MMIC components for electronic warfare transmitter arrays; (6) miniaturized microwave and millimeter wave ferrite circulators; (7) automated millimeter wave load pull test station; and (8) on-wafer known good die test station. Continue development of remaining advanced sensor technology with demonstrations of improved performance coupled with cost savings. ($22.5M)
- Provide quantitative demonstrations of performance improvements and cost savings achieved through MAFET program activities for selected, critical system applications. ($7.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E, Project MT-06

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	22.3	50.7	52.9
Appropriated	20.5	N/A	N/A
Current Budget	19.5	48.8	47.9

(U) **Change Summary Explanation**:

FY 1995-97 Changes due to internal program reprioritization.

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-06

(U) **Schedule Profile**:

Plan	Milestones
Jun 96	Standard model format for foundries; benchmark of baseline system.
Jul 96	Fabricate and test InP millimeter wave integrated circuits.
Mar 97	Standard for simulator and design environment interoperability.
Mar 97	Produce broadband electronic warfare multichip assemblies.
Jun 97	Demonstrate millimeter wave test probes and automated on-wafer test station.
Dec 97	Interactive simulation from layout.
Mar 98	Physics based active device model generator; fully interoperable design environment tools.
Dec 98	Develop plastic high density modules.
Dec 98	Deliver low cost miniaturized circulators for microwave and millimeter wave applications.
Sep 99	1000x speed improvement on EM simulation of arbitrary structures; behavioral specification simulation capability.

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DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Advanced Electronics Technologies,
PE 0603739E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Centers of Excellence MT-07	35,786	22,142	0	0	0	0	0	0	109,402

(U) **Mission Description**: This project provides funding for Centers of Excellence including the Robert C. Byrd Institute for Advanced Manufacturing at Marshall University, the Focus: Hope National Center for Advanced Technologies (NCAT) and the Center for Computing Excellence at the Greater Philadelphia Consortium. The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems.

(U) The Institute for Advanced Flexible Manufacturing provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness. The National Center for Advanced Technology (NCAT) is a component of the Focus: Hope Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research.

(U) This project also includes funding for the U.S.-Japan Management Training Program whose purpose is to build a growing infrastructure of American scientists and engineers with knowledge about the Japanese R&D enterprise and providing training in the Japanese language.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed the installation of the planned manufacturing neighborhoods at NCAT. ($13.0M)
- Continued the on-going technology development at Institute for Advanced Flexible Manufacturing which includes technology evaluation, research into dual-use flexible manufacturing and technology transfer to local business. ($4.0M)
- Established a Regional Consortium for Advanced Education and Training Technologies which will provide for the development of computer software education and training technologies required to further adult training in advanced technology jobs critical to the defense industry. It will also focus on the retraining of defense personnel for industry jobs. ($10.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-07

- Created eleven centers of excellence to support students, researchers, and executives to understand Japan's manufacturing infrastructure, culture and language. ($8.8M)
- Northeast Consortium.

(U) FY 1996 Program:

- Develop, demonstrate and evaluate new technologies for insertion and transfer to manufacturing centers and industry, with a focus on small to medium manufacturing companies. ($7.0M)
- Develop software to integrate 3D computer model with numerically controlled machine tools, and demonstrate its production capability. ($4.0M)
- Demonstrate an electronic (digital) library in the context of education and training of machinists. ($3.0M)
- Continue to support the centers of excellence to train students and professionals to understand Japan's manufacturing infrastructure, culture and language. ($8.1M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	15.0	23.6	19.9
Appropriated	25.0	N/A	N/A
Current Budget	35.7	22.1	0

(U) **Change Summary Explanation**:

FY 1995 Increase reflects congressional direction to fund the Northeast Consortium.

(U) **Other Program Funding Summary Cost**: N/A

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(U) **Schedule Profile**:

Plan	Milestones
Sep 95	Complete installation of the manufacturing neighborhoods.
	Complete Center for Computing Excellence at the Greater Philadelphia Consortium.
Sep 96	Develop, demonstrate and evaluate technology insertion and technology transferred to medium and small manufacturing companies.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Manufacturing Technology Applications MT-08	47,798	78,942	63,850	33,455	23,000	9,951	0	0	264,174

(U) **Mission Description**: Future military systems will be affordable only if the manufacturing process is considered as an integral part of product design, production takes place in flexible, multi-product factories, and if advanced manufacturing technology is combined effectively with advanced business practices. This program focuses on demonstrations of process technology combined with innovative industrial practices, and will measure the improvements in cost, schedule and quality achievable in key defense product areas. Three major initiatives are included in the FY 1995-1998 program: Affordable Multi-Missile Manufacturing (AM3); Agile Manufacturing Pilot Programs; and the ARPA/Tri-Service Flexible Interferometric Fiber Optic Gyroscope (IFOG) Manufacturability Program.

(U) The Affordable Multi-Missile Manufacturing (AM3) program is an Advanced Technology Demonstration initiated in FY 1995. The AM3 objective is to demonstrate the feasibility of 25-50% reductions in the unit cost of tactical missiles, both in ongoing missile production programs and in new missiles and major modifications. This will be accomplished by teams of missile prime contractors, component suppliers and manufacturing equipment and software vendors who develop and demonstrate the combined effects of advanced manufacturing and assembly systems and processes, missile value engineering changes, and acquisition reform and business practice innovations. A major technical theme is to achieve economies across a mix of missiles to compensate for the decline in individual missile quantities. Demonstrations will be conducted in the design and manufacture of components and guidance and control/seeker assemblies for multiple missiles, including R&D and production programs.

(U) Agile Manufacturing is an industry-developed vision for 21st century manufacturing, which focuses on the ability to thrive in an environment of changing product technologies, customer demands, and development and production team members. This new paradigm is ideally suited to the needs of defense manufacturing in the future. Agile Manufacturing Pilot Programs are structured to evaluate the manufacturing enterprise concepts and enabling technology required for agility on and above the factory floor. Since over 50% of the cost of weapon systems is attributable to components from lower tier suppliers, the major emphasis is on tightly integrating the supplier chain and other elements of the manufacturing enterprise.

(U) Interferometric Fiber Optic Gyroscopes (IFOG) are emerging as preferred technology for future military and commercial inertial navigation applications. The IFOG Manufacturability Program emphasis will be on achieving the design and manufacturing flexibility required to make low volume Defense access to high volume commercial production

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economically viable. This program will develop the large throughput robotic assembly, packaging and testing technologies necessary to fabricate navigation-grade (0.01 deg/hr) IFOGs at less than $1,500 per axis as a goal. This will enable affordable, accurate (1nm/hr) inertial navigators for use during extended periods of Global Positioning System (GPS) signal outage due to enemy jamming. Flexible manufacturability enables, from the same production line, fabrication of navigation grade, military tactical grade (0.1 - 1.0 deg/hr) IFOGs and lower performing (> 1 deg/hr) commercial IFOGs. Example technology development areas include: (1) low loss, low reflectivity, polarization-preserving optical connectors between optical fiber subassemblies, optical sources, detectors and miniature integrated optical circuits; (2) rapid, precision coil winding machines; (3) geometrically stable, environmentally robust (temperature and vibration) packaging of critical optical subassemblies; and (4) automatic testing machines. Phase 1 will identify IFOG manufacturing process requirements for components, subassemblies and complete IFOG units. Phase 2 will demonstrate advanced manufacturing methods, controls and equipment. Phase 3 establishes and demonstrates a prototype automated, flexible IFOG manufacturing facility, transitioning the manufacturing processes and controls from Phase 2.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Initiated detailed functional design of the multi-missile enterprise, including definition of enabling tools and technology to be demonstrated in Phase 2, layout of the factories, definition of key organization interfaces and business practice improvements, and definition of proposed changes in missile design. ($11.4M)
- Initiated AM3 cost analysis and benefits measurement process, including predicted metrics for the enterprise, comparison to relevant benchmarks from military and commercial firms, assessment of impact on the target missile mix, and development of the validation plan for Phases 2 and 3. ($1.2M)
- Initiated Agile Manufacturing Enabling Technology Demonstrations of decision support, enterprise command and control, and flexible shop floor control. ($8.0M)
- Initiated Agile Manufacturing Advanced Business Process Demonstrations of activity based cost systems, agile workforce management systems, supplier chain management integration, and contracting approaches for instant partnerships. ($6.3M)
- Initiated Agile Manufacturing Pilot Programs and enterprise level demonstrations of technology and business practices in space launch vehicle manufacturing and in supplier chains for large metal castings. ($6.4M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08

- Continued Agile Manufacturing industry forum activities to develop technical underpinnings and supporting data for agility concepts, education and tech transfer, and integration of demonstration results into an agility tool kit. ($5.0M)
- Defined advanced manufacturing processes for Interferometric Fiber Optic Gyroscopes (IFOG) components and subassemblies. ($.4M)
- Defined advanced architectures and manufacturing processes for IFOG units. ($9.1M)

(U) FY 1996 Program:

- Complete AM3 Phase 1, approve validation plans, and initiate Phase 2 demonstrations to assess and mitigate risks, including simulation and modeling, design and component-level manufacturing demonstrations, and qualification testing. ($15.7M)
- Competitive awards to research labs, universities and manufacturing system vendors for development of technology to fill gaps identified in AM3 Phase 1. ($8.7M)
- Continue AM3 technical integration activities, conduct independent evaluation of contract cost/savings analyses, and complete initial set of benchmark comparison studies for the missile sector. ($2.7M)
- Complete Agile Manufacturing business practice demonstrations and documentation, insert results in Pilot Program testbeds, and disseminate results for DoD and industry implementation. ($8.4M)
- Complete Agile Manufacturing enabling technology demonstrations, initiate beta test in Pilot Programs, and transfer technology through the Industry Forum and through vendor products. ($8.4M)
- Continue Agile Manufacturing pilots in space launch vehicles and castings. ($9.4M)
- Continue Agile Manufacturing industry forum activities, including delivery of first version of agility toolkit. ($5.0M)
- Develop and implement manufacturing processes for coil winding and optical components/subassemblies. ($3.8M)
- Complete Interferometric Fiber Optic Gyroscopes (IFOG) architectures and begin to develop and implement manufacturing processes. ($16.8M)

