Department of Defense
Fiscal Year (FY) 2017 President's Budget Submission

February 2016

Navy

Justification Book Volume 1 of 5

Research, Development, Test & Evaluation, Navy

Budget Activities 1, 2, and 3

The estimated cost for this report for the Department of the Navy (DON) is $13,322.

The estimated total cost for supporting the DON budget justification material is approximately $1,834,000 for the 2016 fiscal year. This includes $75,200 in supplies and $1,758,800 in labor.

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Research, Development, Test and Evaluation, Navy

For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, $17,354,624,000, to remain available for obligation until September 30, 2017.

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Department of Defense
FY 2017 President's Budget
Exhibit R-1 FY 2017 President's Budget
Total Obligational Authority
(Dollars in Thousands)

14 Jan 2016

Appropriation	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Research, Development, Test & Eval, Navy	16,067,423	18,111,247	35,747	18,146,994	17,276,301	78,323	17,354,624
Total Research, Development, Test & Evaluation	16,067,423	18,111,247	35,747	18,146,994	17,276,301	78,323	17,354,624

R-1C1: FY 2017 President's Budget (Published Version of PB Position), as of January 14, 2016 at 09:41:42

Department of Defense
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(Dollars in Thousands)

14 Jan 2016

Summary Recap of Budget Activities	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Basic Research	634,410	671,875		671,875	542,970		542,970
Applied Research	855,861	965,872		965,872	861,151		861,151
Advanced Technology Development	625,631	696,226		696,226	736,988		736,988
Advanced Component Development & Prototypes	4,357,168	5,022,272		5,022,272	4,662,867	41,897	4,704,764
System Development & Demonstration	5,119,875	6,274,796		6,274,796	6,025,655		6,025,655
Management Support	1,278,299	918,223		918,223	853,736		853,736
Operational Systems Development	3,196,179	3,561,983	35,747	3,597,730	3,592,934	36,426	3,629,360
Total Research, Development, Test & Evaluation	16,067,423	18,111,247	35,747	18,146,994	17,276,301	78,323	17,354,624
Summary Recap of FYDP Programs							
Strategic Forces	140,959	164,143		164,143	196,948		196,948
General Purpose Forces	1,292,908	1,326,178		1,326,178	1,447,043		1,447,043
Intelligence and Communications	754,576	719,253		719,253	713,042		713,042
Research and Development	12,620,194	14,380,627		14,380,627	13,638,282	41,897	13,680,179
Central Supply and Maintenance	60,896	28,506		28,506	52,526		52,526
Administration and Associated Activities	137	355		355			
Classified Programs	1,197,753	1,492,185	35,747	1,527,932	1,228,460	36,426	1,264,886
Total Research, Development, Test & Evaluation	16,067,423	18,111,247	35,747	18,146,994	17,276,301	78,323	17,354,624

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Department of the Navy
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Appropriation: 1319N Research, Development, Test & Eval, Navy

Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
1	0601103N	University Research Initiatives	01	129,331	146,196		146,196	101,714		101,714	U
2	0601152N	In-House Laboratory Independent Research	01	18,997	19,126		19,126	18,508		18,508	U
3	0601153N	Defense Research Sciences	01	486,082	506,553		506,553	422,748		422,748	U
	Basic Research			634,410	671,875		671,875	542,970		542,970	
4	0602114N	Power Projection Applied Research	02	94,944	87,223		87,223	41,371		41,371	U
5	0602123N	Force Protection Applied Research	02	159,556	178,616		178,616	158,745		158,745	U
6	0602131M	Marine Corps Landing Force Technology	02	44,629	51,643		51,643	51,590		51,590	U
7	0602235N	Common Picture Applied Research	02	44,874	42,538		42,538	41,185		41,185	U
8	0602236N	Warfighter Sustainment Applied Research	02	46,202	45,047		45,047	45,467		45,467	U
9	0602271N	Electromagnetic Systems Applied Research	02	102,750	114,644		114,644	118,941		118,941	U
10	0602435N	Ocean Warfighting Environment Applied Research	02	62,643	72,252		72,252	42,618		42,618	U
11	0602651M	Joint Non-Lethal Weapons Applied Research	02	5,728	6,114		6,114	6,327		6,327	U
12	0602747N	Undersea Warfare Applied Research	02	88,204	150,839		150,839	126,313		126,313	U
13	0602750N	Future Naval Capabilities Applied Research	02	171,992	179,538		179,538	165,103		165,103	U
14	0602782N	Mine and Expeditionary Warfare Applied Research	02	34,339	37,418		37,418	33,916		33,916	U
15	0602898N	Science and Technology Management - ONR Headquarters	02					29,575		29,575	U
	Applied Research			855,861	965,872		965,872	861,151		861,151	

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
16	0603114N	Power Projection Advanced Technology	03	36,651	36,971		36,971	96,406		96,406	U
17	0603123N	Force Protection Advanced Technology	03	25,148	38,044		38,044	48,438		48,438	U
18	0603271N	Electromagnetic Systems Advanced Technology	03	62,860	34,856		34,856	26,421		26,421	U
19	0603640M	USMC Advanced Technology Demonstration (ATD)	03	125,696	131,490		131,490	140,416		140,416	U
20	0603651M	Joint Non-Lethal Weapons Technology Development	03	11,163	12,745		12,745	13,117		13,117	U
21	0603673N	Future Naval Capabilities Advanced Technology Development	03	257,806	265,562		265,562	249,092		249,092	U
22	0603680N	Manufacturing Technology Program	03		57,074		57,074	56,712		56,712	U
23	0603729N	Warfighter Protection Advanced Technology	03	39,374	36,299		36,299	4,789		4,789	U
24	0603747N	Undersea Warfare Advanced Technology	03	9,639	13,748		13,748	25,880		25,880	U
25	0603758N	Navy Warfighting Experiments and Demonstrations	03	55,363	65,946		65,946	60,550		60,550	U
26	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	1,931	3,491		3,491	15,167		15,167	U
		Advanced Technology Development		625,631	696,226		696,226	736,988		736,988	
27	0603207N	Air/Ocean Tactical Applications	04	39,669	37,832		37,832	48,536		48,536	U
28	0603216N	Aviation Survivability	04	4,280	10,904		10,904	5,239		5,239	U
29	0603237N	Deployable Joint Command and Control	04	2,991	3,086		3,086				U
30	0603251N	Aircraft Systems	04	14,270	26,643		26,643	1,519		1,519	U
31	0603254N	ASW Systems Development	04	7,602	5,551		5,551	7,041		7,041	U

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
32	0603261N	Tactical Airborne Reconnaissance	04	5,870	3,080		3,080	3,274		3,274	U
33	0603382N	Advanced Combat Systems Technology	04	1,582	1,631		1,631	57,034		57,034	U
34	0603502N	Surface and Shallow Water Mine Countermeasures	04	83,793	90,472		90,472	165,775		165,775	U
35	0603506N	Surface Ship Torpedo Defense	04	56,802	71,300		71,300	87,066		87,066	U
36	0603512N	Carrier Systems Development	04	5,954	8,348		8,348	7,605		7,605	U
37	0603525N	PILOT FISH	04	140,841	122,939		122,939	132,068		132,068	U
38	0603527N	RETRACT LARCH	04	29,725	28,803		28,803	14,546	3,907	18,453	U
39	0603536N	RETRACT JUNIPER	04	79,059	112,604		112,604	115,435		115,435	U
40	0603542N	Radiological Control	04	667	710		710	702		702	U
41	0603553N	Surface ASW	04	1,020	1,096		1,096	1,081		1,081	U
42	0603561N	Advanced Submarine System Development	04	65,913	85,834		85,834	100,565		100,565	U
43	0603562N	Submarine Tactical Warfare Systems	04	7,986	10,371		10,371	8,782		8,782	U
44	0603563N	Ship Concept Advanced Design	04	17,831	10,459		10,459	14,590		14,590	U
45	0603564N	Ship Preliminary Design & Feasibility Studies	04	8,007	3,332		3,332	15,805		15,805	U
46	0603570N	Advanced Nuclear Power Systems	04	499,961	482,040		482,040	453,313		453,313	U
47	0603573N	Advanced Surface Machinery Systems	04	20,357	24,143		24,143	36,655		36,655	U
48	0603576N	CHALK EAGLE	04	529,885	511,651		511,651	367,016		367,016	U
49	0603581N	Littoral Combat Ship (LCS)	04	80,199	91,416		91,416	51,630		51,630	U
50	0603582N	Combat System Integration	04	20,741	32,561		32,561	23,530		23,530	U
51	0603595N	Ohio Replacement	04	833,274	971,393		971,393	700,811		700,811	U

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52	0603596N	LCS Mission Modules	04	172,602	203,143		203,143	160,058		160,058	U
53	0603597N	Automated Test and Analysis	04	7,816	23,000		23,000				U
54	0603599N	Frigate Development	04		30,000		30,000	84,900		84,900	U
55	0603609N	Conventional Munitions	04	7,603	7,678		7,678	8,342		8,342	U
56	0603611M	Marine Corps Assault Vehicles	04	101,175	212,173		212,173	158,682		158,682	U
57	0603635M	Marine Corps Ground Combat/Support System	04	1,241	378		378	1,303		1,303	U
58	0603654N	Joint Service Explosive Ordnance Development	04	22,274	15,329		15,329	46,911		46,911	U
59	0603658N	Cooperative Engagement	04	41,158	73,786		73,786				U
60	0603713N	Ocean Engineering Technology Development	04	6,127	4,520		4,520	4,556		4,556	U
61	0603721N	Environmental Protection	04	13,200	19,289		19,289	20,343		20,343	U
62	0603724N	Navy Energy Program	04	62,412	56,391		56,391	52,479		52,479	U
63	0603725N	Facilities Improvement	04	2,588	3,726		3,726	5,458		5,458	U
64	0603734N	CHALK CORAL	04	162,900	174,771		174,771	245,860		245,860	U
65	0603739N	Navy Logistic Productivity	04	3,355	3,866		3,866	3,089		3,089	U
66	0603746N	RETRACT MAPLE	04	346,830	359,856		359,856	323,526		323,526	U
67	0603748N	LINK PLUMERIA	04	260,179	237,376		237,376	318,497		318,497	U
68	0603751N	RETRACT ELM	04	32,889	37,700		37,700	52,834		52,834	U
69	0603764N	LINK EVERGREEN	04	44,894	47,312		47,312	48,116		48,116	U
70	0603787N	Special Processes	04	24,336	17,392		17,392	13,619		13,619	U
71	0603790N	NATO Research and Development	04	8,659	8,320		8,320	9,867		9,867	U

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72	0603795N	Land Attack Technology	04	310	887		887	6,015		6,015	U
73	0603851M	Joint Non-Lethal Weapons Testing	04	32,955	29,444		29,444	27,904		27,904	U
74	0603860N	Joint Precision Approach and Landing Systems - Dem/Val	04	41,644	81,466		81,466	104,144		104,144	U
75	0603925N	Directed Energy and Electric Weapon Systems	04	54,154	41,730		41,730	32,700		32,700	U
76	0604112N	Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 - 80)	04	46,308	98,105		98,105	70,528		70,528	U
77	0604122N	Remote Minehunting System (RMS)	04	20,534	17,589		17,589	3,001		3,001	U
78	0604272N	Tactical Air Directional Infrared Countermeasures (TADIRCM)	04	5,677	18,969		18,969	34,920	37,990	72,910	U
79	0604279N	ASE Self-Protection Optimization	04	5,121	7,874		7,874				U
80	0604292N	MH-XX	04	3,007	4,516		4,516	1,620		1,620	U
81	0604454N	LX (R)	04	32,522	75,486		75,486	6,354		6,354	U
82	0604536N	Advanced Undersea Prototyping	04					78,589		78,589	U
83	0604653N	Joint Counter Radio Controlled IED Electronic Warfare (JCREW)	04	14,987	3,790		3,790				U
84	0604659N	Precision Strike Weapons Development Program	04		9,595		9,595	9,910		9,910	U
85	0604707N	Space and Electronic Warfare (SEW) Architecture/Engineering Support	04	21,916	20,203		20,203	23,971		23,971	U
86	0604786N	Offensive Anti-Surface Warfare Weapon Development	04	181,719	285,849		285,849	252,409		252,409	U
87	0605812M	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	04	8,970	32,149		32,149	23,197		23,197	U