(U) FY 1997 Program:

- Complete AM3 Phase 2 component-level validation demonstrations. ($6.2M)
- Downselect to two pilot enterprises for AM3 Phase 3, and initiate cost-shared implementation and demonstration of concepts and technology across the target missile mix. ($15.3M)
- Complete initial demonstrations of technologies to fill gaps identified in AM3 Phase 1, expand benchmarking studies, and continue technical integration and independent cost analysis. ($5.5M)

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- Complete Agile Manufacturing pilots in space launch vehicles and metal castings, transfer results through the Industry Forum and through vendor products and network services. ($10.0M)
- Complete Agile Manufacturing industry forum activities, transition to self-sustainment that does not require DoD funding. ($5.0M)
- Evaluate wound coils and packaged subassemblies. ($4.8M)
- Continue to implement brassboard IFOG unit manufacturing processes. ($14.7M)
- Initiate Phase 3 (e.g., procure long-lead items). ($2.3M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	54.7	78.9	91.2
Appropriated	48.7	N/A	N/A
Current Budget	47.8	78.9	63.9

(U) **Change Summary Explanation**:

FY 1995 Adjustment due to minor repricing.
FY 1997 Decrease reflects completion of the Agile Manufacturing enabling technology.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 96	Define processes for assembling IFOG optical components (e.g. sources, detectors).
Apr 96	Establish IFOG unit architectures and baseline configurations.
Apr 96	Complete IFOG investigations of designs and methods for coil winding.
Apr 96	Approve validation plans and initiate AM3 Phase 2 contracts.
Sep 96	Complete Agile Manufacturing enabling technology and business practice demos.
Oct 97	Complete IFOG advanced coil winding machinery.
Oct 97	Demonstrate winding of coils with advanced coil winding machinery.

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Jul 97	Complete AM3 Phase 2 demos, downselect to two contractors for Phase 3.
Aug 97	Demonstrate production of novel wavelength stabilized IFOG light source.
Sep 97	Complete initial integrated pilots and transition Industry Forum to self-sustainment.
Mar 98	Demonstrate assembly of brassboard IFOG units.
Dec 99	Complete AM3 Phase 3 multi-missile manufacturing demos.

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BA 3 Advanced Development

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Advanced Electronics Technologies,
PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Lithography MT-10	56,321	39,003	51,404	40,000	40,000	40,000	40,000	Continuing	Continuing

(U) **Mission Description**: Lithography technology has enabled the dramatic growth in microelectronics capability over the past three decades and microelectronics is a key to improved weapon system performance. The improved capabilities in semiconductor technology contribute to significant system gains in speed, reliability, cost, power consumption, and weight. Advanced microelectronics technology is essential for computing and signal processing throughout essentially all military systems, including command, control, communications, and intelligence, electronic warfare, and beam forming for radar and sonar. Further improvements in areas such as target recognition, autonomous guided missiles, and digital battlefield applications require microcircuits with smaller features to meet the operational speed, power, weight and volume constraints of these systems.

(U) Current microelectronics fabrication utilizes feature sizes of 0.35 microns. The Advanced Lithography Program emphasizes longer term research with expected high payoff in the fabrication of semiconductor devices with 0.1 micron feature sizes. These programs, including ion and electron projection, will develop technology for sub 0.1 micron features. Current programs in cross-cutting technologies (mask, stages, resists, metrology) and x-ray lithography will be completed in two - three years. The projection ion beam and e - beam developments will demonstrate alpha tool versions late in the decade.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Developed mask technology and fabricated a perfect x-ray mask for 64 megabit memory. ($22.0M)
- Synchrotron stepper was installed at synchrotron. ($10.0M)
- 193 nm optical lithography was used to print 0.09 micron features. ($3.0M)
- Picosecond laser source for x-rays demonstrated 10% conversion efficiency with significant reduction of debris. ($4.0M)
- Formed the Proximity X-Ray Association and fabricated 0.1 micron logic with stage delays of 30 picoseconds. ($12.0M)
- Projection e-beam printed 0.15 micron features and space charge experiments were completed for projection ion beam. ($5.3M)

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(U) FY 1996 Program:

- Demonstrate prototype projection electron-beam and ion-beam lithography lenses. ($10.0M)
- Demonstrate processing using x-ray lithography and point source development. ($15.0M)
- Develop alignment sub-assemblies and mask technology for 0.18 micron lithography system. ($14.0M)

(U) FY 1997 Program:

- Demonstrate stage control for lithography tools with 0.12 micron capability. ($6.0M)
- Demonstrate breadboard subsystems of electron-beam and ion-beam projection lithography systems. ($14.0M)
- Fabricate devices and x-ray sources for 0.18 micron design rules. ($25.0M)
- Improve e-beam writing, inspect, repair, and processing for 0.12 mask capability. ($6.4M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	57.7	39.0	61.4
Appropriated	54.1	N/A	N/A
Current Budget	56.3	39.0	51.4

(U) **Change Summary Explanation**:

FY 1995 Increase necessary to satisfy commitments in ion-beam research.
FY 1997 Decrease reflects the descoping of projection systems, but continued research of Advanced Technologies.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mar 96	Deliver prototype x-ray masks with 0.18 µm features.
Jun 96	Demonstrate mask repair tool for masks with 0.15 micron features.
Sep 96	Fabricate devices with 0.18 micron features.

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Jan 97	Deliver mask writer for writing 0.18 µm features.
Mar 97	Demonstrate x-ray source suitable for x-ray prototype tool for 0.18 µm features.
Mar 97	Demonstrate stage control to 10 nm, suitable for 0.12 micron lithography tools.
Apr 97	Demonstrate breadboard (alpha) version of electron-beam lithography system.
Dec 97	Demonstrate alpha version of ion beam lithography tool.

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RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Commerce Resource Centers MT-11	33,755	34,247	10,604	0	0	0	0	0	121,606

(U) **Mission Description**: The mission of this program is the transfer of electronic commerce (EC) technologies to small- and medium-size enterprises (SMEs) through a network of regional deployment centers. This mission is a subset of the overall DoD plans for Continuous Acquisition and Life-cycle Support (CALS) and for electronic commerce as part of Acquisition Reform. To reflect the focus on that subset, the program name was changed in FY 1994 from CALS Shared Resource Centers to Electronic Commerce Resource Centers (ECRCs). In transferring EC technologies to SME's, the ECRC technical vision is that manufacturing companies will move down a path of increasing EC capability that ranges from linking suppliers with customers, via electronic data interchange, to the establishment of virtual enterprises. An ECRC technology hub has been established to keep abreast of EC technologies and to ensure that technical consultants in the regional ECRCs are equipped with the latest information and training on EC technologies.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Reestablished Orange, TX ECRC under management of Lamar University (Congressional direction). ($2.0M)
- Continued Regional ECRC activities; expanded the depth of specialized ECRC expertise through technology demonstration projects; establish and executed a plan for support of the DoD Electronic Commerce in Contracting initiative; convened a series of DoD Prime/supplier chain forums and followed up with small- and medium-size suppliers to implement electronic commerce transaction capabilities. ($18.8M)
- Conducted technology hub operations with initiatives for Electronic Commerce Testbed and for advances in tools needed for development of Standard for Exchange of Product Data (STEP) application protocols. ($7.0M)
- Competitive awards to Electronic Commerce Resource Centers (ECRC)/university/business teams were awarded for near-term innovations in electronics commerce practices. ($6.0M)

(U) FY 1996 Program:

- Competitive award for an integrated ECRC network of sites for nationwide delivery of education, training, and technical support services. ($22.2M)
- Continue Technology Hub operations with initiatives for Electronic Commerce (EC) Testbed, and for advances in tools needed for development of STEP applications. ($6.0M)
- Complete ECRC/university/business demonstrations of near-term innovations in EC practices. ($6.0M)

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Exploratory Development

R-1 ITEM NOMENCLATURE
Advanced Electronics Technologies,
PE 0603739E, Project MT-11

(U) FY 1997 Program:

- Continue Technology Hub functions under contractor winning full and open competition. ($3.0M)
- Operate network of ECRCs under management of team winning competition; provide education, training, and technical support to SMEs in the supplier chains of DoD and DoD primes. ($7.6M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	38.3	34.2	20.6
Appropriated	33.8	N/A	N/A
Current Budget	33.8	34.2	10.6

(U) **Change Summary Explanation**:

FY 1997 Decrease reflects repricing to account for anticipated industry cost sharing and PDM reductions.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Sep 95	Complete initial demonstrations, show feasibility of non-Federal cost sharing.
Sep 96	Demonstrate value of networked access to ECRC services; implement mechanisms for non-Federal cost sharing.
Sep 97	Transition Electronic Commerce Resources Center (ECRC) retail deployment activities to manufacturing extension program beyond RDT&E.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Electronics Technologies, PE 0603739E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microelectromechanical Systems (MEMS) MT-12	(23,962)*	30,991	42,800	47,060	48,549	24,281	0	0	193,681

*The FY 1995 MEMS program was funded from Project MT-04 and ES-01.

(U) **Mission Description**: The Microelectromechanical Systems (MEMS) program is a broad, cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems. The MEMS program addresses the issues ranging from the scaling of devices and physical forces to new organization and control strategies for distributed, high-density arrays of sensor and actuator elements.