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88	0303354N	ASW Systems Development - MIP	04	6,495	9,835		9,835	9,110		9,110	U
89	0304270N	Electronic Warfare Development - MIP	04	332	580		580	437		437	U
		Advanced Component Development & Prototypes		4,357,168	5,022,272		5,022,272	4,662,867	41,897	4,704,764	
90	0603208N	Training System Aircraft	05	13,115	17,989		17,989	19,938		19,938	U
91	0604212N	Other Helo Development	05	34,436	11,101		11,101	6,268		6,268	U
92	0604214N	AV-8B Aircraft - Eng Dev	05	24,558	27,668		27,668	33,664		33,664	U
93	0604215N	Standards Development	05	52,842	53,049		53,049	1,300		1,300	U
94	0604216N	Multi-Mission Helicopter Upgrade Development	05	11,159	18,858		18,858	5,275		5,275	U
95	0604218N	Air/Ocean Equipment Engineering	05	2,126	4,515		4,515	3,875		3,875	U
96	0604221N	P-3 Modernization Program	05	698	1,514		1,514	1,909		1,909	U
97	0604230N	Warfare Support System	05	9,050	5,875		5,875	13,237		13,237	U
98	0604231N	Tactical Command System	05	52,287	73,533		73,533	36,323		36,323	U
99	0604234N	Advanced Hawkeye	05	171,189	217,645		217,645	363,792		363,792	U
100	0604245N	H-1 Upgrades	05	43,469	27,235		27,235	27,441		27,441	U
101	0604261N	Acoustic Search Sensors	05	24,395	31,235		31,235	34,525		34,525	U
102	0604262N	V-22A	05	50,188	76,483		76,483	174,423		174,423	U
103	0604264N	Air Crew Systems Development	05	14,503	12,665		12,665	13,577		13,577	U
104	0604269N	EA-18	05	18,653	46,921		46,921	116,761		116,761	U
105	0604270N	Electronic Warfare Development	05	27,250	20,113		20,113	48,766		48,766	U
106	0604273N	Executive Helo Development	05	356,567	507,093		507,093	338,357		338,357	U
107	0604274N	Next Generation Jammer (NGJ)	05	224,578	387,770		387,770	577,822		577,822	U

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
108	0604280N	Joint Tactical Radio System - Navy (JTRS-Navy)	05	6,725	24,985		24,985	2,365		2,365	U
109	0604282N	Next Generation Jammer (NGJ) Increment II	05		13,000		13,000	52,065		52,065	U
110	0604307N	Surface Combatant Combat System Engineering	05	178,430	386,576		386,576	282,764		282,764	U
111	0604311N	LPD-17 Class Systems Integration	05	363	747		747	580		580	U
112	0604329N	Small Diameter Bomb (SDB)	05	53,950	57,144		57,144	97,622		97,622	U
113	0604366N	Standard Missile Improvements	05	50,241	115,644		115,644	120,561		120,561	U
114	0604373N	Airborne MCM	05	37,831	9,647		9,647	45,622		45,622	U
115	0604376M	Marine Air Ground Task Force (MAGTF) Electronic Warfare (EW) for Aviation	05	9,219	2,778		2,778				U
116	0604378N	Naval Integrated Fire Control - Counter Air Systems Engineering	05	14,903	23,695		23,695	25,750		25,750	U
117	0604404N	Unmanned Carrier Launched Airborne Surveillance and Strike (UCLASS) System	05	382,542	434,699		434,699				U
118	0604501N	Advanced Above Water Sensors	05	19,320	43,914		43,914	85,868		85,868	U
119	0604503N	SSN-688 and Trident Modernization	05	70,053	109,893		109,893	117,476		117,476	U
120	0604504N	Air Control	05	28,669	57,928		57,928	47,404		47,404	U
121	0604512N	Shipboard Aviation Systems	05	120,062	120,217		120,217	112,158		112,158	U
122	0604518N	Combat Information Center Conversion	05					6,283		6,283	U
123	0604522N	Air and Missile Defense Radar (AMDR) System	05	126,525	232,677		232,677	144,395		144,395	U
124	0604558N	New Design SSN	05	85,787	157,056		157,056	113,013		113,013	U

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Appropriation: 1319N Research, Development, Test & Eval, Navy

Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
125	0604562N	Submarine Tactical Warfare System	05	37,768	52,713		52,713	43,160		43,160	U
126	0604567N	Ship Contract Design/ Live Fire T&E	05	39,459	38,925		38,925	65,002		65,002	U
127	0604574N	Navy Tactical Computer Resources	05	3,884	4,096		4,096	3,098		3,098	U
128	0604580N	Virginia Payload Module (VPM)	05	106,223	167,719		167,719	97,920		97,920	U
129	0604601N	Mine Development	05	10,962	15,122		15,122	10,490		10,490	U
130	0604610N	Lightweight Torpedo Development	05	39,664	43,738		43,738	20,178		20,178	U
131	0604654N	Joint Service Explosive Ordnance Development	05	8,978	8,123		8,123	7,369		7,369	U
132	0604703N	Personnel, Training, Simulation, and Human Factors	05	5,925	7,686		7,686	4,995		4,995	U
133	0604727N	Joint Standoff Weapon Systems	05	4,389	405		405	412		412	U
134	0604755N	Ship Self Defense (Detect & Control)	05	64,704	145,336		145,336	134,619		134,619	U
135	0604756N	Ship Self Defense (Engage: Hard Kill)	05	94,534	86,811		86,811	114,475		114,475	U
136	0604757N	Ship Self Defense (Engage: Soft Kill/EW)	05	107,319	105,416		105,416	114,211		114,211	U
137	0604761N	Intelligence Engineering	05	200	2,053		2,053	11,029		11,029	U
138	0604771N	Medical Development	05	26,589	25,291		25,291	9,220		9,220	U
139	0604777N	Navigation/ID System	05	28,952	32,456		32,456	42,723		42,723	U
140	0604800M	Joint Strike Fighter (JSF) - EMD	05	487,940	537,901		537,901	531,426		531,426	U
141	0604800N	Joint Strike Fighter (JSF) - EMD	05	486,978	504,736		504,736	528,716		528,716	U
142	0604810M	Joint Strike Fighter Follow On Development - Marine Corps	05	10,086	20,798		20,798	74,227		74,227	U

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Appropriation: 1319N Research, Development, Test & Eval, Navy

Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
143	0604810N	Joint Strike Fighter Follow On Development - Navy	05	10,302	21,200		21,200	63,387		63,387	U
144	0605013M	Information Technology Development	05	2,670	4,824		4,824	4,856		4,856	U
145	0605013N	Information Technology Development	05	55,106	85,816		85,816	97,066		97,066	U
146	0605024N	Anti-Tamper Technology Support	05					2,500		2,500	U
147	0605212N	CH-53K RDTE	05	538,192	592,317		592,317	404,810		404,810	U
148	0605215N	Mission Planning	05					33,570		33,570	U
149	0605217N	Common Avionics	05					51,599		51,599	U
150	0605220N	Ship to Shore Connector (SSC)	05	41,616	7,778		7,778	11,088		11,088	U
151	0605327N	T-AO (X)	05					1,095		1,095	U
152	0605414N	Carrier Based Aerial Refueling System (CBARS)	05					89,000		89,000	U
153	0605450N	Joint Air-to-Ground Missile (JAGM)	05	6,104	25,898		25,898	17,880		17,880	U
154	0605500N	Multi-mission Maritime Aircraft (MMA)	05	297,380	156,293		156,293	59,126		59,126	U
155	0605504N	Multi-Mission Maritime (MMA) Increment III	05		91,616		91,616	182,220		182,220	U
156	0204202N	DDG-1000	05	196,987	103,179		103,179	45,642		45,642	U
157	0303167N	Pre-Auction Spectrum Relocation Fund	05	1,569							U
158	0303267N	Auctioned Spectrum Relocation Fund	05	4,569							U
159	0304231N	Tactical Command System - MIP	05	1,011	998		998	676		676	U
160	0304785N	Tactical Cryptologic Systems	05	10,157	17,785		17,785	36,747		36,747	U
161	0305124N	Special Applications Program	05	73,975	35,905		35,905	35,002		35,002	U

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Appropriation: 1319N Research, Development, Test & Eval, Navy

Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
162	0306250M	Cyber Operations Technology Development	05					4,942		4,942	U
		System Development & Demonstration		5,119,875	6,274,796		6,274,796	6,025,655		6,025,655	
163	0604256N	Threat Simulator Development	06	40,178	30,769		30,769	16,633		16,633	U
164	0604258N	Target Systems Development	06	66,251	71,152		71,152	36,662		36,662	U
165	0604759N	Major T&E Investment	06	121,108	61,234		61,234	42,109		42,109	U
166	0605126N	Joint Theater Air and Missile Defense Organization	06	4,800	6,995		6,995	2,998		2,998	U
167	0605152N	Studies and Analysis Support - Navy	06	3,412	4,011		4,011	3,931		3,931	U
168	0605154N	Center for Naval Analyses	06	43,054	47,071		47,071	46,634		46,634	U
169	0605285N	Next Generation Fighter	06	4,794	5,000		5,000	1,200		1,200	U
170	0605502N	Small Business Innovative Research	06	325,429							U
171	0605804N	Technical Information Services	06	1,290	925		925	903		903	U
172	0605853N	Management, Technical & International Support	06	83,789	83,024		83,024	87,077		87,077	U
173	0605856N	Strategic Technical Support	06	2,500	3,258		3,258	3,597		3,597	U
174	0605861N	RDT&E Science and Technology Management	06	72,943	76,948		76,948	62,811		62,811	U
175	0605863N	RDT&E Ship and Aircraft Support	06	127,634	132,122		132,122	106,093		106,093	U
176	0605864N	Test and Evaluation Support	06	335,791	351,912		351,912	349,146		349,146	U
177	0605865N	Operational Test and Evaluation Capability	06	16,423	17,985		17,985	18,160		18,160	U
178	0605866N	Navy Space and Electronic Warfare (SEW) Support	06	2,992	5,316		5,316	9,658		9,658	U

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179	0605867N	SEW Surveillance/Reconnaissance Support	06	8,325	6,519		6,519	6,500		6,500	U
180	0605873M	Marine Corps Program Wide Support	06	17,449	13,627		13,627	22,247		22,247	U
181	0605898N	Management HQ - R&D	06					16,254		16,254	U
182	0606355N	Warfare Innovation Management	06					21,123		21,123	U
183	0909980N	Judgment Fund Reimbursement	06		353		353				U
184	0909999N	Financing for Cancelled Account Adjustments	06	137	2		2				U
		Management Support		1,278,299	918,223		918,223	853,736		853,736	
186	0604402N	Unmanned Combat Air Vehicle (UCAV) Advanced Component and Prototype Development	07	35,309							U
187	0605525N	Carrier Onboard Delivery (COD) Follow On	07	8,873							U
188	0607658N	Cooperative Engagement Capability (CEC)	07					84,501		84,501	U
189	0607700N	Deployable Joint Command and Control	07					2,970		2,970	U
190	0101221N	Strategic Sub & Weapons System Support	07	93,912	96,404		96,404	136,556		136,556	U
191	0101224N	SSBN Security Technology Program	07	29,146	46,481		46,481	33,845		33,845	U
192	0101226N	Submarine Acoustic Warfare Development	07	4,366	4,700		4,700	9,329		9,329	U
193	0101402N	Navy Strategic Communications	07	13,535	16,558		16,558	17,218		17,218	U
194	0203761N	Rapid Technology Transition (RTT)	07	8,323	8,632		8,632				U
195	0204136N	F/A-18 Squadrons	07	84,976	135,755		135,755	189,125		189,125	U

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
196	0204163N	Fleet Telecommunications (Tactical)	07	26,333	41,538		41,538	48,225		48,225	U
197	0204228N	Surface Support	07	3,000	36,045		36,045	21,156		21,156	U
198	0204229N	Tomahawk and Tomahawk Mission Planning Center (TMPC)	07	25,543	25,227		25,227	71,355		71,355	U
199	0204311N	Integrated Surveillance System	07	72,315	49,587		49,587	58,542		58,542	U
200	0204413N	Amphibious Tactical Support Units (Displacement Craft)	07	5,522	11,335		11,335	13,929		13,929	U
201	0204460M	Ground/Air Task Oriented Radar (G/ ATOR)	07	90,577	65,598		65,598	83,538		83,538	U
202	0204571N	Consolidated Training Systems Development	07	38,359	34,325		34,325	38,593		38,593	U
203	0204574N	Cryptologic Direct Support	07	1,627	1,915		1,915	1,122		1,122	U
204	0204575N	Electronic Warfare (EW) Readiness Support	07	15,993	46,403		46,403	99,998		99,998	U
205	0205601N	HARM Improvement	07	17,377	23,708		23,708	48,635		48,635	U
206	0205604N	Tactical Data Links	07	135,582	142,361		142,361	124,785		124,785	U
207	0205620N	Surface ASW Combat System Integration	07	25,567	24,435		24,435	24,583		24,583	U
208	0205632N	MK-48 ADCAP	07	25,920	47,703		47,703	39,134		39,134	U
209	0205633N	Aviation Improvements	07	83,083	106,255		106,255	120,861		120,861	U
210	0205675N	Operational Nuclear Power Systems	07	104,023	101,323		101,323	101,786		101,786	U
211	0206313M	Marine Corps Communications Systems	07	82,576	77,909		77,909	82,159		82,159	U
212	0206335M	Common Aviation Command and Control System (CAC2S)	07	31,568	13,431		13,431	11,850		11,850	U