(U) The MEMS program has three principal objectives: the realization of advanced devices and systems concepts; the development and insertion of MEMS products into DoD systems; and the creation of support and access technologies to catalyze a MEMS technology infrastructure. These three objectives cut across a number of focus application areas to create revolutionary military capabilities, make high-end functionality affordable to low-end systems, and extend the operational performance and lifetimes of existing weapons platforms. The major technical focus areas for the MEMS program are: 1) inertial measurement; 2) fluid sensing and control; 3) electromagnetic and optical beam steering; 4) mass data storage; 5) chemical reactions on chip; 6) electromechanical signal processing; 7) active structural control; 7) analytical instruments; and 8) distributed networks of sensors and actuators.

(U) Accomplishments to date include: a wind-tunnel test of an integrated MEMS sensor and actuator array distributed along the leading edge of a model aircraft wing creating rolling moments of sufficient strength to control aircraft flight, pointing the way to future fighter aircraft with advanced maneuverability unattainable using conventional, large and discrete control surfaces; a demonstration of a MEMS-based accelerometer capable of surviving and operating in the near 100,000 G accelerations generated by firing artillery shells, making possible affordable guidance systems to what are presently unguided munitions and increasing both their effectiveness and life cycle costs; and the establishment of a regularly scheduled, shared, MEMS fabrication service for domestic DoD, commercial and academic users. The service has lowered barriers to access and has allowed hundreds of researchers, students and industrial users, nearly half for the first time, to inexpensively and rapidly fabricate MEMS devices.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated and multi-site evaluated a sensor cluster for environmental monitoring; multi-device chip run with over twenty different devices (including accelerometers, gyroscopes, flow-sensors, and resonators) fabricated from a single, common, high-volume surface micromachining process; successful operation of a vertical-wall silicon carbide reactor to deposit sensor-grade films over multiple, 100 mm wafers; inserted and tested MEMS inertial measurement devices in projectile munitions. ($10.2M)
- Demonstrated single-crystal, micromachined tunneling tips with integrated, three-dimensional positioning actuators; prototype multiple-component conformal MEMS sensing and actuating arrays applied to delta-wing model and operated in wind-tunnel tests; demonstrated organization and processing of signals from sensors distributed across control surfaces of underwater vehicles. ($4.4M)
- Disseminated and continued development of a multi-use design library for MEMS devices and systems; dissemination of CAD tools that are coupled to shared fabrication services; completion and continued offering of ninth shared surface micromachining fabrication run reaching over 350 users in the government, industry and academia. ($2.5M)

(U) FY 1996 Program:

- Achieve factor of 3-5x increase in electronics-to-mechanics integration ratios with new fabrication processes; begin development of related information-driven and fault-tolerant designs for devices; begin incorporation of extreme condition materials into sensor and actuator designs. ($7.0M)
- Achieve 200-300 mechanical components/sq. cm systems densities with associated increases in both process yields and device performance uniformities; begin exploration of new organization and control strategies for multiple, heterogeneous and distributed MEMS components; continue development of complete and stressing MEMS systems demonstration projects in areas such as fluid vortex control, adaptive optics, combustion control and atomic-resolution mass-data storage. ($18.0M)
- Extension of distributed shared fabrication services to enable process experimentation; continue development of fabrication, packaging and metrology tools to address devices and systems developments; expand available set of shared fabrication processes and associated CAD tools and design libraries. ($6.0M)

(U) FY 1997 Program:

- Achieve additional factor of 5-10x increase in electronics-to-mechanics integration ratios; explore space of related device designs and architectures enabled by order-of-magnitude increase in integration ratios

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

including electromechanical signal processing elements and radio-frequency components; continue development of fault-tolerant and parallel designs including low-noise, low-drift multi-axis accelerometers and gyroscopes; demonstration of extreme temperature and pressure sensor function in operational environments. ($10.7M)

- Achieve 400-500 mechanical components/sq. cm systems densities with integrated or hybrid fabrication/assembly techniques; demonstrate MEMS applications using massively parallel MEMS components; initiate new dual-use areas including analytical instruments, precision assembly, on-demand structural strength enhancement and air-vehicle aerodynamic control; begin creation of shared testbed for development and validation of new organizational and control strategies for large-scale, distributed MEMS. ($23.2M)
- Begin transition of mature fabrication services to self-sufficiency; demonstrate scalable distributed fabrication services for MEMS process experimentation; continue development of MEMS-specific unit processes and associated processing equipment; continue the extension of simulators to address the modeling and coupling of multiple physical forces encountered in MEMS applications; continue dissemination and validation of CAD tools and design libraries. ($8.9M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget*	0	31.0	42.8
Appropriated	0	N/A	N/A
Current Budget	0	31.0	42.8

* MEMS funding was previously included in Project MT-04 and ES-01.

(U) **Change Summary Explanation**: N/A

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

(U) **Schedule Profile**:

Plan	Milestones
Dec 95	Distributed multi-parameter sensor cluster deployment.
Feb 96	Condition-based maintenance tests.
Jun 96	MEMS-based weapons safeing and arming tests.
Aug 96	Aerodynamic control of model airplane flight with distributed MEMS.
Oct 96	Microcombustion heat exchanger operation.
Mar 97	Navigation-grade inertial measurement and guidance devices.
Jun 97	VGA-resolution monochrome grating light-valve display.
Sep 97	25k Tracks/in magnetic recording with dual-stage actuators.
Jan 98	Self-sufficiency of mature shared fabrication services.
Jun 98	Controlled chemical reactions and processing on chip.
Jan 99	Atomic-resolution data storage using precision, multiple read/write structures.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Simulation-National Guard, PE 0603744E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Simulation (National Guard) SM-01	27,910	5,399	0	0	0	0	0	0	60,816

(U) **Mission Description**: In FY 1992, Congress appropriated funds to initiate a program to apply advanced technology to the training of National Guard Roundout Brigades. This program was initiated to respond to issues that developed in the 1991 Desert Shield/Desert Storm mobilization and is now a part of the Synthetic Theater of War Advanced Concept Technology Demonstration.

(U) The program goal is to achieve the significant improvement in training effectiveness required for reserve component maneuver force mobilization through the use of advanced distributed information technologies and innovative training strategies at a lower cost than current active component methods for conducting the same training. The intent is to develop and integrate technologies that enable National Guard soldiers to conduct sophisticated training either at the local community armory, or at the soldier's home. The program will capitalize on existing commercial technologies where feasible.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Established nodes on the Defense Simulation Internet (DSI) for two test brigades. ($1.4M)
- Conducted initial functionality test of two platoons of reconfigurable ground simulator. ($7.1M)
- Completed development and assessment of location instrumentation and intervehicular communications technology. ($1.1M)
- Continued development of desktop simulators and advanced technology distributed training capabilities and delivery technologies. ($15.1M)
- Continued development of measures of performance and conducted program evaluation research. ($3.2M)

(U) FY 1996 Program:

- Operate one test brigade on the Defense Simulation Internet (DSI). ($.8M)
- Develop innovative training programs and delivery assessment technologies. ($1.4M)
- Continue development of desktop simulators and advanced technology distributed training capabilities and delivery technologies. ($1.1M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Simulation-National Guard, PE 0603744E, Project SM-01

- Continue development of measures of performance and conduct of program evaluation research. ($1.2M)
- Complete program completion and final technical report. ($.9M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	29.5	5.8	14.6
Appropriated	28.6	N/A	N/A
Current Budget	27.1	5.4	0

(U) **Change Summary Explanation**:

FY 1995-97 Reductions reflect phase-down and program completion.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 95	Deliver draft assessment measures and plan.
Oct 95	Complete field Deployable Force-on-Force Instrumentation System.
Nov 95	Deliver Bde scenarios (SIMBART).
Nov 95	Implement program evaluation program.
Oct 95	Test MOS-specific distance learning technology.
Jan 96	Complete field trials of assessment tools.
Mar 96	Evaluate JANUS WAN at 116th Brigade.
Apr 96	Deliver last equipment simulators.
Apr 96	Complete fielding of ARSI Platoons (Phase II).
Aug 96	Evaluate first experimental brigade at the National Training Center (NTC).
Sep 96	Demonstrate initial links on DSI.
Oct 96	Complete Phase I Assessment Results/Recommendations.
Nov 96	Deliver modified training programs from FY 1996 NTC rotation.
Dec 96	Deliver final report.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Semiconductor Manufacturing Technology, PE 0603745E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
SEMATECH EM-01	88,327	89,554	0	0	0	0	0	0	N/A

(U) **Mission Description**: This project supports SEMATECH, a pre-competitive industrial consortium that addresses the long-term semiconductor manufacturing requirements for military applications. The goal of SEMATECH is to continue reducing costs while maintaining the state-of-the-art in complexity and performance for silicon technologies. It concentrates on future factory design and process definition and control efforts for flexible manufacturing of both low- and high-volume devices in the same factory. Environmentally conscious manufacturing, and safety and health of manufacturing personnel are also part of this effort. This project will combine advances in physical equipment with software advances, i.e., fully computer-integrated manufacturing (CIM) systems, and modeling and simulation tools for designing processes, tools, and factories. SEMATECH comprises the companies that supply the majority of the integrated circuits used in defense systems, and it has a proven track record of working with equipment suppliers effectively. FY 1996 is the final year of direct government funding.

(U) Program Accomplishments and Plans:

(U) FY 1995 Accomplishments:

- Demonstrated full flow 0.25µm pilot-line capable manufacturing technologies. ($15.0M)
- Completed development of key equipments and unit processes to enable 0.25µm semiconductor manufacturing. ($48.3M)
- Developed software tools and models that assisted in the design and analysis of processes and equipment. ($8.0M)
- Initiated technology development efforts for critical equipment for 0.18µm technology generation. ($5.0M)
- Initiated projects in generic integrated circuit design tools that will support advanced capabilities. ($1.0M)
- Demonstrated improved manufacturing tools and methods with enhanced Environmental Safety Health (ESH) performance. ($9.0M)
- Demonstrated fabrication capabilities of projection gas immersion laser doping (PGILD) to produce ultra-shallow junctions. ($2.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Semiconductor Manufacturing Technology, PE 0603745E, Project EM-01

(U) FY 1996 Program:

- Investigate equipment requirements, advanced process flows, and design tools for the 0.18µm device technology generation. ($17.0M)
- Initiate key equipment development efforts to provide early access to 0.18µm process capabilities. ($54.8M)
- Coordinate and analyze the results of sophisticated physical experiments using external vendors to process silicon-on-insulator wafers for various suppliers. ($1.7M)
- Develop new approach to design of rapid-thermal process chambers that supports advanced process capabilities. ($3.0M)
- Develop neutral stream etch technologies. ($1.8M)
- Develop materials technologies for deposition of low dielectric constant materials. ($1.0M)
- Develop assembly and packaging technologies for cost-effective, high performance chip-to-package interconnection and robust manufacturing methodologies. ($2.3M)
- Investigate equipment and unit processes that have improved Environmental Safety Health (ESH) performance. ($9.0M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	89.2	89.6	0
Appropriated	89.2	N/A	N/A
Current Budget	88.3	89.6	0

(U) **Change Summary Explanation:**

FY 1995 Reduction due to minor program repricing.

(U) **Other Program Funding Summary Cost:** N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Semiconductor Manufacturing Technology, PE 0603745E, Project EM-01

(U) **Schedule Profile**:

Plan	Milestones
Nov 95	Demonstrate generic design tools that support first-pass success and reduced design cycle times.
Dec 95	Complete full-flow 0.25 micron process technology development projects and transfer technology to member companies.
Mar 96	Transfer software tool suites that support reduced development cycle times.
Jun 96	Demonstrate operation of key elements of a fully integrated advanced manufacturing system enabling maximum flexibility and rapid response to process modifications.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Maritime Technology,
PE 0603746E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Shipbuilding Technology MR-01	50,780	49,657	49,708	50,000	0	0	0	0	238,895

(U) **Mission Description**: The shipbuilding technology program is designed to preserve the shipbuilding segment of the defense industrial infrastructure by improving competitiveness of the U.S. shipbuilding industry through advanced technology applications. For the Defense Department, a competitive shipbuilding industry will optimize Navy ship acquisition reform and facilitate the Department's objective for affordable Navy ships. The goal of the DoD Acquisition Reform program is to take advantage of the best commercial practices of industry and thereby achieve cost reductions of the ships and systems it purchases. The government's attempt at acquisition reform, as it applies to ship acquisition, could fall short if U.S. shipyards are not commercially competitive. Having operated exclusively in a protected domestic market, the U.S. shipbuilding industry has not implemented the best commercial processes necessary to compete in the international arena or to build affordable Navy ships. The key for acquisition reform is for the U.S. shipbuilding industry to attain global commercial competitiveness.

(U) The shipbuilding technology program is a two phased effort that will provide products and infrastructure for both the near and long term. The near term effort will enhance international competitiveness through identification and development of competitive build strategies that would be implemented in the next 2-3 years, and the development of a portfolio of U.S. ship designs for the international marketplace. This effort will be enhanced by developing an infrastructure that would include the implementation of electronic communications and commerce throughout the industry, and by participating in an industry-wide forum for problem solving on a technical level.

(U) The long term effort will include the infusion of innovative product technologies and process improvements that will bring the capabilities of the U.S. shipbuilding industry above those of foreign shipyards. This will result in a larger share of the international market, and in a self-sustaining, highly efficient U.S. shipbuilding industry.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Maritime Technology, PE 0603746E, Project MR-01

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued development of advanced shipbuilding strategies and affordable designs commenced in FY 1994. ($16.9M)
- Initiated additional shipbuilding strategies and affordable design initiatives. ($6.5M)
- Initiated advanced technology development initiatives to improve ship production processes and/or ship/shipboard systems operations. ($13.9M)
- Initiated Phase II of National Shipbuilding Network's (NSnet's) infrastructure development. ($0.6M)
- Completed National Maritime Technology Needs study. ($0.2M)
- Initiated study to determine how best to integrate competitive commercial practices for affordable Naval ship construction. ($0.2M)
- Commenced development of advanced shipbuilding capabilities demonstration. ($0.5M)
- Commenced development of distributed simulation of ship self defense. ($3.0M)
- Commenced development of Hypervelocity Interceptor Technology demonstration. ($6.8M)
- Commenced development of Over-the-Horizon (OTH)/Early Detection Technology. ($1.2M)
- Demonstrated Initial Human Computer Interaction Suite for Scene Understanding. ($1.0M)

(U) FY 1996 Program:

- Complete all shipbuilding strategy development initiatives and new ship designs begun in prior years. ($12.8M)
- Complete advanced technology development initiatives started in FY 1995. ($11.5M)
- Initiate additional advanced technology developments for improving ship production processes and products. ($14.0M)
- Establish a National Shipbuilding Consortium. ($1.2M)
- Commence Electronic Commerce Computer Integrated Enterprise for Maritime community development. ($2.4M)
- Continue to improve and expand NSnet. ($.6M)
- Commence new initiatives for advanced shipbuilding strategies and new commercial designs. ($7.2M)

(U) FY 1997 Program:

- Initiate additional advanced technology developments for improving ship production processes and products. ($12.5M)
- Complete advanced technology developments started in FY 1996. ($12.5M)
- Continue to improve and provide support for NSnet. ($0.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Maritime Technology, PE 0603746E, Project MR-01

- Electronic Commerce and Computer Integrated Enterprise. ($11.0M)
- Support National Shipbuilding Consortium. ($1.0M)
- Complete advanced shipbuilding strategies and commercial ship design initiator. ($12.0M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	52.0	49.7	49.7
Appropriated	50.8	N/A	N/A
Current Budget	50.8	49.7	49.7

(U) **Change Summary Explanation:** N/A

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan	Milestones
Sep 95	Complete Live Fire Exercises with existing hypervelocity ship self-defense interceptors.
Sep 95	More than one U.S. shipyard successful in selling ships on international market.
Sep 95	Detect, track and intercept synthetic theater ballistic missile and high altitude anti-ship cruise missile.
Jul 96	Complete program on environmentally friendly surface preparation and coating of ship surfaces.
Jul 96	Complete program on advanced ship welding technologies.
Sep 96	Form National Shipbuilding Consortium.
Jan 97	Complete program on robotic applications for shipbuilding programs.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Electric Vehicles,
PE 0603747E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electric Vehicles EV-01	14,170	0	0	0	0	0	0	0	60,420

(U) **Mission Description**: Electric and hybrid electric drivetrains provide compelling advantages for future tactical and combat vehicles. Of particular importance is a 50-percent reduction in fuel consumption due to higher efficiency, improved acceleration and maneuverability due to immediate torque to the wheels or tracks, and dramatically reduced thermal and acoustic signatures when operating from on-board energy storage. Affordability is addressed through reduced logistics requirements and the dual use applications of the technologies.

(U) The ARPA Electric and Hybrid Vehicle Technology program is pursuing research, development, and demonstrations of technologies for electric and hybrid vehicles that address military missions, modernization, and cost mitigation. Established by Congress in FY 1993, the program has accelerated technology development and is essential for the armed services to respond to increasing power demands for military systems, enhance national energy security, and comply with Federal clean air legislation. ARPA uses a unique decentralized management approach working directly with seven regional consortia. These diverse consortia provide a minimum of 50% of the funding and cooperatively function to overcome the challenges of developing electric and hybrid vehicle technologies. Their participants include military laboratories and bases, state and local governments, large and small defense contractors, well-established and startup manufacturers of vehicles and components, electric and gas utilities, public interest groups, and universities. Military requirements and infrastructure are implemented within this program at minimal Federal investment, leveraging significant funds.

(U) Technology development is focused on: High-specific power engine/generator sets, including multi-fuel capable, high efficiency, and low emissions turbines and fuel cells; Power control devices, including high-performance power semiconductors, cooling systems, control algorithms, and circuit integration and packaging; Energy storage devices, including advanced batteries, rapid battery recharging, flywheels, and capacitors; Electromechanical conversion, including alternating current, direct current, and linear motors; and Lightweight high-strength materials, including space-frames and composites.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electric Vehicles, PE 0603747E, Project EV-01

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated hybrid electric drivetrains and silent operation in High Mobility Multipurpose Wheeled Vehicles (HMMWVs) (2 ea.), M113 Armored Personnel Carrier, Bradley Fighting Vehicle, M939A1 5-ton truck, and USMC/Special Operations Forces vehicle. ($4.0M)
- Demonstrated hybrid and electric drivetrains in 40 ft transit buses (3 ea.), 31 ft shuttle buses (10 ea.), 22 ft shuttle buses (3 ea.), utility vans (11 ea.), and a 60,000 lb refuge truck. ($3.0M)
- Developed flexible manufacturing technology and cost reduction practices for composite materials to support affordability and high-strength, lightweight chassis development. Doubled vehicle range through vehicle weight reduction. ($1.5M)
- Developed enabling technology for affordable electric and hybrid vehicle power systems including: flywheel energy storage systems (3 ea.); high-power electrochemical storage devices; high temperature and high power conditioning; induction, reluctance, permanent magnet, and homopolar traction motors and controllers; and very rapid battery chargers and associated infrastructure. ($4.7M)
- Demonstrated electric and hybrid vehicle safety through crash testings, met electric and hybrid vehicle emissions standards, and initiated military user vehicle acceptance testing. ($1.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	14.2	N/A	N/A
Current Budget	14.2	0	0

(U) **Change Summary Explanation**: N/A

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electric Vehicles, PE 0603747E, Project EV-01

(U) **Schedule Profile**:

Plan	Milestones
Sep 95	Demonstrate flywheel energy storage system.
Oct 95	Demonstrate hybrid electric propulsion system in a 22 ft. shuttle bus.
Feb 96	Demonstrate a 20 W-hr Ultracapacitor.
Apr 96	Demonstrate hybrid electric propulsion with advanced batteries in the M113 Armored Personnel Carrier.
May 96	Demonstrate hybrid electric propulsion of a High Mobility Multi purpose Wheeled Vehicle (HMMWV).
Sep 96	Demonstrate hybrid electric propulsion of a Bradley Fighting Vehicle.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Joint Advanced Strike Technology,
PE 0603800E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Joint Advanced Strike Technology JA-01	*(37,819)	30,675	80,925	83,922	19,000	16,000	10,000	0	240,522

*Funded under JAST program, PE 0603800N. Provided directly to ARPA from JAST.