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
213	0206623M	Marine Corps Ground Combat/ Supporting Arms Systems	07	49,173	48,590		48,590	47,877		47,877	U
214	0206624M	Marine Corps Combat Services Support	07	18,185	19,955		19,955	13,194		13,194	U
215	0206625M	USMC Intelligence/Electronic Warfare Systems (MIP)	07	16,178	12,671		12,671	17,171		17,171	U
216	0206629M	Amphibious Assault Vehicle	07	87,940	45,110		45,110	38,020		38,020	U
217	0207161N	Tactical AIM Missiles	07	36,361	71,016		71,016	56,285		56,285	U
218	0207163N	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	9,820	32,172		32,172	40,350		40,350	U
219	0219902M	Global Combat Support System - Marine Corps (GCSS-MC)	07					9,128		9,128	U
223	0303109N	Satellite Communications (SPACE)	07	34,716	47,312		47,312	37,372		37,372	U
224	0303138N	Consolidated Afloat Network Enterprise Services (CANES)	07	24,137	21,667		21,667	23,541		23,541	U
225	0303140N	Information Systems Security Program	07	22,655	28,081		28,081	38,510		38,510	U
227	0305160N	Navy Meteorological and Ocean Sensors-Space (METOC)	07	356	599		599				U
228	0305192N	Military Intelligence Program (MIP) Activities	07	6,166	6,207		6,207	6,019		6,019	U
229	0305204N	Tactical Unmanned Aerial Vehicles	07	8,505	8,550		8,550	8,436		8,436	U
230	0305205N	UAS Integration and Interoperability	07		41,831		41,831	36,509		36,509	U
231	0305208M	Distributed Common Ground/Surface Systems	07	10,916	1,105		1,105	2,100		2,100	U
232	0305208N	Distributed Common Ground/Surface Systems	07	18,146	23,149		23,149	44,571		44,571	U
233	0305220N	MQ-4C Triton	07	419,242	227,118		227,118	111,729		111,729	U

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Line No	Program Element Number	Item	Act	FY 2015 (Base & OCO)	FY 2016 Base Enacted	FY 2016 OCO Enacted	FY 2016 Total Enacted	FY 2017 Base	FY 2017 OCO	FY 2017 Total	Sec
234	0305231N	MQ-8 UAV	07	43,294	52,770		52,770	26,518		26,518	U
235	0305232M	RQ-11 UAV	07	682	635		635	418		418	U
236	0305233N	RQ-7 UAV	07	851	688		688	716		716	U
237	0305234N	Small (Level 0) Tactical UAS (STUASL0)	07	4,813	4,647		4,647	5,071		5,071	U
238	0305239M	RQ-21A	07	7,782	6,251		6,251	9,497		9,497	U
239	0305241N	Multi-Intelligence Sensor Development	07	17,751	39,645		39,645	77,965		77,965	U
240	0305242M	Unmanned Aerial Systems (UAS) Payloads (MIP)	07	1,900	9,246		9,246	11,181		11,181	U
241	0305421N	RQ-4 Modernization	07	30,000	129,892		129,892	181,266		181,266	U
242	0308601N	Modeling and Simulation Support	07	4,556	4,757		4,757	4,709		4,709	U
243	0702207N	Depot Maintenance (Non-IF)	07	20,678	24,185		24,185	49,322		49,322	U
244	0708011N	Industrial Preparedness	07	36,031							U
245	0708730N	Maritime Technology (MARITECH)	07	4,187	4,321		4,321	3,204		3,204	U
9999	9999999999	Classified Programs		1,197,753	1,492,185	35,747	1,527,932	1,228,460	36,426	1,264,886	U
		Operational Systems Development		3,196,179	3,561,983		3,597,730	3,592,934		3,629,360	
Total Research, Development, Test & Eval, Navy				16,067,423	18,111,247		18,146,994	17,276,301	78,323	17,354,624	

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601103N *I University Research Initiatives*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	129.331	146.196	101.714	-	101.714	120.481	118.351	118.388	118.397	Continuing	Continuing
0000: *University Research Initiatives*	0.000	109.991	116.196	101.714	-	101.714	120.481	118.351	118.388	118.397	Continuing	Continuing
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

This program includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that enable the U.S. Navy to maintain technological superiority, and for university research infrastructure to acquire research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary University Research Initiative (MURI) efforts involve teams of researchers investigating high priority topics and opportunities that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovation, accelerate research progress and expedite transition of results into Naval applications. The Defense University Research Instrumentation Program (DURIP) supports university research infrastructure essential to high quality, Navy-relevant research. The instrumentation program complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The program supports Presidential Early Career Awards for Scientists and Engineers (PECASE), single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This program provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	133.908	116.196	118.764	-	118.764
Current President's Budget	129.331	146.196	101.714	-	101.714
Total Adjustments	-4.577	30.000	-17.050	-	-17.050
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	30.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-4.577	0.000			
• Program Adjustments	0.000	0.000	-2.145	-	-2.145
• Rate/Misc Adjustments	0.000	0.000	-14.905	-	-14.905

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601103N *I University Research Initiatives*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	19.340	30.000
Congressional Add Subtotals for Project: 9999	19.340	30.000
Congressional Add Totals for all Projects	19.340	30.000

Change Summary Explanation

The FY 2017 request was reduced by -$12.4 million as required for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Technical: N/A

Schedule: N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601103N / *University Research Initiatives*	Project (Number/Name) 0000 / *University Research Initiatives*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *University Research Initiatives*	0.000	109.991	116.196	101.714	-	101.714	120.481	118.351	118.388	118.397	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority of the U.S. Navy, and for university research infrastructure to acquire instrumentation needed to maintain and improve the quality of university research important to the Navy. MURI efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovation, accelerate research progress, and expedite transition of results into Naval applications. The DURIP project supports university research infrastructure essential to high quality, Navy-relevant research. The instrumentation project complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The PECASE project supports single-investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. This project provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM (DURIP)	22.596	23.060	20.557	0.000	20.557
Description: DURIP funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants. Individual grants range from $50K to $1.5M. The DURIP program is an Office of the Secretary of Defense (OSD) interest item and OSD directs that funding for the DURIP efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. In turn, universities need to purchase the instrumentation and take delivery before any billings are generated. It frequently takes several months for delivery and billing to be completed. DURIP is a one year program. The decrease in FY2017 reflects a reduction in the number of DURIP awards.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
FY 2015 Accomplishments: - Continued competition for research instrumentation awards to universities. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 ***FY 2017 OCO Plans:*** N/A					
Title: MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI) ***Description:*** Research efforts include high priority topics that intersect more than one traditional discipline. MURI topics are selected to address Naval Science and Technology (S&T) Focus Areas as described in the Naval S&T Strategic Plan. The MURI program is an OSD interest item and OSD directs that funding for the MURI efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. Since the MURI program funds academic researchers, execution of the efforts typically ramps up during the summer academic break months. MURI projects make significant contributions to Navy and DoD objectives by; speeding up scientific programs by cross-fertilization of ideas, hastening the transition of basic research to practical applications, and training students in cross-disciplinary approaches to science and engineering research of importance to DoD. MURI is a five year program. The increase in funding from FY 2015 to FY 2016 reflects the increased number of topics/awards in FY 2016. The FY 2017 reduction reflects fewer topics/awards in coordination with OSD. ***FY 2015 Accomplishments:*** - Continued competition for new MURI awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Approximately eight high priority research topics will be identified for publication in a BAA to solicit proposals. - Continued MURI projects begun in prior years. ***FY 2016 Plans:***	78.896	84.459	73.416	0.000	73.416

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 ***FY 2017 OCO Plans:*** N/A					
Title: PRESIDENTIAL EARLY CAREER AWARDS (PECASE) ***Description:*** PECASE awards are made to academic scientists early in their research careers for extremely prestigious, single-investigator research in areas of vital importance to the Navy. Awards provide national recognition and research grants of up to $200K per year for five years. OSD, with policy and oversight responsibility for the PECASE program, directed that the number of PECASE awards be set at four new awards per year. PECASE is a five year program. ***FY 2015 Accomplishments:*** - Selected six outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. - Continued PECASE programs begun in earlier years. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, and award four new awards per OSD guidance. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, and award four new awards per OSD guidance. ***FY 2017 OCO Plans:*** N/A	8.499	8.677	7.741	0.000	7.741
Accomplishments/Planned Programs Subtotals	109.991	116.196	101.714	0.000	101.714

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

E. Performance Metrics

This University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs. The initiative is a collection of specialized research programs performed by academic research institutions. Individual project metrics are tailored to the needs of specific applied research and advanced development programs. Example metrics include extending the life of Thermal Barrier Coatings for transition to the Enterprise and Platform Enablers Future Naval Capability program. It is projected that the life time of Thermal Barrier Coating on Turbine Blades can be doubled. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601103N / *University Research Initiatives*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

This congressional increase furthers the Navy's efforts to support multidisciplinary basic research in a wide range of scientific and engineering disciplines that enable the U.S. Navy to maintain technological superiority. Through this increase, additional Multidisciplinary University Research Initiative (MURI), Defense University Research Instrumentation Program (DURIP) and Presidential Early CareerAwards for Scientists and Engineers (PECASE) will be selected and funded.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase	19.340	30.000
FY 2015 Accomplishments: - Expanded the competition for new Multidisciplinary University Research Initiative (MURI) awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. - Expanded the competition for new Defense University Research Instrumentation Program (DURIP) awards to universities. - Funded an outstanding university researcher to receive the five-year PECASE research award to conduct research of importance to the Navy.		
FY 2016 Plans: - Expand the competition for new Multidisciplinary University Research Initiative (MURI) awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. - Expand the competition for new Defense University Research Instrumentation Program (DURIP) awards to universities. - Fund an outstanding university researcher to receive the five-year Presidential Early Career Award for Scientists and Engineers (PECASE) research award to conduct research of importance to the Navy.		
Congressional Adds Subtotals	19.340	30.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 9999 / *Congressional Adds*

E. Performance Metrics

This University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601152N / *In-House Lab Independent Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	18.998	19.126	18.508	-	18.508	19.438	19.434	19.440	19.441	Continuing	Continuing
0000: *In-House Lab Independent Res*	0.000	18.603	19.126	18.508	-	18.508	19.438	19.434	19.440	19.441	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.395	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.395

A. Mission Description and Budget Item Justification

This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority by providing new technological concepts for the maintenance of Naval power and national security, and by helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNCs). The Department of Navy (DON) component responds to S&T directions of the Naval S&T Strategic Plan for long term Navy and Marine Corps improvements and is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command. It enables technologies that significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work.

This PE addresses DON Basic Research, which includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental, and life sciences, and is the core of Discovery and Invention. Basic research projects are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in thirteen research focus areas: Power and Energy; Operational Environments; Maritime Domain Awareness; Asymmetric and Irregular Warfare; Information, Analysis and Communication; Power Projection; Assure Access and Hold at Risk; Distributed Operations; Naval Warfighter Performance and Protection; Survivability and Self-Defense; Platform Mobility; Fleet/Force Sustainment; Affordability, Maintainability and Reliability.

This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for: basic research to support the execution of their assigned missions; developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems; promoting hiring and development of new scientists; and encouragement of collaboration with universities, private industry, and other Navy and Department of Defense laboratories.