(U) **Mission Description**: The Joint Advanced Strike Technology (JAST) Program has been chartered to facilitate the evolution of fully validated affordable operational requirements and proven operational concepts, and to transition the key technologies to enable the successful development and production of affordable next generation strike aircraft weapon systems for the Navy, Marine Corps, Air Force, and our allies. The JAST Program is a joint program with no executive Service. Beginning in FY 1995, the Navy and Air Force each provide approximately equal shares of annual program funding ARPA's Advanced Short Take Off Vertical Landing (ASTOVL)/Conventional Take Off and Landing (CTOL) Common Affordable Lightweight Fighter (CALF) project (previously known as ASTOVL) was integrated with the JAST program by FY 1995 legislation. ARPA contributes funding for the JAST Concept Demonstration Phase commencing in FY 1996 under this new program element. The US/UK international collaborative CALF Program conceived by ARPA was investigating a revolutionary approach for melding advanced technology, multi-service commonality, and improved business practices directed toward demonstrating an affordable, capable replacement for the F-16, F/A-18, and AV-8B. ARPA is bringing this insight and experience to bear in integrating the structure and philosophy of the CALF program within the JAST framework. The ARPA program manager now is serving as a Director within the JAST program organization. This ensures that ARPA's expertise in ASTOVL technologies, streamlined acquisition, and rapid prototyping are brought to bear in the JAST technology demonstration program.

(U) **Program Accomplishments and Plans**:

FY 1995 Accomplishments:

- Initiated large scale wind tunnel testing and large scale propulsion system tests for the Shaft Coupled Lift Fan Concept. ($16.7M)
- Completed large scale propulsion system tests for the Gas Coupled Lift Fan Concept. ($9.6M)
- Initiated large scale powered model system tests for the Direct Lift Concept. ($8.5M)
- NASA Test Support provided in the form of model instrumentation and special facility provisions to accommodate large scale models. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Joint Advanced Strike Technology, PE 0603800E, Project JA-01

(U) FY 1996 Program:

- Complete critical technology validation program for the Direct Lift and Shaft Coupled Lift Fan Concepts. ($6.9M)
- Commence Concept Demonstration Phase with the competitive award of two contracts for ground and flight demonstrations and continue concept refinement for a tri-service family aircraft that meets services needs and optimizes commonality among the variants to minimize the life cycle costs. ($23.8M)

(U) FY 1997 Program:

- Continue ground and flight demonstrations and concept refinement for the tri-service family of aircraft. ($80.9M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	37.8*	30.7	80.9
Appropriated	N/A	N/A	N/A
Current Budget	37.8*	30.7	80.9

*Funds appropriated to JAST program, PE 0603800N and sent directly to ARPA.

(U) **Change Summary Explanation**:

No change.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Joint Advanced Strike Technology,
PE 0603800E, Project JA-01

(U) **Other Program Funding Summary Cost**: *(In Millions)*

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
PE 0603800F	83.8	151.2	198.8	302.8	411.5	196.0	0.0	0	1,344.1
PE 0603800N	98.3**	149.3	198.1	291.9	408.6	196.1	0.0	0	1,342.3
United Kingdom*	0.0	14.0*	71.0*	55.0	20.0	20.0	20.0	0	200.0

*MOU in negotiation; signature anticipated in October 1995.
**Includes $37.819 shown in JA-01 Funding Summary for this project.

(U) Related RDT&E: PEs 0604800N & 0604800F: Milestone II for a joint follow-on engineering & manufacturing development (E&MD) program for the next generation strike fighter weapon system(s) is planned in FY 2000. The follow-on aircraft weapon system(s) program will develop a family of aircraft from concepts proven under the JAST Program, incorporating affordable technologies transitioned from the JAST Program.

(U) **Schedule Profile**:

Planned	Milestones
Jan 96	Complete Large Scale Propulsion Model Testing.
Mid 96	Award concept demonstration contract.
Mid 97	Complete preliminary design of Concept Demonstration Aircraft.
Mid 98	Complete detailed design of Demonstration Aircraft.
FY 1999	Begin flight demonstrations.
FY 2001	End concept demonstration phase.

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Dual Use Applications Program, PE 0603805E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Dual Use Applications Programs GC-01	0	0	300,000	300,000	300,000	300,000	300,000	0	1,500,000

(U) **Mission Description**: The objective of this program is to leverage emerging, dual-use (e.g. potentially viable in both commercial and defense applications) technologies to the direct benefit of military system acquisition. An important additional objective is to assure consideration of the dual-use approach as a routine part of DoD's R&D process whenever commercial technology is better able to meet DoD's cost and performance requirements. This program will be jointly executed by ARPA and the Military Services to ensure transition of the technology to the Services and, equally important, to embed the lessons learned from this program directly in the mainstream R&D approaches of the Military Departments.

(U) Technology thrusts will be selected jointly by ARPA and the Military Services and will be based on: (1) Potential of commercial technology development to meet Military Service needs and unique requirements; (2) Potential of a commercial technology to reduce product cost to the military; (3) Extent of opportunity for insertion of technology into DoD systems, subsystems or demonstrations; (4) Extent of multi-service interest; and (5) Viable transition plan for incorporation into military systems. Cost shared technology projects which best accomplish the program's objectives will be competitively selected, negotiated, and managed by a DoD team.

(U) ARPA and the Services will jointly select projects across all of the thrusts. Individual projects will then be managed by the appropriate Services, with technical and dual use process advice from ARPA, as appropriate.

(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- In FY 1997, technology thrusts will be selected and competed. Initial projects will be selected and management will be assigned to the Military Services. Projects will be performed primarily with industry and/or industry teams with support from universities and military laboratories as appropriate. The Selection of new technology thrusts for FY 1998 will begin.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Exploratory Development	R-1 ITEM NOMENCLATURE Dual Use Applications Program, PE 0603805E, Project GC-01

(U) **Program Change Summary**: N/A

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

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

DATE September 1995

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 6 RDT&E Management Support	Management Headquarters (R&D), PE 0605898E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Management Headquarters MH-01	30,158	33,699	35,869	36,815	37,986	38,647	39,491	Continuing	Continuing

(U) **Mission Description**: This program element is budgeted in the Management Support Budget Activity because it provides funding for the administrative support costs of the Advanced Research Projects Agency. This funding provides for personnel compensation and benefits for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

(U) **Program Accomplishments And Plans**:

(U) FY 1995 Accomplishments:

- Funding under this program element in FY 1995 supported management and administration for the RDT&E program assigned to ARPA. The majority of the funds were required for the pay of personnel who operate the Agency. The funding level reflects the rental costs associated with the expansion of office space, and the related support requirements necessary to adequately execute the increased responsibilities assigned to the Agency.

(U) FY 1996 Program:

- ARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1995.

(U) FY 1997 Program:

- ARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1996.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE September 1995
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 6 RDT&E Management Support	R-1 ITEM NOMENCLATURE Management Headquarters (R&D), PE 0605898E, Project MH-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	30.2	32.6	33.9
Appropriated	28.7	N/A	N/A
Current Budget	30.2	33.7	35.9

(U) **Change Summary Explanation**:

FY 1997 Increases reflect minor repricing and enhanced security requirements.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

SECTION III

MANPOWER

ADVANCED RESEARCH PROJECTS AGENCY
FY 1997 DEFENSE BUDGET REVIEW

SCHEDULE OF CIVILIAN AND MILITARY PERSONNEL

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
I. CIVILIAN PERSONNEL							
RDT&E Defensewide							
US Direct Hire	179	167	157	157	157	151	147
Intergovermental Personnel Act (IPA)	38	50	60	60	60	60	60
Total, RDT&E	217	217	217	217	217	211	207
II. ACTIVE MILITARY PERSONNEL							
Officer, Army	3	3	3	3	3	3	3
Officer, Navy	4	4	4	4	4	4	4
Officer, Air Force	11	11	11	11	11	11	11
Enlisted, Air Force	1	1	1	1	1	1	1
Total Air Force	12	12	12	12	12	12	12
Total Military	19	19	19	19	19	19	19
TOTAL	236	236	236	236	236	230	226

Exhibit PB-4
September, 1995

ADVANCED RESEARCH PROJECTS AGENCY
ANALYSIS OF PAY INCREASE COSTS
FISCAL YEAR 1996
(Thousands of Dollars)

Organizational Unit and Account Title	Increase in Direct Pay and Other Related Costs: Direct Pay	Related Costs	Total Cost	Payments To ( )	Reimbursements From ( )	Net Cost	Gross Absorption Within Available Funds	Additional Appropriation Required
RDT&E, Defensewide								
Civilian Personnel								
Classified	215	36	251	0	0	251	251	0
Total	215	36	251	0	0	251	251	0

Exhibit PB-05
September 1995

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1997 DEFENSE BUDGET REVIEW
Fiscal Year 1995

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars Compensation O.C. 11	Benefits O.C. 12	Total Compensation	Average Compensation
Direct Hire Civilians,United States:						
Classified and administrative	179	155	11955	1861	13816	89.14
Other:						
Intergovernmental Personnel Act (IPA)	38	35	4984	0	4984	142.40
Total United States	217	190	16939	1861	18800	98.95
Total Civilian Personnel Costs	217	190	16939	1861	18800	98.95
RDT&E Defensewide						
Direct Hire Civilians,United States:						
Classified and administrative	179	155	11955	1861	13816	89.14
Other:						
Intergovernmental Personnel Act (IPA)	38	35	4984	0	4984	142.40
Total United States	217	190	16939	1861	18800	98.95

EXHIBIT PB 31-R
SEPTEMBER 1995

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1997 DEFENSE BUDGET REVIEW
Fiscal Year 1996

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars Compensation O.C. 11	Benefits O.C. 12	Total Compensation	Average Compensation
Direct Hire Civilians,United States:						
Classified and administrative	167	163	12497	2019	14516	89.06
Other:						
Intergovernmental Personnel Act (IPA)	50	47	7003	0	7003	149.00
Total United States	217	210	19500	2019	21519	102.47
Total Civilian Personnel Costs	217	210	19500	2019	21519	102.47
RDT&E Defensewide						
Direct Hire Civilians,United States:						
Classified and administrative	167	163	12497	2019	14516	89.06
Other:						
Intergovernmental Personnel Act (IPA)	50	47	7003	0	7003	149.00
Total United States	217	210	19500	2019	21519	102.47

EXHIBIT PB 31-R
SEPTEMBER 1995

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1997 DEFENSE BUDGET REVIEW
Fiscal Year 1997

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars Compensation O.C. 11	Benefits O.C. 12	Total Compensation	Average Compensation
Direct Hire Civilians,United States:						
Classified and administrative	157	152	12137	1975	14112	92.84
Other:						
Intergovernmental Personnel Act (IPA)	60	58	9106	0	9106	157.00
Total United States	217	210	21243	1975	23218	110.56
Total Civilian Personnel Costs	217	210	21243	1975	23218	110.56
RDT&E Defensewide						
Direct Hire Civilians,United States:						
Classified and administrative	157	152	12137	1975	14112	92.84
Other:						
Intergovernmental Personnel Act (IPA)	60	58	9106	0	9106	157.00
Total United States	217	210	21243	1975	23218	110.56

EXHIBIT PB 31-R
SEPTEMBER 1995

ADVANCED RESEARCH PROJECTS AGENCY
FY 1997 DEFENSE BUDGET REVIEW
BUDGETED MILITARY AND CIVILIAN PAY RAISE AMOUNTS
($ in Thousands)

			FY 1995	FY 1996	FY 1997
MILITARY PERSONNEL	N/A		0	0	0
CIVILIAN PERSONNEL					
RDT&E Defensewide					
Classified					
	Effective	Percent			
FY 1995	1-Jan-95	3.07%	255	341	341
FY 1996	1-Jan-96	2.4%	0	251	335
FY 1997	1-Jan-97	3.1%	0	0	315
Total			255	592	991
TOTAL PERSONNEL			255	592	991

Exhibit PB-53
September 1995

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1997 DEFENSE BUDGET REVIEW
FY 1995/96/97
($ in Thousands)

DATE: September 1995

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Prior Year (PY) = 1995

TRES	DP CD	LN IT	DESCRIPTION	PY BEGIN STRENGTH	PY END STRENGTH TOTAL	PY END STRENGTH FTP	WORK YEARS TOTAL	WORK YEARS FTP	PY BASIC COMP	PY OVER TIME	PY HOL PREM	PY OTHER OC 11	PY TOTAL VARIAB	PY TOTAL OC 11	PY BENEFIT OC 12	PY TOTAL COST
400	50	1	Senior Executive Schedule	23	25	24	20	18	2223	0	0	516	516	2739	371	3110
400	50	3	General Schedule	131	154	153	135	132	8770	51	3	392	446	9216	1490	10706
400	50		Subtotal	154	179	177	155	150	10993	51	3	908	962	11955	1861	13816
400	50		Subtotal (Rate)						70.92258				0.08751	77.12903	0.16929	89.13548
400	50	4	Special Schedule (IPA)	34	38	38	35	35	4984					4984		4984
400	50		IPA (Rate)						142.40000					142.40000		142.40000
400	50		Total Civilian	188	217	215	190	185	15977	51	3	908	962	16939	1861	18800
400	50		Total Civilian (Rate)						84.08947				0.08751	89.15263	0.11648	98.94737

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1997 DEFENSE BUDGET REVIEW
FY 1995/96/97
($ in Thousands)

DATE: September 1995

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Current Year (CY) = 1996

TRES	DP CD	LN IT	DESCRIPTION	CY BEGIN STRENGTH	CY END STRENGTH TOTAL	CY END STRENGTH FTP	WORK YEARS TOTAL	WORK YEARS FTP	CY BASIC COMP	CY OVER TIME	CY HOL PREM	CY OTHER OC 11	CY TOTAL VARIAB	CY TOTAL OC 11	CY BENEFIT OC 12	CY TOTAL COST
400	50	1	Senior Executive Schedule	25	25	24	23	22	2618	0	0	304	304	2922	404	3326
400	50	3	General Schedule	154	142	141	140	137	9313	54	3	205	262	9575	1615	11190
400	50		Subtotal	179	167	165	163	159	11931	54	3	509	566	12497	2019	14516
400	50		Subtotal (Rate)						73.19632				0.04744	76.66871	0.16922	89.05521
400	50	4	Special Schedule (IPA)	38	50	50	47	47	7003					7003		7003
400	50		IPA (Rate)						149.00000					149.00000		149.00000
400	50		Total Civilian	217	217	215	210	206	18934	54	3	509	566	19500	2019	21519
400	50		Total Civilian (Rate)						90.16190				0.04744	92.85714	0.10663	102.47143

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1997 DEFENSE BUDGET REVIEW
FY 1995/96/97
($ in Thousands)

DATE: September 1995

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Budget Year Plus One (BY1) = 1997

TRES	DP CD	LN IT	DESCRIPTION	BY BEGIN STRENGTH	BY1 END STRENGTH TOTAL	BY1 END STRENGTH FTP	WORK YEARS TOTAL	WORK YEARS FTP	BY1 BASIC COMP	BY1 OVER TIME	BY1 HOL PREM	BY1 OTHER OC 11	BY1 TOTAL VARIAB	BY1 TOTAL OC 11	BY1 BENEFIT OC 12	BY1 TOTAL COST
400	50	1	Senior Executive Schedule	25	25	24	24	23	2816	0	0	285	285	3101	395	3496
400	50	3	General Schedule	142	132	131	128	125	8779	57	3	197	257	9036	1580	10616
400	50		Subtotal	167	157	155	152	148	11595	57	3	482	542	12137	1975	14112
400	50		Subtotal (Rate)						76.28289				0.04674	79.84868	0.17033	92.84211
400	50	4	Special Schedule (IPA)	50	60	60	58	58	9106					9106		9106
400	50		IPA (Rate)						157.00000					157.00000		157.00000
400	50		Total Civilian	217	217	215	210	206	20701	57	3	482	542	21243	1975	23218
400	50		Total Civilian (Rate)						98.57619				0.04674	101.15714	0.09541	110.56190

SECTION IV

OTHER REQUIRED EXHIBITS

CONSULTING SERVICES

PB-15 Exhibit

ADVANCED RESEARCH PROJECTS AGENCY

Appropriation: RDT&E Defensewide

(Dollars in Thousands)

		FY 1994	FY 1995	FY 1996	FY 1997
I.	Management & Professional Support Services	45,217	36,709	35,109	35,045
II.	Studies, Analysis, & Evaluations	10,200	10,764	9,115	9,297
III.	Engineering & Technical Services	0	0	0	0
	Totals	55,417	47,473	44,224	44,342

Prepared by: L. Golobic
(703) 696-2396
September 1995

MANAGEMENT HEADQUARTERS

ADVANCED RESEARCH PROJECTS AGENCY

	FY 1995 Estimate				FY 1996 Estimate				FY 1997 Estimate			
	Mil ES	Civ ES	Tot ES	Total Oblig	Mil ES	Civ ES	Tot ES	Total Oblig	Mil ES	Civ ES	Tot ES	Total Oblig
Departmental Activities												
Military Services												
Military												
U.S. Army	3		3	211	3		3	211	3		3	214
U.S. Navy	4		4	299	4		4	305	4		4	309
U.S. Air Force	12		12	966	12		12	875	12		12	876
			19	1,476			19	1,391			19	1,399
Defense Agencies												
RDT&E Defensewide												
Civilian												
U.S. Direct Hire		179	179	13,816		167	167	14,516		157	157	14,112
IPAs			38	4,984			50	7,003			60	9,106
Other Costs				11,358				12,580				13,151
			217	30,158			217	34,099			217	36,369
TOTAL END STRENGTH			236				236				236	

(Dollars in Thousands; End Strengths in Whole Numbers)

Exhibit PB-22
September 1995

Advanced Research Projects Agency
SUMMARY OF FUNDS BUDGETED FOR ENVIRONMENTAL PROJECTS
FY 1997 DEFENSE BUDGET

Environmental Programs		($ In Thousands) FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	*Change FY 96/97*	*Change FY 97/98*
Environmental Cleanup	Not Applicable						
Environmental Compliance	Not Applicable						
Environmental Conservation	Not Applicable						
Pollution Prevention	Not Applicable						
Environmental Technology							
Appropriation:	RDT&E Defensewide						
	Pollution Prevention						
	Supercritical Fluid Technology	725					
	Hazardous Waste Management	7,368					
	Environmental Super Critical Water Oxidation	7,000	7,598	7,801		*203*	*-7,801*
	Joint Casting Emissions Reduction	10,575					
	Environmental Green	905	3,558	8,400	12,608	*4,842*	*4,208*
	Fire Protection Technology	50					
	CFC Free Manufacturing (SEMATECH)	9,000	9,000			*-9,000*	
	Bioremediation		3,916	3,568	2,514	*-348*	*-1,054*
	Environmental Sensors		4,581			*-4,581*	
Base Realignment and Closure	Not Applicable						
	Grand Total	35,623	28,653	19,769	15,122	*-8,884*	*-4,647*

Justification for Changes The outyear funding changes reflect contractual requirements.