ILIR efforts are selected by Naval Warfare Centers/Lab Commanding Officers and Technical Directors near the start of each Fiscal Year through internal competition. Efforts typically last three years, and are generally designed to assess the promise of new lines of research. Successful efforts attract external, competitively awarded funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601152N *I In-House Lab Independent Res*

In FY15 the ILIR PE 06011652N was simplified from seven Naval technology interests (advanced materials, electronics sensor sciences, energy sciences, human performance sciences, information sciences, naval platform design sciences, and ocean/space sciences) into one encompassing ILIR program. It is still possible to report which naval technology interest each project falls under. Due to the number of efforts in PE 06011652N, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	19.142	19.126	19.499	-	19.499
Current President's Budget	18.998	19.126	18.508	-	18.508
Total Adjustments	-0.144	0.000	-0.991	-	-0.991
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.145	0.000			
• Rate/Misc Adjustments	0.001	0.000	-0.991	-	-0.991

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	0.395	0.000
Congressional Add Subtotals for Project: 9999	0.395	0.000
Congressional Add Totals for all Projects	0.395	0.000

Change Summary Explanation

The FY 2017 request was reduced by -$0.573 million as required for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601152N / *In-House Lab Independent Res*	Project (Number/Name) 0000 / *In-House Lab Independent Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *In-House Lab Independent Res*	0.000	18.603	19.126	18.508	-	18.508	19.438	19.434	19.440	19.441	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project sustains U.S. Naval S&T superiority, provides new technological concepts for the maintenance of naval power and national security, and mitigates scientific surprises, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNC's). It responds to S&T directions of the Naval S&T Strategic Plan for long term Navy and Marine Corps improvements. It is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command (NWDC) and the Marine Corps Combat Development Command (MCCDC), and enables technologies that significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities.

This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities, private industry, and other Navy and Department of Defense laboratories.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	16.130	16.601	16.065	0.000	16.065
Description: Starting in FY 2015, these requirements have been consolidated into a separate R-2 project to provide greater visibility of the program by providing an easily navigable overview of all In-House Laboratory Independent Researc(ILIR) Programs in a single location. Funding increase in FY 2016 is due to rebalancing programs within the Program Element. ***FY 2015 Accomplishments:*** -Continued research for polymer materials to understand improved helmet blast protection. -Continued fundamental research for composite materials for reduced signature for undersea vehicles. -Continued research for the fundamental understanding of graphene type Radio Frequency (RF) Antennas. -Continued fundamental research for the understanding of optimization of undersea sensor distribution in littoral environments. -Continued research for understanding effects of energetic materials under high pressure environment. -Continued research on Operational Fatigue of Warfighters due to Stress Environments. -Continued research on Human Gesture and Computer Interface and Functionality.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Continued research framework for Efficient Quantum Computing. -Continued research for Autonomous Routing of Unmanned Vehicles. -Continued fundamental research for undersea imaging and analysis. -Continued research for modeling super-cavitation of Advanced Propulsor Designs. -Continued research for Predictive Performance Modeling of Advanced Naval Hull Designs. -Continued research for Design and Performance of High Speed Naval Vessels. -Continued research for Advanced Smart Wireless Cooperative Vehicular Network. -Continued research for Undersea Laser Communication and Identification in Littoral Environments. -Continued ILIR projects that are intended to be approximately three years in length researching littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. -Initiated FY 2015 ILIR projects that are intended to be approximately three years in length to research topics including: Structural materials, functional materials, maintenance reduction, hydrodynamics, power generation, energy conservation and conversion. -Complete research to develop broadband dynamically controllable artificial dialetrics. -Sensing, diagnostics, and detectors; navigation and timekeeping; nano electronics; real time targeting, Electro-Optical/InfraRed (EO/IR) electronics; EO/IR electronic warfare; and EO/IR sensors for surface and subsurface surveillance. -Undersea weaponry, energetic materials and propulsion, directed energy, and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations. -Biosensors, biomaterial, bioprocesses; marine mammals; casualty care management, undersea medicine; human factors and organizational design; manpower, personnel and advanced cockpit; and operational training and education. These efforts are coordinated with the Navy Medical Research Center (NMRC). -Mathematical foundation and computational theory and tools for design communications, decision support theory, algorithm and tools, information assurance, secure and reliable infrastructure for command and control, mathematical optimization for optimal resource allocation and usage, modeling and computational propagation, seamless, robust connectivity and networking and cyber warfare. -Novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms. -Littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. -Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. -Command and Control and connectivity research. - Initiated research for polymer materials to understand improved helmet blast protection. - Initiated fundamental research for composite materials for reduced signature for undersea vehicles. - Initiated research for the fundamental understanding of graphene type Radio Frequency (RF) Antennas. - Initiated research for complex unmanned sensor networks.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Initiate FY 2016 ILIR projects that are intended to be approximately three years in length to research topics including : - Structural materials, functional materials, maintenance reduction, hydrodynamics, power generation, energy conservation and conversion. - Sensing, diagnostics, and detectors; navigation and timekeeping; nano electronics; real time targeting, Electro-Optical/InfraRed (EO/IR) electronics; EO/IR electronic warfare; and EO/IR sensors for surface and subsurface surveillance. - Undersea weaponry, energetic materials and propulsion, directed energy, and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations. - Biosensors, biomaterial, bioprocesses; marine mammals; casualty care management, undersea medicine; human factors and organizational design; manpower, personnel and advanced cockpit; and operational training and education. These efforts are coordinated with the Navy Medical Research Center (NMRC). - Mathematical foundation and computational theory and tools for design communications, decision support theory, algorithm and tools, information assurance, secure and reliable infrastructure for command and control, mathematical optimization for optimal resource allocation and usage, modeling and computational propagation, seamless, robust connectivity and networking and cyber warfare. - Novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms. - Littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. - Tailoring Instruction to the Individual: Investigating the Utility of Trainee Aptitudes for use in Adaptive Training. - Research to Improve Situational Awareness Using Learned Representations and Autonomous Systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Developing Novel Propellants for Solid Ramjet Application. - Anomalous Capacity Loss and Recovery in Lead Acid Batteries Following Rapid Pulsed Discharge Power and Energy. - Research of n+InP as a Possible New Semiconductor Material for Fast Neutron Spectroscopy. - Polarimetric Radar Cross Section Control. - Broadband Prewhitening Filtering Framework to Improve Beamforming Detection Performance inLinear Arrays under reduced Snapshot Support Conditions. - Automated Storytelling: Co-clustering of Topic Models for Topic Detection and Tracking - Developing the Theory of Superabsorption. - Topological Methods for the Analysis of Big Data. - Complete Development of a Unified Theory for Multiphase Flows - Complete Mechanistic Studies of Alane Decomposition - Neutralization Using Air-Deployable Self-surveying UUV - Optimized Waterspace Management & Scheduling for Heterogeneous Teams of Autonomous Vehicles. - Secure Underwater Communications Study for the Advanced Undersea Weapons (AUWS). - Acoustic Reception and Transmission in High Speed Flows. - Beamforming with Arrays of Sensor Elements with Uncertain Location. - Develop Design, Testing, and Analysis of Zero Poisson Ratio Metamaterials - Beam Space Multiple Input Multiple Output. - Graphene Broadband Infrared Light-Emitting Devices. - Machine Learning of Autonomous Vehicle Tactics through Human Evaluation. - Nomad: A Hybrid-Cloud Aware High Assurance and Availability Cloud Service. - Nonvolatile and Cryogenic Compatible Quantum Memory Devices. - Stochastic Compiler Hacks as Software Immunization Mechanisms (SCHSIM). - Energy Harvesting for Future E - Projects selected for FY 2016 will focus on supporting: - Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering. - Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Command and Control and connectivity research. ***FY 2017 Base Plans:*** -Continue all efforts of FY 2016, less those noted as completed above. -Complete FY 2015 ILIR projects which were three years in duration. -Continue ILIR projects started in FY2016. -Initiate FY 2017 ILIR projects that are to be approximately three years in length. ***FY 2017 OCO Plans:*** N/A					
Title: SCIENCE TECHNOLOGY ENGINEERING AND MATH (STEM) EFFORTS AT NAVY LABS	2.473	2.525	2.443	0.000	2.443
Description: This effort will support both the Science and Engineering Apprenticeship Program (SEAP) and the Naval Research Enterprise Intern Program (NREIP) summer programs to encourage participating students to pursue science and engineering careers, to further their education via mentoring by laboratory personnel and their participation in research, and to make them aware of DoN research and technology efforts, which can lead to employment within the DoN. Participating students will spend eight to ten weeks during the summer doing research at approximately 19 to 20 DoN laboratories. Participants will receive a stipend distributed by the Contractor. The stipend is a monthly allowance paid to interns for their participation in the research efforts. This activity was separated from ILIR in FY 2013 to highlight Science Technology Engineering and Math (STEM) efforts at Navy labs previously funded within the Ocean/Space Sciences activity in this PE. Funding increase in FY 2015 results from temporary augmentation of STEM within the PE, but the FY 2016 decrease plan rebalances the PE to focus on the NREIP and SEAP programs, scaling back on other STEM efforts. ***FY 2015 Accomplishments:*** - Continued Naval Research Enterprise Intern Program (NREIP) to support undergraduate and graduate students performing Navy-related research at Naval Warfare Centers under the supervision and mentorship of DON Scientists, thus exposing them to interesting and challenging work done at the centers. NREIP is a continuing Navy education program. - Continued Science and Engineering Apprenticeship Program (SEAP) supporting high school student programs. - Continued Science, Technology, Engineering and Mathematics (STEM) projects that are intended to be approximately three years in length. Projects selected for STEM funding will focus on engaging and educating future Naval scientists and engineers and incorporating naval relevance,					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
diversity, and STEM best practices. These efforts complement and support the ongoing independent research, education and outreach efforts taking place at the naval laboratories. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, unless noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	18.603	19.126	18.508	0.000	18.508

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered environment since it is basic research, but many projects focus on applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing systems. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601152N / *In-House Lab Independent Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.395	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.395

A. Mission Description and Budget Item Justification

This Congressional increase will help sustain U.S. Naval Science and Technology (S&T) superiority by providing new technological concepts for the maintenance of Naval power and national security, and by helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNCs). The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase	0.395	0.000
FY 2015 Accomplishments: Continued efforts for the In-house Laboratory Independent Research (ILIR) program.		
FY 2016 Plans: N/A		
Congressional Adds Subtotals	0.395	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601153N *I Defense Research Sciences*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	486.082	506.553	422.748	-	422.748	460.050	464.493	463.728	465.010	Continuing	Continuing
0000: *Defense Research Sciences*	0.000	434.398	451.553	422.748	-	422.748	460.050	464.493	463.728	465.010	Continuing	Continuing
9999: *Congressional Adds*	0.000	51.684	55.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	106.684

A. Mission Description and Budget Item Justification

This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise. It is based on investment directions as defined in the Naval Science & Technology Strategy approved by the S&T Corporate Board (20 Jan 2015). This new strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs).

This PE addresses basic research efforts including scientific study and experimentation directed toward increasing knowledge and understanding in national security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research on the order of a hundred technology and capability-related 'thrusts', which are consolidated into about fifteen research areas. These in turn support the major research areas of the Navy and Marine Corps: Autonomous Systems; Command, Control, Communications and Computers (C4); Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend. There are currently five NNRs.

S&T investment in basic research also includes the Basic Research Challenge Program which was established to competitively select and fund promising research programs in new areas not addressed by the current basic research program. The Basic Research Challenge Program stimulates new, high-risk basic research projects in multi-disciplinary and departmental collaborative efforts, and funds topics that foster leading edge science and attracts new principal investigators and organizations. Basic Research Challenge awards are for a period of four years.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	497.103	451.606	471.726	-	471.726
Current President's Budget	486.082	506.553	422.748	-	422.748
Total Adjustments	-11.021	54.947	-48.978	-	-48.978
• Congressional General Reductions	-	-0.053			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	55.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-11.021	0.000			
• Program Adjustments	0.000	0.000	-7.511	-	-7.511
• Rate/Misc Adjustments	0.000	0.000	-41.467	-	-41.467

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	51.684	55.000
Congressional Add Subtotals for Project: 9999	51.684	55.000
Congressional Add Totals for all Projects	51.684	55.000

Change Summary Explanation

The FY 2017 request was reduced by -$34.9 million as required for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy										Date: February 2016		
Appropriation/Budget Activity 1319 / 1				R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*					Project (Number/Name) 0000 / *Defense Research Sciences*			
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
0000: *Defense Research Sciences*	0.000	434.398	451.553	422.748	-	422.748	460.050	464.493	463.728	465.010	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise. It is based on investment directions as defined in the Naval Science & Technology Strategy. This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs).

This PE addresses basic research efforts including scientific study and experimentation directed toward increasing knowledge and understanding in national security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research on the order of a hundred technology and capability-related 'thrusts', which are consolidated into about fifteen research areas. These in turn support the major research areas of the Navy and Marine Corps: Autonomous Systems; Command, Control, Communications and Computers (C4); Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support. Activities in this area also support maintenance of the Science and Engineering Workforce and STEM Education and Outreach.