The SEMATECH program ends in FY 1996.

Exhibit PB-28 (page 1 of 2)

Advanced Research Projects Agency
SUMMARY OF FUNDS BUDGETED FOR ENVIRONMENTAL PROJECTS
FY 1997 DEFENSE BUDGET

($ in Thousands)

Environmental Programs		FY 1999	FY 2000	FY 2001	FY 2002
Environmental Cleanup	Not Applicable				
Environmental Compliance	Not Applicable				
Environmental Conservation	Not Applicable				
Pollution Prevention	Not Applicable				
Environmental Technology					
Appropriation:	RDT&E Defensewide				
	Pollution Prevention				
	Supercritical Fluid Technology				
	Hazardous Waste Management				
	Environmental Super Critical Water Oxidation				
	Joint Casting Emissions Reduction				
	Environmental Green	12,000	0	0	0
	Fire Protection Technology				
	CFC Free Manufacturing (SEMATECH)				
	Bioremediation	1,819	0	0	0
	Environmental Sensors				
Base Realignment and Closure	Not Applicable				
	Grand Total	13,819	0	0	0

Exhibit PB-28 (page 2 of 2)
Prepared by: Ann Morgan
(703) 696-2413
September 1995

DoD Aeronautics Budget
Advanced Research Projects Agency

($ in Thousands)

Appropriation Summary:	FY 1994 Actual	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate
Research Development, Test and Evaluation, Defensewide	37,132	0	55,350	95,674	88,922

Program Data:

Program Title	Program Element	FY 1994 Actual	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate
Aeronautics Technology	0602702E	5,991	0	0	0	0
ASTOVL/COTL	0603226E	25,712	0	0	0	0
Tier III	0603226E	5,429	0	24,675	14,749	5,000
Joint Advanced Strike Technology	0603800E	0	0	30,675	80,925	83,922

Exhibit PB-52A
DoD Aeronautics Budget
September 1995

DoD Space Budget
Advanced Research Projects Agency

($ In Thousands)

Appropriation Summary:	FY 1994 Actual	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999-2001 Estimate
Research Development, Test and Evaluation, Defensewide	30,659	4,381	0	0	0	0

Program Data:

Program Element	Program Title	Appropriation Code	Factor	Category	FY 1994 Actual	FY 1995 Actual	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999-2001 Estimate
0603226E	Advanced Spac Technology	RDT&E, DA	100%	Communication	2,949	3,226	0	0	0	0
				Launch Vehicle	14,790	0	0	0	0	0
				Surveillance	12,268	1,155				
				Support RDT&E	652	0	0	0	0	0

Exhibit PB-52B
DoD Space Budget
September 1995

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY (ARPA)
FY 1997 OSD/OMB SUBMISSION
EXECUTIVE SUMMARY ON INFORMATION TECHNOLOGY

1. Activities: Information technology (IT) activities provide direct support to a total agency staff of over two hundred personnel engaged in making research investments in new technologies considered to be critical to the nation's defense. ARPA IT support is provided for the functions of office automation and decision support. These functions accomplish four IT goals: (1) to provide products for externally required reporting (e.g., Defense budget input); (2) to support internal management processes (e.g., research investment strategy decisions); (3) to provide an in-house base for various information system research prototypes, and (4) to provide an efficient and effective work environment. ARPA IT is viewed as three inter-linked systems providing this functional support: Desktop Automation, Central Processing, and Network Communications. Desktop Automation provides office desktop tools such as word processing, spreadsheets, and presentation graphics. Central Processing provides the presentation of financial data through both an executive information system and through data manipulation software. Central Processing also provides other local information to support administrative processes such as the handling of ARPA funding documents prior to entering the Defense Finance and Accounting System, National Science Foundation and external reporting requirements, internal management requirements, and internal management controls. Network Communications provides productivity products such as electronic mail, centralized calendaring and management of meetings, and on-line access to policy, forms, and historic data. The Network further provides both the linking of internal systems and access to external communications such as the Defense Data Network.

2. Initiatives: No significant initiatives have been started or planned. The greatest influences on the current estimates are general, evolutionary development/modernization (dev/mod) and increases in Agency personnel and work flow.

IT dev/mod includes technology upgrades to take advantage of newly available commercial products which are cost-effective and which broaden functional support. Procurement choices are made to maintain a balance between functional expansion and expenditures. This balance works to maximize staff productivity and work-quality gains while keeping a positive return on investment. The budget estimates also reflect the recognition that sufficient resources must be directed toward dev/mod. Resources are directed toward dev/mod at the earliest point at which the benefit from dev/mod exceeds the benefit from operations/maintenance. In this context, dev/mod is assumed to entail increases in functional support.

Agency-wide personnel increases and the stresses of expanding research and development requirements have dramatically increased IT support requirements. In addition to the acquisition of desktop computer systems for new personnel, enhanced networking capabilities, portable computing, and new software functions have been added to bridge the widening gap between mission tasks and personnel available to accomplish them.

3. Changes: The FY 1995 total IT resources reflect an increase from the previous estimate to support additional Agency personnel. Other year figures have been increased adjusted accordingly.

ADVANCED RESEARCH PROJECTS AGENCY
REPORT ON INFORMATION TECHNOLOGY (IT) RESOURCES
FY 1997 BUDGET ESTIMATES
(Dollars in Thousands)

	FY95	FY96	FY97	FY98
1. Equipment ($000)				
A. Capital Purchases *	1806	1858	1967	2079
B. Purchases/leases *	0	0	0	0
Subtotal	**1806**	**1858**	**1967**	**2079**
2. Software ($000)				
A. Capital Purchases *	0	0	0	0
B. Purchases/leases *	374	385	408	431
Subtotal	**374**	**385**	**408**	**431**
3. Services ($000)				
A. Communications	0	0	0	0
B. Processing	0	0	0	0
C. Other	0	0	0	0
Subtotal	**0**	**0**	**0**	**0**
4. Support Services ($000)				
A. Software	1300	1337	1416	1496
B. Equipment Maintenance	445	458	485	513
C. Other	3309	3404	3604	3809
Subtotal	**5054**	**5199**	**5505**	**5818**
5. Supplies ($000)	35	36	38	40
6. Personnel (Compensation, Benefits) ($000)				
A. Software	0	0	0	0
B. Processing	0	0	0	0
C. Other	461	472	486	497
Subtotal	**461**	**472**	**486**	**497**
7. Other (Non-FIP Resources) ($000)				
A. Capital Purchases *	0	0	0	0
B. Purchases/leases *	204	210	222	235
Subtotal	**204**	**210**	**222**	**235**
8. Intra-Governmental Payments ($000)				
A. Software	0	0	0	0
B. Equipment Maintenance	0	0	0	0
C. Processing	0	0	0	0
D. Communications	210	216	229	242
E. Other	0	0	0	0
Subtotal	**210**	**216**	**229**	**242**
9. Intra-Governmental Collections ($000)				
A. Software	0	0	0	0
B. Equipment Maintenance	0	0	0	0
C. Processing	0	0	0	0
D. Communications	0	0	0	0
E. Other	0	0	0	0
Subtotal	**0**	**0**	**0**	**0**
NET IT RESOURCES (sum 1-9 above)	**8144**	**8376**	**8855**	**9342**
Workyears	5	5	5	5

Appropriation: All funding is RDT&E, Defensewide

* FY 1995 estimates reflect a $50 thousand investment/expense threshold; FY 1996 and the outyear estimates adhere to the centrally managed criteria.

Exhibit 43 Report on Information Technology Resources

ADVANCED RESEARCH PROJECTS AGENCY
INFORMATION TECHNOLOGY (IT) RESOURCES BY CIM FUNCTIONAL AREA
FY 1997 BUDGET ESTIMATES
(Dollars in Thousands)

	FY95	FY96	FY97	FY98
A. Science and Technology				
1. Major Systems/Initiatives				
NONE				
2. Non Major Systems/Initiatives				
NONE				
3. All Other				
Development/Modernization	4039	4091	4200	4312
Current Services	4105	4285	4655	5030
Subtotal	8144	8376	8855	9342
Appropriation/Fund				
RDT&E, Defensewide				
4. TOTAL Science and Technology				
Total Development/Modernization	4039	4091	4200	4312
Total Current Services	4105	4285	4655	5030
Subtotal	8144	8376	8855	9342
Appropriation/Fund				
RDT&E, Defensewide				
A. CIM Grand Total				
Development/Modernization	4039	4091	4200	4312
Current Services	4105	4285	4655	5030
Subtotal	8144	8376	8855	9342
Appropriation/Fund				
RDT&E, Defensewide				

Note: FY 1995 estimates reflect a $50 thousand investment/expense threshold;
FY 1996 and the outyear estimates adhere to the centrally managed criteria.

xhibit 43(IT-1) Report on Information Technology Resources

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-1, Physical Security)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	15	15	15	15	15	15	15

Exhibits SA-1 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-1, Physical Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	.047	.705	.720	.750	.780	.825	.849
Subtotal Personnel Costs	.100	.759	.776	.808	.840	.888	.914
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other - PE 0605898E	.041	.147	.058	.075	.041	.042	.043
Subtotal Security Equipment Costs	.041	.147	.058	.075	.041	.042	.043
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.141	.906	.834	.883	.881	.930	.957