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), S&T areas that are uniquely important to maintaining U.S. Naval superiority. With the designation in 2011 of Sea-Based Aviation as an NNR, there are currently five NNRs.

S&T investment in basic research also includes the Basic Research Challenge program which was established to competitively select and fund promising research programs in new areas not addressed by the current basic research program. The Basic Research Challenge Program stimulates new, high-risk basic research projects in multi-disciplinary and departmental collaborative efforts, and funds topics that foster leading edge science and attracts new principal investigators and organizations. Basic Research Challenge awards are for a period of four years.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Title: AIR, GROUND AND SEA VEHICLES	54.596	56.574	52.065	0.000	52.065
Description: Surface/subsurface reduced signatures; free-surface, subsurface, and propulsor hydromechanics; hull life assurance; advanced ship concepts; distributed intelligence for automated survivability; advanced electrical power systems; air vehicles; air platforms propulsion and power; air platforms survivability and					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
signature control; special aviation projects; Unmanned Air Vehicle/Unmanned Combat Air Vehicle (UAV/UCAV); environmental quality; logistics; power generation, energy conversion, and storage; and advancements in naval technology innovations. Funding increase in FY16 is the result of changing S&T investment priorities within the Department of the Navy, resulting from increased funding across the PE each year resulting in higher investment levels in each major category of Air, Ground and Sea Vehicles. Funding decrease in FY 2017 results from decreased PE level funding availability resulting in lower investment levels in each major category of AIR, GROUND AND SEA VEHICLES. Accomplishments and plans described below are examples for each effort category. ***FY 2015 Accomplishments:*** Air Vehicles - Continued investigations into controlled initiation and recovery from aggressive, non-linear aero-maneuvers conducted by unmanned air vehicles. - Continued university research in rotorcraft technology areas such as tilt rotor aeromechanics, rotor flow field/ ship air wake coupling during shipboard operations, flight simulation of advanced ducted fan air vehicles, active rotor control for enhanced shipboard operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications. - Continued research in computational simulation of rotorcraft operations in a shipboard environment. - Continued investigation of advanced structural concepts, providing a high degree of crew protection during crashes. - Continued research into new analytical methods for high-fidelity prediction of rotorcraft performance, loads, and vibration. - Continued university and Navy laboratory research in basic rotorcraft science with emphasis on enabling concepts for variable geometry/variable rotor-speed aircraft. - Continued Sea-Based Aviation NNR research in Virtual Dynamic Interface, Advanced Manned/Unmanned Handling Qualities and Control for Naval Operations, Improved Fixed Wing Launch and Recovery High Lift Aerodynamics and Performance, Enhanced Fixed Wing V/STOL Operations, and Autonomous Deck Operations. Science of Autonomy					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued multi-disciplinary research into the science of autonomy, including multi-vehicle collaboration, intelligence, and human interaction. - Continued research in scalable and robust distributed collaboration among autonomous systems. - Continued research in human/unmanned system collaboration. - Continued research in autonomous perception and intelligent decision-making. - Continued research in intelligent architectures for autonomous systems. - Continued research in integrated design analysis/prognosis to optimize airframe structural properties and match material selection to operational requirements. - Continued modeling of complex behaviors/interactions to predict risk, probability and mechanism of failure and forecast lifetime performance. Ship Concepts and Hydrodynamics - Continued modeling and optimization techniques for naval design of multi-hulls, optimal functional arrangements for both ship and submarine design, and optimization for semi-displacement craft. - Continued implementation of nationwide program to increase interest in naval engineering education. - Continued further examination of computational mechanics to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control. - Continued research in propeller tip vortex cavitation and sheet-to-cloud cavitation. - Continued computational and experimental investigation into complex, three-dimensional flow separation problems. - Continued modeling and understanding of full-scale circulation control bow planes design. - Continued validation of Unsteady Reynolds Averaged Navier Strokes (URANS) prediction on maneuvering effects on ship motion in waves. - Continued modeling of hydro-acoustics of advanced materials propulsor. - Continued program to investigate renewable energy technologies for Navy applications. - Continued computational and experimental investigations of wakes in stratified fluids. - Continued Large Eddy Simulation (LES) modeling of crashback of underwater vehicle with propulsor. - Continued measurement and modeling of unsteady high-speed craft hydrodynamics. - Continued high-fidelity fluid-structure interaction program. - Continued computational prediction and validation of damaged ship maneuvering. - Continued research efforts on multi objective optimization of hull shapes using hybrid hull concepts to achieve high efficiency, reduced slamming loads and hydrodynamic/structural performance. - Continued development of the understanding of shockwave propagation and failure mechanisms of high strain rate, sensitive polymers and their interaction in composites with structural and armor materials.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research into the extension of bubble-wake modeling to physical far-field regime. Ship Signatures, Structures, and Materials - Continued the structural performance of hybrid ship hulls and hybrid joints subject to sea loads and weapons effects for application to high speed, low signature vessels. - Continued modeling of alternating current sources and propagation. - Continued Particle Image Velocimetry (PIV)/Laser Doppler Velocimetry (LDV) studies of multiphase bubble flows and interaction with elastic plates in a small, quiet water tunnel. - Continued LDV of scaling effects studies of unsteady elastic duct and propulsor interaction in a wind tunnel. - Continued pressure-shear experiments at ultra-high loading rates of Explosion Resistant Coating (ERC) in combination with light weight composites, including glass, acrylics, Poly(methyl methacrylate) (PMMA) and development of computational simulation capability for understanding the behavior and failure effect of ERC on the materials. - Continued computational methods for simulation of fragmentation, including tracking interactions of fragments and their interactions with composites of various materials (and fluid fragment interaction). - Continued effort on much higher strain rate loading and constitutive behavior of ERC for strain rates appropriate to ballistic events. - Continued work on cohesive elements for dynamic fracture under combined mode for application to failure in joints in ship structures under blast loading. - Continued work on hybrid ship (non-magnetic stainless steel/composite) hull concepts. - Continued further examination of computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis, and error control. - Continued concept for development of photonic band gap waveguide. - Continued developing methods to model the mechanisms of interaction between an elastic duct wall and fluid-flow in a duct with a propeller. - Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures. - Continued efforts developing alternative hull approaches for fast ships and hybrid ship hull structures. - Continued efforts to develop a better understanding of explosion resistant coating under extreme loads and its interaction with other armor and structural materials. - Continued investigation into methods to control airborne noise transmission using active control methods. - Continued development of metamaterial concepts for radio frequency (RF) signature control and photonic and acoustic applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued experimental facility development for sea-slamming loads in fast ships, and consideration for hydro-elasticity and structural details in composites panels and scale effects to support measurements used to develop new theoretical models. - Continued performing measurements of sea-slamming loads in fast ships at various sea states and speeds for composite panels on the experimental facility and developed/verified theoretical/computational models considering hydro elasticity and structural details and scale effects. - Continued study of droplet & volume scattering phenomena. - Continued the development of predictive models for infrared emission and reflection from breaking waves. - Continued development of computational electromagnetic tools for electromagnetic materials design & optimization. - Continued development of a methodology for highly reliable composite to metallic joints. - Continued fundamental efforts in multi-scale, time-varying, hull structural reliability models and processes for structural performance analysis. - Continued the development and understanding of elastomeric polymers for multi-functionality in protection systems/armor and structural acoustics, with superior properties against environmental effects and extreme temperature. - Continued development of advanced electromagnetic energy absorbing composite materials. - Continued efforts to further the physics based understanding of structural acoustics for the next generation submarine. - Continued improvements for predictive capabilities of surface ship propulsion systems and underwater acoustic signatures. - Continued Sea-Based Aviation NNR structures and materials research in Structural Mode Characterization, High-Loading/Lightweight Materials, Advanced Structural Concepts, Material Degradation/Corrosion, and Structural Protection and Maintenance. Ship and Air Platform Machinery and Systems - Continued efforts to understand and control the generation and propagation of far-field jet noise. - Continued development of Pulsed Detonation Engine (PDE) Technology. - Continued development and understanding of control capabilities and distributed intelligence strategies for shipboard systems. - Continued propulsion system cost-reduction efforts through vibration reduction, noise and thermal fluctuation at the source by controlling combustion. - Continued passive and active high speed noise control. - Continued studies of alternate propulsion systems for PDE and generated prediction models.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued investigation of thermal management approaches for cooling high power electronic devices. - Continued research on non-vapor, compression based refrigeration cycles. - Continued studies of advanced air-breathing propulsion concepts. - Continued study of advanced materials for PDE applications. - Continued efforts to expand the model based reasoning control algorithm approach to multiple heterogeneous systems. - Continued studies of complexity in heterogeneous distributed control systems. - Continued efforts to investigate a market based control approach to distributed control. - Continued efforts to perform physics based modeling of fluid actuation systems. - Continue Sea-Based Aviation NNR propulsion research in Propulsion Cycles, Subsystems, and Integration, Turbomachinery and Drive Systems with Enhanced Maintainability, Jet Noise Reduction, Hot Section Materials and Coatings, and Small UAV Propulsion. Power Generation, Energy Conversion and Storage - Continued evaluation of stability and control of electrical power systems. - Continued analyzing synchronization of 19 diode lasers to produce intense beams. - Continued efforts in nanostructures, novel electrolytes, and electrode materials to enable new, 3D, power source architectures and to improve the safety and capacity of rechargeable lithium and lithium-ion batteries. - Continued exploration and development of materials for high energy density, passive power electronics (Capacitors). - Continued expanding the fundamental understanding of direct electrochemical oxidation and the use of logistic fuels in solid oxide fuel cells. - Continued development of phase change cooling approaches for high power electronic devices. - Continued efforts developing a science base for optimized combustion of alternative fuels. - Continued the investigation of the long-term durability effects of coating/substrate systems from combustion chemistries and products derived from current petroleum-based fuel and from petroleum-based/synthetic fuel blends that lead to predictive models. - Continued effort in energy and power management to include understanding and reliability of high power electronics. - Continued investigation into rare earth-free permanent magnet materials. - Continued investigating thermodynamic cycle analogy for harvesting waste heat using multiferroic (pyromagnetic & pyroelectric) materials. - Continued research into thermionic energy conversion using inter-gap molecular species in a heat cell with low work function materials.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research into cyber-physical, real-time distribution and control of power & energy networks, physics-based models, hardware-in the-loop simulation. - Continued development of novel approaches to deposition of ultra-high quality SiC epilayers needed to enable highvoltage, high frequency, high-power wide bandgap semiconductor devices. - Continued study of fault tolerant electromechanical energy converter concepts for naval applications. - Continued research to understand new energy conversion methods (pyroelectrics, thermionics, and combustion). - Continued basic research in next generation wide bandgap semiconductors. - Continued experimental and computational investigation of dynamic response of marine gas turbines for on-demand and flexible power supply. - Continued power and energy management science, particularly understanding new magnetic materials and sliding electrical contacts. - Continued fundamental research in novel, high temperature superconducting (HTS) material synthesis. - Completed investigation into rare earth-free permanent magnet materials. - Completed development of novel approaches to deposition of ultra-high quality SiC epilayers needed to enable highvoltage, high-frequency, high-power wide bandgap semiconductor devices. - Completed power and energy management science, particularly understanding new magnetic materials and sliding electrical contacts. - Completed basic research in next generation wide bandgap semiconductors. Advancements in Naval Technology Innovations - Continued development of the Centers for Innovative Naval Technology (CINT), which will expand and apply the Center for Innovative Ship Design (CISD) approach to other Navy facilities to dramatically expand participation and the breadth of naval technologies covered.					
FY 2016 Plans: Air Vehicles - Continue all efforts of FY 2015, less those noted as completed above. Science of Autonomy - Continue all efforts of FY 2015, less those noted as completed above. Ship Concepts and Hydrodynamics - Continue all efforts of FY 2015, less those noted as completed above.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Ship Signatures, Structures, and Materials - Continue all efforts of FY 2015, less those noted as completed above. Ship and Air Platform Machinery and Systems - Continue all efforts of FY 2015, less those noted as completed above. Power Generation, Energy Conversion and Storage - Continue all efforts of FY 2015, less those noted as completed above. Advancements in Naval Technology Innovations - Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** Air Vehicles - Continue all efforts of FY 2016, less those noted as completed above. Science of Autonomy - Continue all efforts of FY 2016, less those noted as completed above. Ship Concepts and Hydrodynamics - Continue all efforts of FY 2016, less those noted as completed above. - Complete modeling and optimization techniques for naval design of multi-hulls, optimal functional arrangements for both ship and submarine design, and optimization for semi-displacement craft. Ship Signatures, Structures, and Materials - Continue all efforts of FY 2016, less those noted as completed above. - Complete work on hybrid ship (non-magnetic stainless steel/composite) hull concepts. - Complete efforts developing alternative hull approaches for fast ships and hybrid ship hull structures. Ship and Air Platform Machinery and Systems - Continue all efforts of FY 2016, less those noted as completed above. Power Generation, Energy Conversion and Storage					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2016, less those noted as completed above. Advancements in Naval Technology Innovations - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: ATMOSPHERE AND SPACE SCIENCES ***Description:*** Efforts include: Marine Meteorology and Prediction, and Space Sciences. Accomplishments and plans described below are examples for each effort category. ***FY 2015 Accomplishments:*** Marine Meteorology and Prediction - Continued the development of next-generation ocean-atmosphere coupled models. - Continued effort to investigate and better understand the bulk exchanges, aerosol-cloud interaction, and physical processes that take place at the atmospheric boundary layer interface. - Continued theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking. - Continued effort to gain a fundamental understanding of the flow-dependent limits of predictability by combining research in data assimilation and atmospheric instability. - Continued investigation into the near-earth environmental effects on electromagnetic propagation. - Continued investigation of sub-grid-scale processes that influence marine boundary layer turbulence, aerosol production and removal, and marine stratocumulus cloud and drizzle formation and dissipation with the goal of improving the predictability of these phenomena in high-resolution mesoscale prediction systems. - Continued investigation of Western Pacific tropical cyclone dynamics in order to improve the predictability of storm genesis, structure and intensity changes, radii of maximum winds and effects on sea surface waves. - Continued effort to assimilate WindSat wind vector, Ozone Mapping and Profiler Suite (OMPS) ozone profiles, and Global Positioning System (GPS) temperature and water vapor profile retrievals into NOGAPS (Navy Operational Prediction System). - Continued assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models. - Continued development of new soil moisture retrieval algorithm that addresses the basic modeling issues pertinent to soil moisture retrieval using passive microwave data from the WindSat instrument.	24.530	24.867	24.352	0.000	24.352

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued demonstration and validated a new data assimilation capability in NOGAPS ALPHA to generate the first global atmospheric analysis fields that extend from the ground to the edge of space. - Continued effort to derive and test advanced nonlinear atmospheric data assimilation algorithms using variational and ensemble techniques that are firmly based on modern inverse problem theory. - Continued effort to understand the fundamental physics and dynamics that control cloud and aerosol variability in the marine boundary layer. - Continued effort to improve understanding of sub-seasonal, seasonal and intra-seasonal oscillation in a fully coupled (air, sea, land, ice) Model with the goal of developing a seamless, high-resolution earth system prediction capability for extended range forecasts. - Continued the effort to understand the impact of skewness on our ability to estimate meteorological variables and their uncertainty. - Continued the effort to understand the predictability of weather in future extreme environments by quantifying how these changes impact forecast error growth and energy, non-local errors and tropical cyclone prediction. - Continued the study to understand the interplay of deep convective and boundary layer processes in tropical cyclone eye/eyewall dynamics and symmetric/asymmetric inner-core variability through a combination of numerical models, observation and improving upon existing theory. - Continued investigation of tropical cyclone intensification and structure changes that occur in response to changes in upper level outflow, large scale environmental interactions and/or internal changes in convection using innovative new observing systems and satellite observations. - Continued the effort to understand and diagnose the aspects of a multi-model ensemble prediction system that make it ostensibly superior to a single model ensemble prediction system, with the aim of extending the Navy's ensemble predictive capabilities and providing the Navy with an ensemble prediction system that performs competitively with multi-model ensembles. Space Sciences - Continued program to advance state-of-the-art specification and prediction of the space environment to improve space system performance and their on-call availability. - Continued monitoring of other-agency efforts for 'Naval Harvest' of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography. - Continued a focused program to develop a predictive, operational capability for the onset and evolution of equatorial spread-F that limits space-based communications and navigation capabilities. - Continued program to extend magneto-hydrodynamic models of solar activity, and related effects on the near-Earth space environment, toward an improved predictive capability on communication and navigation systems, and other related effects on DoD operations.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued effort to develop a better physical understanding of small-scale atmospheric wave dynamics in the middle and upper atmosphere. - Continued effort to develop understanding to forecast the sun's changing extreme ultraviolet (EUV) radiation and the responses of the upper atmosphere and ionosphere one-to-ten days in advance. - Continued investigation of the driving mechanisms, mode characteristics, and impact on space plasmas of electromagnetic waves relevant to radiation belt remediation and auroral ionospheric space weather. - Continued effort to assemble individual databases and model components of the Sun-Earth System. - Continued effort to quantify the evolution of probability density functions for orbiting objects in a crowded space environment, which will help inform orbital debris mitigation and avoidance strategies. - Continued investigation into the coupling physics, dynamics, and chemistry from the lower atmosphere, earth surface, and ocean into the upper atmosphere and ionosphere, focusing on processes relevant to ionospheric specification and forecasting. - Continued efforts to estimate the probable state of the extended operational environment, from surface to space, in future years-to-decades as a result of natural and anthropogenic influences. - Continued efforts to use acoustic wave analysis techniques to produce three-dimensional maps of emerging solar flux below the sun's surface, towards giving longer warning times for geoeffective space weather that is driven by solar disturbances.					
FY 2016 Plans: Marine Meteorology and Prediction - Continue all efforts of FY 2015, less those noted as completed above. Space Sciences - Continue all efforts of FY 2015, less those noted as completed above.					
FY 2017 Base Plans: Marine Meteorology and Prediction - Continue all efforts of FY 2016, less those noted as completed above. - Complete investigation of Western Pacific tropical cyclone dynamics in order to improve the predictability of storm genesis, structure and intensity changes, radii of maximum winds and effects on sea surface waves. - Complete assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models. Space Sciences					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: COUNTER IMPROVISED EXPLOSIVE DEVICE (IED) SCIENCES	14.254	16.533	17.032	0.000	17.032
Description: The Basic Research Counter IED program seeks to develop innovative scientific concepts that will form the foundation for future technologies that may be developed and implemented to efficiently and effectively address the IED threat. The effort will emphasize fundamental scientific concepts that can be applied to the detection, neutralization, destruction and mitigation of the effects of these devices, to advance anticipation, and affect the occurrence or potential occurrence of IED events. The program also seeks to establish and nurture a multidisciplinary counter-IED Science and Technology community of Government, academic and industry researchers to accelerate the transition of new science and technology into fielded systems. Funding increase in Counter IED in FY16 is the result of increased investment in Basic Research within the Department of Defense, resulting from increased funding across the PE resulting in higher investment levels in each major category of Counter IED. Accomplishments and plans described below are examples for each effort category. ***FY 2015 Accomplishments:*** - Continued effort in the area of Prediction to develop theoretical and technical approaches that permit prediction and analysis of IED emplacement as well as the assembly of IEDs. This included recognition of emplacement patterns, human activity recognition from video and other sensing systems, human intelligence and social network analysis of terrorist networks, modeling and simulation of the full spectrum of IED activities, analysis of communications, and knowledge management systems to combine diverse data sources. - Continued effort in the area of Detection to develop concepts that would permit stand-off detection and localization of the explosive, the case materials, the environment in which the device is located, and other components of the IED. - Continued effort in the area of Neutralization to develop scientific concepts that may be applied to remotely render an IED ineffective without necessarily having to detect or destroy it. - Continued effort in the area of Destruction to develop scientific concepts that may be applied to quickly and remotely destroy IEDs without necessarily having to detect them. - Continued creation of new spectroscopy for sensitive characterization of semiconductor nanostructures, ultrathin molecular films and chemical/biological threat materials and explosives.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of a new chemical explosive detection concept based on pump/probe ultra-short pulse lasers. - Continued research on characterizing background noise in urban and riverine environments in support of IED signature detection. - Continued effort to directly observe lattice deformations in explosives under shock impact. - Continued investigations into sociological and cultural aspects of defeating insurgent networks. - Continued investigations into standoff wide area neutralization and pre-detonation of IEDs. - Continued investigations into stronger lightweight armor including nanoparticle designs. - Continued investigations into detection of physical and temporal device characteristics. - Continued investigations into challenges within the Riverine environment. - Continued investigations into challenges in the temporal domain in various land environments. - Continued an effort to integrate observable behaviors with social behavior models to provide inputs for predictions and validation. - Continued a program to investigate nano-technologies applied to miniaturized remote molecular sensors, with an additional emphasis on low fidelity detection of trace explosive vapor partial-pressures. - Continued research into emerging very-broad-band spectroscopic capabilities to achieve a low-fidelity mosaic of partial pressure detections of explosives. - Continued study of energy transduction through soft armor. - Continued a Neutralize effort to investigate the identification of techniques to deflagrate or detonate explosives by creating hot spots or other localized effects that do not quench. - Continued a Neutralize effort to investigate new energy conversion schemes and extraction mechanisms for high-powered microwave sources that have potential to dramatically reduce the size, weight, and power required. - Continued a Neutralize effort to research compact wideband metamaterial multifunctional antennas. - Continued a Mitigate effort to explore new chemistry techniques to optimize polymer fiber growth and hardening. - Continued a Mitigate effort to develop in-situ analytical tools to observe nano to micro structure of materials during fabrication and treatment processes. - Continued study of Evaluation of the Dynamic Behavior and Material Parameters of the Human Brain. - Continued study of Real-Time Control of NMR Relaxation for Improved Sensitivity and Resolution. - Completed a Neutralize effort to investigate emitter recognition and related network behavioral analysis. - Completed a Mitigate effort to research multifunctional ballistic fibers with Custom Designed and Engineered Nanostructure. - Completed work on neural correlates of cross-culture adaptation.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed work on distinguishing the optical signature of explosive molecules from background molecules. - Initiated research on lightweight flexible materials that can selectively absorb, dissipate, and convert high energy electromagnetic waves or blast waves. - Initiated research on compact and efficient high voltage pulsed switches that can rapidly charge and discharge at a high repetition rate. - Initiated an effort to detect a wider variety of homemade explosives.					
FY 2016 Plans: - Continue all effort of FY 2015, less those noted as completed above. - Complete Neutralize effort to investigate new energy conversion schemes and extraction mechanisms for high-powered microwave sources that have potential to dramatically reduce the size, weight, and power required. - Complete a Neutralize effort to research compact wideband metamaterial multifunctional antennas - Initiate research into the improved biomechanics and physiology of detection dogs for use in the detection of explosive hazards. - Initiate research efforts to produce the knowledge and understanding necessary to detect and locate asymmetric explosive threats and their components by exploring combination of their unique passive and active characteristic responses at safe stand-off distances from various expeditionary platforms. - Initiate research efforts to explore new lightweight multifunctional material design and techniques to optimize existing materials to improve protection from detonation effects. - Initiate research efforts to neutralize or prevent explosive threats with or without direct knowledge of their locations. - Initiate research efforts to provide understanding of the human and social elements and their relationships with asymmetric explosive threats to predict and prevent explosive events.					
FY 2017 Base Plans: - Continue all effort of FY 2016, less those noted as completed above. - Complete efforts in the area of Destruction to develop scientific concepts that may be applied to quickly and remotely destroy IEDs without necessarily having to detect them. - Complete creation of new spectroscopy for sensitive characterization of semiconductor nanostructures, ultrathin molecular films and chemical/biological threat materials and explosives - Complete effort to directly observe lattice deformations in explosives under shock impact - Complete investigations into challenges within Riverine Environment. - Initiate research efforts to improve stimulated electromagnetic explosive signature collection efficiencies.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate research efforts to explore compact rapid high selectivity spectroscopic detection in distributed unmanned platforms. ***FY 2017 OCO Plans:*** N/A					
Title: HUMAN SYSTEMS ***Description:*** Efforts include: Human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition. Accomplishments and plans described below are examples for each effort category. Funding decrease in FY17 is the result of changing S&T investment priorities within the Department of the Navy, resulting from decreased PE level funding availability resulting in lower investment levels in each major category of Human Systems ***FY 2015 Accomplishments:*** - Continued research of social networks for counterterrorism. - Continued expansion of the cognitive architectural modeling capability to increase coverage, including spatial reasoning, multitasking, and impact of physiological and stress variables. - Continued research of human cognition and performance to create more realistic simulations for training. - Continued program to combine cognitive architectures with computational neuroscience to better predict human performance. - Continued program on implantable electronics for performance enhancement. - Continued investment in natural language interaction capability for artificially intelligent training systems. - Continued research of neuro-control of high-lift bio-inspired Unmanned Underwater Vehicles and active vision and cognitive navigation skills in mobile robots. - Continued computational neuroscience for novel pattern recognition and sensory augmentation. - Continued research of human-robot interaction to support team collaboration. - Continued the output human performance usability models with actual human performance results obtained in usability testing on systems under development. These systems include future Naval Combat Systems and Homeland Security Operation Centers. - Continued investigation of human sensory performance for optimizing video and audio human-electronic device interfaces.	16.822	17.117	16.078	0.000	16.078