Exhibits SA-1 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-1, Physical Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.141	.906	.834	.883	.881	.930	.957

Exhibit SA-1 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-2, Classified Management Security)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	2	2	2	2	2	2	2

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-2, Classified Management Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	0	.094	.196	.100	.104	.110	.114
Subtotal Personnel Costs	.053	.148	.252	.158	.164	.173	.179
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other							
Subtotal Security Equipment Costs	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.053	.148	.252	.158	.164	.173	.179

Exhibits SA-2 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-2, Classified Management Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other (Specifically identify each applicable appropriation/account)							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.053	.148	.252	.158	.164	.173	.179

Exhibit SA-2 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-3, Information Systems Security)
(Communications Security (COMSEC)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	1	1	1	1	1	1	1

Exhibits SA-3 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-3, Information Systems Security)
Communications Security (COMSEC)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	.047	.047	.048	.050	.052	.053	.054
Subtotal Personnel Costs	.100	.101	.104	.108	.112	.116	.119
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other - PE 0605898E							
Subtotal Security Equipment Costs	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.100	.101	.104	.108	.112	.116	.119

Exhibits SA-3 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-3, Information Systems Security)
Communications Security (COMSEC)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.100	.101	.104	.108	.112	.116	.119

Exhibit SA-3 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-4, Information Systems Security)
Automated Information Systems (AIS)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	0	0	0	0	0	0	0
Workyears							
TOTAL DOD MANPOWER							
End Strength	0	0	0	0	0	0	0
Contract Personnel							
Workyears	2	2	2	2	2	2	2

Exhibits SA-4 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-4, Information Systems Security, Automated Information Systems (AIS)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M, Active							
(5) O&M, National Guard							
(6) O&M, Reserve							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	0	0	0	0	0	0	0
(b) Contract	0	.094	.096	.100	.104	.110	.113
Subtotal Personnel Costs	0	.094	.096	.100	.104	.110	.113
b. Security Equipment							
(1) O&M, Active							
(2) O&M, National Guard							
(3) O&M, Reserve							
(4) Other							
Subtotal Security Equipment Cost	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	0	.094	.096	.100	.104	.110	.113

Exhibits SA-4 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-4, Information Systems Security, Automated Information Systems (AIS)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	0	.094	.096	.100	.104	.110	.113

Exhibit SA-4 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-5, Technical Security Countermeasures (TSCM)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	1	1	1	1	1	1	1

Exhibits SA-5 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-5, Technical Surveilance Countermeasures (TSCM)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	0	.042	.048	.052	.052	.055	.056
Subtotal Personnel Costs	.053	.096	.104	.110	.112	.118	.121
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other - PE 0605898E	0	0	0	0	0	0	0
Subtotal Security Equipment Costs	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.053	.096	.104	.110	.112	.118	.121

Exhibits SA-5 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-5, Technical Serveillance Countermeasures (TSCM)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.053	.096	.104	.110	.112	.118	.121

Exhibit SA-5 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-6, Compromising Emanations (TEMPEST)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military	0	0	0	0	0	0	0
End Strength							
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	0	0	0	0	0	0	0
Workyears							
TOTAL DOD MANPOWER							
End Strength	0	0	0	0	0	0	0
Contract Personnel							
Workyears	0	0	0	0	0	0	0

Exhibits SA-6 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-6, Compromising Emanations (TEMPEST)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	0	0	0	0	0	0	0
(b) Contract	0	0	0	0	0	0	0
Subtotal Personnel Costs	0	0	0	0	0	0	0
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other - PE 0605898E	0	0	0	0	0	0	0
Subtotal Security Equipment Costs	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	0	0	0	0	0	0	0

Exhibits SA-6 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-6, Compromising Emanations (TEMPEST)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	0	0	0	0	0	0	0

Exhibit SA-6 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-7, Personnel Security-Clearance Passing and Verification)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	1	1	1	1	1	1	1

Exhibits SA-7 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-7, Personnel Security-Clearance Passing and Verification)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M (Active)							
(5) O&M (National Guard)							
(6) O&M (Reserve)							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	0	.047	.048	.050	.052	.055	.056
Subtotal Personnel Costs	.053	.101	.104	.108	.112	.118	.121
b. Security Equipment							
(1) O&M (Active)							
(2) O&M (National Guard)							
(3) O&M (Reserve)							
(4) Other - PE 0605898E							
Subtotal Security Equipment Costs	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.053	.101	.104	.108	.112	.118	.121

Exhibits SA-7 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-7, Personnel Security-Clearance Passing and Verification)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.053	.101	.104	.108	.112	.118	.121

Exhibit SA-7 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-8, Counter Intelligence Support)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	1	1	1	1	1	1	1

Exhibits SA-8 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-8, Counter Intelligence Support)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M, Active							
(5) O&M, National Guard							
(6) O&M, Reserve							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	0	.047	.048	.050	.052	.055	.056
Subtotal Personnel Costs	.053	.101	.104	.108	.112	.118	.121
b. Security Equipment							
(1) O&M, Active							
(2) O&M, National Guard							
(3) O&M, Reserve							
(4) Other							
Subtotal Security Equipment Cost	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.053	.101	.104	.108	.112	.118	.121

Exhibits SA-8 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-8, Counter Intelligence Support)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.053	.101	.104	.108	.112	.118	.121

Exhibit SA-8 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-9, DoD Industrial Security (Collateral)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	2	2	2	2	2	2	2

Exhibits SA-9 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-9, DoD Industrial Security (Collateral)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M, Active							
(5) O&M, National Guard							
(6) O&M, Reserve							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	0	.094	.096	.100	.104	.110	.113
Subtotal Personnel Costs	.053	.148	.152	.158	.164	.173	.178
b. Security Equipment							
(1) O&M, Active							
(2) O&M, National Guard							
(3) O&M, Reserve							
(4) Other							
Subtotal Security Equipment Cost	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.053	.148	.152	.158	.164	.173	.178

Exhibits SA-9 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-9, DoD Industrial Security (Collateral)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E, Defensewide							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.053	.148	.152	.158	.164	.173	.178

Exhibit SA-9 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-10, Special Access Programs (SAP)
Security Oversight and Inspections)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	1	1	1	1	1	1	1
Workyears							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	1	1	1	1	1	1	1
Workyears							
TOTAL DOD MANPOWER							
End Strength	1	1	1	1	1	1	1
Contract Personnel							
Workyears	1	9	9	9	9	9	9

Exhibits SA-10 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-10, Special Access Programs (SAP)
Security Oversight and Inspections)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M, Active							
(5) O&M, National Guard							
(6) O&M, Reserve							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.053	.054	.056	.058	.060	.063	.065
(b) Contract	.047	.423	.432	.450	.468	.495	.509
Subtotal Personnel Costs	.100	.477	.488	.508	.528	.558	.574
b. Security Equipment							
(1) O&M, Active							
(2) O&M, National Guard							
(3) O&M, Reserve							
(4) Other							
Subtotal Security Equipment Cost	0	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.100	.477	.488	.508	.528	.558	.574

Exhibits SA-10 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-10, Special Access Programs (SAP)
Security Oversight and Inspections)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA.	.100	.477	.488	.508	.528	.558	.574

Exhibit SA-10 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)

MANPOWER

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel							
a. Officers							
End Strength	0	0	0	0	0	0	0
Average Strength							
b. Enlisted							
End Strength	0	0	0	0	0	0	0
Average Strength							
c. Total Military							
End Strength	0	0	0	0	0	0	0
Average Strength							
Civilian Personnel							
a. Direct Hire							
End Strength	8	8	8	8	8	8	8
Workyear							
b. Indirect Hire							
End Strength	0	0	0	0	0	0	0
Workyears							
c. Total DoD Civilians							
End Strength	8	8	8	8	8	8	8
Workyears							
TOTAL DOD MANPOWER							
End Strength	8	8	8	8	8	8	8
Contract Personnel							
Workyears	26	34	34	34	34	34	34

Exhibits SA-11 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS							
a. Personnel							
(1) Military (Active)							
(2) Military (National Guard)							
(3) Military (Reserve)							
(4) O&M, Active							
(5) O&M, National Guard							
(6) O&M, Reserve							
(7) Other - PE 0605898E							
(a) Direct Hire, Civilian	.424	.432	.448	.464	.480	.504	.520
(b) Contract	.141	1.593	1.732	1.702	1.768	1.868	1.920
Subtotal Personnel Costs	.565	2.025	2.180	2.166	2.248	2.372	2.440
b. Security Equipment							
(1) O&M, Active							
(2) O&M, National Guard							
(3) O&M, Reserve							
(4) Other - PE 0605898E	.041	.147	.058	.075	.041	.042	.043
Subtotal Security Equipment Cost							
c. Miscellaneous	0	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COST	.606	2.172	2.238	2.241	2.289	2.414	2.483

Exhibits SA-11 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS							
a. Security Equipment							
(1) Other Procurement							
(2) O&M, Active							
(3) O&M, National Guard							
(4) O&M, Reserve							
(5) Defense Business Operations Funds							
(6) Other							
Subtotal Security Equipment	0	0	0	0	0	0	0
b. Security RDT&E							
(1) 6.1 (Research)							
(2) 6.2 (Exploratory Development)							
(3) 6.3 (Advanced Development)							
(4) 6.4 (Engineering Development)							
(5) 6.5 (Management & Support)							
Subtotal Security RDT&E	0	0	0	0	0	0	0
c. Security Construction							
(1) Military Construction appropriation							
(2) O&M appropriation							
Subtotal Security Construction	0	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0	0
TOTAL TOA FOR ARPA.	1.606	2.172	2.238	2.241	2.289	2.414	2.483

Exhibit SA-11 (Page 3 of 3)