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research to create new social modeling tools for understanding the responses of adversaries, determining the best practices for containing and deterring the adversary, and developing effective course of action in non-Western environments for humanitarian and civilian-military operations. - Continued research of advanced biometrics such as biodynamic signatures to support spirals 2 and 3 of the Navy Identity Dominance System - Maritime Domain. - Continued efforts to extend the representational capabilities of cognitive architectures to accommodate aspects of social cognition and teamwork. - Continued efforts to develop an empirical understanding and prediction of the behaviors of individuals and social groups and networks, computational approaches to social network theory and the co-evolution of adversarial tactics and strategies, algorithms for exploring scenarios that take into account socio-cultural factors; political and economic factors; local attitudes, values, and social structure. - Continued research of human activity and intend recognition and dynamic biometrics for improved human system interfaces and force protection. - Continued research into probabilistic reasoning in computation cognitive architectures. - Continued research into computational social neuroscience to provide new models for manpower assignment and incentivization and new social models of cross-cultural interactions. - Continued research on models of social dynamics and culture in small scale societies. - Continued research to explore the development of algorithms to automate assessment of the information value of Command and Control (C2) related data for next generation C2 systems. - Continued research to explore to dynamically provide decision support in support of rapid mission planning, re-planning and execution at command and combatant echelons. Research thrust to include dynamic mapping of decision space and decision-based, dynamic task allocation algorithms. - Continued research to explore concepts of operations for the management of information in hybrid autonomous systems. - Continued research on social neuroscience of Trust. - Continued research on data collection and processing for health surveillance and medical assistance. - Continued research on brain-inspired intelligent systems to enable high-level interaction between warfighters and autonomous systems. - Continued research on geography, health and disaster for next generation information systems for collaborative humanitarian assistance. - Continued socio-culture research of complex humanitarian operations. - Continued development of intelligent, embedded assessment for Intelligent Tutoring System (ITS). - Continued research on socially guided machine learning. This includes robotic teammates learning from human teachers both by demonstration and verbal instruction.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued the early exploration of modeling the cognitive basis for human moral judgments. - Continued research to explore concepts of operations for the management of information in hybrid autonomous systems. - Continued research to improve collaborative systems and trust in computer mediated environments. - Continued research into cost effectively adapting current intelligent tutoring technologies to wider dissemination across Navy schoolhouses. - Completed research of advanced biometrics such as biodynamic signatures to support spirals 2 and 3 of the Navy Identity Dominance System - Maritime Domain. - Initiated research to address visualization and synthesis from multiple data sources to support autonomous systems and small hybrid teams. - Initiated research on portable, intelligent, computer based expert decision aids for maintenance applications. - Initiated research on computational models for predicting human error on procedural tasks. - Initiated research on cognitive modeling for cyber security. - Initiated research seeking a unified theory of the overall decision process, including the role of judgment with the goal that the unified theory will link currently existing, but isolated, conceptual theories of decision making, judgment, sensing, and detection. - Initiated research into strategies for and utility of incorporating uncertainty into planning and asset allocation in Naval missions. - Initiated research on human performance sources of cyber vulnerabilities of unmanned vehicle (UxV) systems. - Initiated human systems integration research to reduce workload and increase operator situational awareness in command information center. - Initiated research to understand and dynamically model context in operational decision making. - Initiated research on statistical language translation for content analysis of threat behaviors and human security issues.					
FY 2016 Plans: FY 2016 Plans: Human Computer Interaction/Visualization - Continue all efforts of FY 2015, less those noted as completed above. Command Decision Making (CDM) - Continue all efforts of FY 2015, less those noted as completed above. Social Network Analysis					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015, less those noted as completed above. Hybrid Human Computer Systems - Continue all efforts of FY 2015, less those noted as completed above. Enhancing Warfighter Cognitive Capability - Continue all efforts of FY 2015, less those noted as completed above. - Initiate research on training and neuro-cognitive plasticity. ***FY 2017 Base Plans:*** Human Computer Interaction/Visualization - Continue all efforts of FY 2016, less those noted as completed above. Command Decision Making (CDM) - Continue all efforts of FY 2016, less those noted as completed above. Social Network Analysis - Continue all efforts of FY 2016, less those noted as completed above. - Initiate research on social cyber-behavior, information operations and hybrid warfare. - Initiate research on data visualization, data fusion and novel information streams for understanding novel warfighting problems. Hybrid Human Computer Systems - Continue all efforts of FY 2016, less those noted as completed above. Enhancing Warfighter Cognitive Capability - Continue all efforts of FY 2016, less those noted as completed above. Cognitive Science of Learning - Initiate research on maintenance skill acquisition and retention. ***FY 2017 OCO Plans:*** N/A					
Title: MATHEMATICS, COMPUTER, & INFORMATION SCIENCES	35.960	45.593	42.190	0.000	42.190

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: Efforts include: Mathematical foundation and computational theory and tools for design, communication, and control of intelligent autonomous systems; theory, algorithms and tools for decision support; decision theory, algorithms, and tools; heterogeneous information integration, management, and presentation; information assurance, computation and information foundation for cyber defense, secure and reliable information infrastructure for command and control; mathematical optimization for optimal resource allocation and usage; modeling and computation of complex physical phenomena; modeling and computation for electromagnetic and acoustic wave propagation and scattering; seamless, robust connectivity and networking; foundations for novel computing hardware, including nanoscale materials, emerging devices and circuits, emerging computational architecture and nanofabrication. Accomplishments and plans described below are examples for each effort category. Funding increase in FY16 is the result of Nanoelectronics effort moving to this R-2 activity from 0601153N R-2 activity Sensors, Electronics and Electronic Warfare (SEEW). Decrease in 2017 is the result of less investment in the areas of Quantum Information and Magnetic Imaging Sciences due to the overall decrease in PE funding. ***FY 2015 Accomplishments:*** - Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, resource allocation, and logistics. - Continued development of improved tactical and battlespace decision aids. - Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and multisource signal data. - Continued to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles. - Continued efforts for enabling teams of autonomous systems to work together and work on representations for evolution of cooperative behaviors, including efforts in multi-modal interactions with autonomous systems. - Continued developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems. - Continued efforts on quantum computing and cryptography. - Continued efforts on model checking and automated theorem prover technologies. - Continued efforts in mathematical modeling of complex physical phenomena.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3 dimensions (3D); adequate representation of the physics of the media and the scatterer; and improved resolution of structural and material properties. - Continued focused efforts in development of mathematical foundations for image understanding on a number of key challenges, such as multimodal imagery representation and metrics, object recognition, scene analysis and understanding. - Continued development of mathematical, statistical, and computational framework leading to robust underlying approaches for automated information integration of disparate sources of data. - Continued research in cognitive radio and networking protocols. - Continued research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. - Continued research in cross-layer wireless protocols for delay sensitive network traffic. - Continued multidisciplinary research efforts to focus on intelligent control systems, cooperative behavior modeling and response, UxV-human interactions and adaptive mission methodologies. - Continued development of an interaction model of how users characterize visual content and context to improve video surveillance. - Continued development of improved formal foundations, methods, and tools for compositional verification and construction of high assurance software systems. - Continued investigation of relational constructive induction, semi-supervised learning, and classifier ensembles to improve collective classification technology and operations based automated decision aids. - Continued research aiming to develop principled, trustworthy, yet practical and usable approaches to address the issue of software producibility and the development of complex software systems with ensured interoperability. - Continued research into anti-tamper and information assurance: research focused on protection techniques, architectures, algorithms, protocols that allow for security and cyber situational awareness. - Continued research to develop mathematical and computational tools for compressive sensing. - Continued the development of theory and algorithms for quantum communications. - Continued efforts addressing the representation, computation, and analysis of information from large diverse data sets. - Continued research efforts to develop tools for proactive information assurance and cyber space security. - Continued multidisciplinary research efforts on reasoning for image understanding in uncertain environments. - Continued multidisciplinary research efforts to provide information assurance foundations for countering the Botnet threats.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research efforts addressing computational complexity arising from network-enabled computing, such as cyber security, information integration, and intelligent autonomy of networked, cooperative systems. - Continued mathematical studies to understand the micro-physics of a liquid-solid-gas interaction in turbulent flow conditions. - Continued research efforts for mathematical development of physics-based computational and signal processing techniques for understanding and characterizing biological-acoustical coupling in acoustic wave propagation and scattering. - Continued effort to optimize quantum communication bandwidth in noisy environments by developing a new mathematical representation of quantum information. - Continued research on mathematical and computational building blocks for machine reasoning and intelligence. - Continued multidisciplinary research efforts on knowledge representation and reasoning for decentralized autonomy. - Continued research efforts on algorithmic solutions and explicit measurement schemes for networks inference and monitoring. - Continued research on novel techniques for interference mitigation. - Continued efforts to develop computer sciences foundation for quantum information sciences leading to new ways of computing and communication. - Continued research to develop a theory of trust-based traffic security by creating models of trust, network structure and dynamics, and incentives and economics. - Continued research to develop the foundation for new techniques that enable the adaptive characterization of evolving computer network traffic patterns. - Continued research on distributed network synchronization. - Continued efforts to extend theory of quantum communication channels beyond completely positive channels. - Continued efforts to leverage node cooperation to counteract interference in tactical networks. - Completed research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. - Completed research to improve teleoperation of robotic manipulators by developing a system trained by a human operator to perform complex manipulation tasks. - Initiated research into improving the perceptual abilities of autonomous systems by developing a unified theory of perception and context that includes spatial and co-occurrence context to enable autonomous systems to effectively reason about context as part of the perceptual process.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed research efforts to develop methods and algorithms for computing with natural language.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Continue studies of analog intelligent nanoelectronics computational architecture (transfer from SEEW). - Continue research on optical and plasmonic properties of graphene in infrared (IR) and terahertz (THz) spectral regions (transfer from SEEW). - Continue research on 2D materials other than grapheme (transfer from SEEW). - Continue research on chemical synthesis of carbon nanostructures (transfer from SEEW). - Continue research towards detecting and manipulating Majorana fermions in condensed matter systems (transfer from SEEW). - Continue studies of topological insulator materials and novel device concepts exploiting properties of transport in their protected electronic state (transfer from SEEW). - Continued research on spin dynamics in Group IV semiconductors and related device concepts (transfer from SEEW). - Continued research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution (transfer from SEEW). - Continued research on defect engineering and characterization in grapheme (transfer from SEEW). - Complete research on duel-STM characterization of graphene film (transfer from SEEW). - Complete studies of chemical vapor deposition (CVD) of graphene on copper (transfer from SEEW). - Complete research on spin properties in topological insulators (transfer from SEEW). - Initiate tip-based atomic-scale nanofabrication program (transfer from SEEW).					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete research on novel techniques for interference mitigation. - Complete research in cross-layer wireless protocols for delay sensitive network traffic. - Complete research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. - Initiate research on dynamic military communications under spectral, spatial and temporal uncertainty. - Initiate research on broadband channel receiver architectures with interference suppression. - Initiate research on capacity limits and optimal transmission strategies for heterogeneous networks. - Initiate research on prioritization, latency, and end-to-end service level guarantees in heterogeneous networks.					
FY 2017 OCO Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: MATERIALS/PROCESSES	54.513	58.162	52.942	0.000	52.942

Description: Efforts include: structural materials; functional materials; maintenance reduction; environmental sciences; and manufacturing science. Accomplishments and plans described below are examples for each effort category. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.

Accomplishments and plans described below are examples for each effort category.

The increase in funding from FY15 to FY16 is the result of a single year increase in emphasis within the Department of Defense in the science of Materials & Processes.

The decrease in 2017 is the result of completion of investment in the Affordability (PR-09 PDM2) initiative and reduction of funding to the Naval Research Laboratory.

FY 2015 Accomplishments:
Structural Materials
- Continued development of first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels.
- Continued quantification of the corrosion effects on fatigue to be incorporated into the Unified Damage Model (UDM) and validated in a few environmental cases on P-3 aircraft real loads data.
- Continued investigating new carbon nanotubes growth methodologies for improved mechanical behavior of advanced composites in next generation ship and aircraft structures.
- Continued development of theoretical basis for composite materials behavior based on x-ray computed microtomography.
- Continued development of understanding and constitutive models of dynamic behavior of naval steels.
- Continued evaluating environmental effects on marine composites and sandwich structures.
- Continued exploration of composition, processing and microstructural evolution in titanium alloys for marine structures.
- Continued exploration of multienergy processes for zero maintenance coatings.
- Continued investigation of a rapid annealing of surface layers and their effects.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued the investigation of processing science (single crystals, coatings, thermal barrier coatings (TBC), heat treatment, etc.) to materials performance for turbine engine components to develop relevant process protocols to optimize and control quality. - Continued to advance the understanding of processing and deformation mechanisms in nanostructured ceramic composites and metal alloys to provide new high strength / high toughness materials for Naval platforms. - Continued to investigate the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg gratings structural health monitoring system. - Continued research on new hybrid composites that integrate polymers, structural fibers, carbon nanotubes, ceramics and metals, with improved blast, ballistic, fire resistance and mechanical characteristics with special emphasis at the interfacial aspects of the new materials. - Continued efforts to understand and predict salt chemistry effects on high temperature coatings and materials in naval gas turbine environments. - Continued establishing fundamental understanding of the dynamic response and failure of marine composites for development of modeling tools for enhancing dynamic response and projectile resistance for and sandwich structures, and develop modeling tools. - Continued development of new methods for room temperature curing and processing of polymer composites with high temperature thermoxidative stability and fire resistance. - Continued assessment of the blast resistance of cellular structures as functions of soil characteristics. - Continued materials and fabrication science for fugitive phase processes for engineered topological structures for vehicle blast and fragmentation protection. - Continued exploration of fundamental mechanisms and initiate development of physics-based models of electrophoretic deposition of ceramic nanoparticles and subsequent sintering. - Continued physics based models for coupled phenomena in marine composite structures (thermo-mechanical loads, environmental effects, and fluid-structure interactions.) - Continued Computer-Aided Materials Design (CAMD) for discovery, synthesis and testing of various materials. - Continued structure and properties of liquid and glassy metals. - Continued first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels. - Continued scientific basis for the rational engineering design of Al-alloys for Naval applications. - Continued development of refractory solid metal carbide composites from metal / polymer precursors. - Continued establishment of mechanics of crack propagation in aluminum structures, and explore concepts for enhancing fracture resistance.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels. - Completed scientific basis for the rational engineering design of Al-alloys for Naval applications. - Completed exploration of multienergy processes for zero maintenance coatings. - Completed development of materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection. Functional Materials - Continued research tools design efforts in electromagnetic and acoustic bandgap materials. - Continued study of new transduction mechanisms. - Continued development of the science and technology base for a highly efficient and stable flexible organic solar cell. - Continued investigation into the properties and fabrication of novel ceramics which have potential to combine hardness, strength, and high transmission in the long wave infrared (LWIR) spectral region. - Continued effort to synthesize beta-SiC power suitable for subsequent densification into transparent beta-SiC ceramic. - Continued meta-materials effort to develop negative index materials with dynamic frequency response. - Continued synthesis and property measurement of new sonar materials predicted by first principle methods. - Continued expansion of first-principles methods devised to calculate piezoelectric properties of materials for sonar transducers to calculate additional materials properties for other applications. - Continued design, processing, and measurements to fashion the new generation of high-strain, high coupling piezoelectric single crystals into high-performance acoustic transducers for naval sonar systems. - Continued basic research into material technology associated with the development of active and conventional armor. - Continued effort to characterize regenerative bacterial nanowires. - Continued effort to synthesize cyclic peptide ring modules and polymerize them into peptide nanotube polymers. - Continued efforts to utilize chemically modified virus proteins as a scaffold to assemble nanostructured metamaterials with unique optical properties including negative index of refraction. - Continued effort to develop surface electrons on diamond. - Continued efforts to develop oxide materials for power management, sensors, and information storage/ processing. - Continued effort to use elastic pentamode metafluid materials for acoustic cloaking.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued effort to develop conjugation strategies that can allow the efficient attachment of multiple biological moieties to nanoparticles (NPs) in a controlled manner. - Continued examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used. - Continued effort to characterize the properties of chemically reactive flows subject to non-Kolmogorov or non-equilibrium turbulence, or that creates these types of turbulence. - Continued exploratory synthesis, electromechanical property evaluation and atomic level analysis of new quaternary piezocrystals in order to optimize materials properties for specific Navy SONAR applications. - Continued development of advanced nanostructured magnetic materials for energy applications. - Continued study of Actuatable Peptidyl Motifs for the Nanoscale Control of Materials within Biological Systems. - Continued study of Nanoscale Measurements of Protein Modification in Live Cells. - Completed study of new transduction mechanisms. - Completed development of cladded single crystal fibers. Maintenance Reduction - Continued development of corrosion models. - Continued mechanistic studies of materials deterioration under chemical environment for ship materials and their interfaces. - Continued stainless steel carburization study to enhance corrosion performance. - Continued the concept study of multiscale corrosion modeling on naval ship materials. - Continued fundamental theoretical and experimental studies on nanoscale corrosion of metals and alloys. - Continued corrosion prediction using an integrated deterministic-based model. - Continued grain boundary engineering to improve corrosion resistance of marine grade aluminum alloys. - Continued modeling and simulation of corrosion phenomena. - Continued studies of surface microstructure optimization to enhance corrosion properties of navy marine alloys - Continued sensor development for monitoring microstructural changes on alloys under thermal and mechanical stresses. - Continued research focused on modeling and simulation for platform and system affordability, lifetime materials, shipboard wireless capability, automation to reduce manning. - Continued development of ab initio models of corrosion reactions. - Continued development of coatings capable of actively responding to environmental stresses. - Continued study of coating failure mechanism on coating-substrate interface. - Continued research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of environmental corrosivity modeling. - Continued development of nanoscale modeling of corrosion kinetics. - Continued development of surface tolerant coatings. Environmental Science - Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations. - Continued broad based program in anti-fouling and fouling release coatings including investigation of effect of new polymers, materials, processes, and novel testing methodologies for coating efficacy. - Continued effort to determine most promising foul-release approaches based on silicones to meet Navy durability requirements. - Continued effort to develop Reverse Osmosis (RO) pre-treatment strategies to allow water recycling on ships. - Continued efforts on treatment strategies of oily water containing synthetic lubricants. Manufacturing Science - Continued a multidisciplinary research task into furthering the sciences associated with advances in manufacturing processes.					
FY 2016 Plans: Structural Materials - Continue all efforts of FY 2015. - Complete fundamental theoretical and experimental studies on nanoscale corrosion of metals and alloys. Functional Materials - Continue all efforts of FY 2015. Maintenance Reduction - Completed grain boundary engineering to improve corrosion resistance of marine grade aluminum alloys. - Continue all efforts of FY 2015, less those noted as completed above. Environmental Science - Continue all efforts of FY 2015. - Complete efforts on treatment strategies of oily water containing synthetic lubricants.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Manufacturing Science - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** Structural Materials - Continue all efforts of FY 2016, less those noted as completed above. - Complete investigation of processing science (single crystals, coatings, thermal barrier coatings (TBC), heat treatment, etc.) to materials performance for turbine engine components to develop relevant process protocols to optimize and control quality. - Complete research on new hybrid composites that integrate polymers, structural fibers, carbon nanotubes, ceramics and metals, with improved blast, ballistic, fire resistance and mechanical characteristics with special emphasis at the interfacial aspects of the new materials. - Complete structure and properties of liquid and glassy metals. - Initiate assessment of materials that incorporate directed energy, ballistic, and blast resistance for structural protection. Functional Materials - Continue all efforts of FY 2016. Maintenance Reduction - Continue all efforts of FY 2016, less those noted as completed above. Environmental Science - Continue all efforts of FY 2016, less those noted as completed above. Manufacturing Science - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Title: MEDICAL/BIOLOGY	17.845	18.205	17.283	0.000	17.283
Description: Efforts include: Bioinspired autonomous and surveillance systems, and bio-inspired processes, materials and sensors; synthetic biology for Naval applications; casualty care and management; casualty prevention; undersea medicine/hyperbaric physiology; biorobotics; expeditionary operations training; stress					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
physiology and regenerative medicine. These efforts are coordinated with the Army and Air Force through joint program reviews and meetings and are complementary, not duplicative. Accomplishments and plans described below are examples for each effort category. Funding decrease in FY 2017 results from decreased PE level funding availability resulting in lower investment levels in each major category of Medical/Biology. ***FY 2015 Accomplishments:*** Medical Sciences: Undersea Medicine- - Continued work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures. - Continued work in understanding the mechanisms of decompression illness and hyperbaric oxygen toxicity. - Continued research to explore mechanisms of "ultrasonic" hearing in divers. - Continued interventions to mitigate underwater sound/blast effects. - Continued research on improved trauma management in submarine Special Forces operators. - Continued research on physiological and genetic effects of long-term diving. - Continued research on individual susceptibilities in extreme environments to include hypoxic and/or hypobaric conditions. - Continued research to assess the effects of hyperbaric oxygen therapy on blast-induced histopathological changes. - Initiated research into the effects of hyperbaric environments on cellular biology (metabolism and signaling). Biomedical Sciences and Environmental Physiology- - Continued research in casualty care and management and casualty prevention, including investigations of mechanisms of hemorrhagic shock, blast injury, tissue repair, and the biomedical effects of military operational exposures such as directed energy, hazardous chemicals, and sound. - Continued research to explore systematic relationships between cognitive and physiological responses to laboratory tasks under operational conditions. - Continued research to explore a novel opioid that will produce analgesia as effective as morphine, with minimal side effects. - Continued research in genetic basis of psychological stress.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research in mitigation of the effects of sleep deprivation. - Continued research in stress effects on the immune system. - Continued research with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)). - Continued research to discriminate fatigue and stress performance effects. - Continued research to evaluate the effects of chronic stress on performance. - Initiated research on individual susceptibilities on health and human performance in military environments to include heat, cold, enclosed spaces, pressure and acceleration. - Initiated research on the mechanisms of nitrogen narcosis/high pressure nervous syndrome. - Initiated investigations of mechanisms of blast-induced neurotrauma at the cellular level. Biological Sciences: Naval Biosciences- - Continued efforts focused on microbe-materials interfacial interactions for detection of materials defects/ failures, including corrosion, and for improved energy harvesting. - Continued efforts in "smart cell engineering" to design microbes that can sense and destroy other microbes through antibiotic production, or can "sense" and qualify their surrounding environment and provide information back to the user. - Continued research on biofouling with emphasis on barnacle adhesion studies using molecular biology tools. - Continued research on invertebrate larval settlement and metamorphosis in response to biofilms and various inhibitors of adhesion. - Continued efforts to identify molecular biomarkers for battlefield injuries, and high-fidelity biosensors for detection in vivo. - Continued research into biomolecular 'logic controllers' for in vivo biosensor and in vivo drug delivery systems. - Continued synthetic biology efforts for designing organisms with non-natural functions (e.g., light detection, electrical 'switch' capability, magnetic field production). - Continued research to identify natural product inhibitors of bacterial folate biosynthesis for development as antibiotics. - Continued studies to control the synthesis of patterned materials from the nano-scale to the micro-scale using bionanotechnology. - Initiated research on characterizing/manipulating human gut microbiome to understand its role in response to behavioral and physical stressors. - Initiated research to integrate programmable, externally-controlled "sensor" cells into micro-robotic devices.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated research to characterize gut microbiota in real-time, in vivo. Life Sciences and Bioengineering- - Continued combinatorial chemical screens for bacterial communication pathway inhibitors as potential antibiotics or fouling control agents. - Continued work to identify plasma biomarkers of domoic acid toxicosis and leptospirosis in California sea lions, and develop a multiplexed assay to measure those plasma biomarkers. - Continued research on stem cells in marine mammals and their potential clinical role. - Continued development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals. - Continued efforts to investigate DNA-scaffold-directed assembly of protein nanoarrays for control over orientation and position of proteins, and investigate triggered isothermal assembly of DNA nanostructures. - Continued efforts in comparing commensal/pathogenic microbiomes in to Atlantic bottlenose dolphin and California sea lion, and for the dolphin diagnosed with chronic/active gastritis. - Completed development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals. - Initiated development of new tools and techniques for the engineering and characterization of DNA nanostructures and the control of DNA based nanodevices. - Initiated the investigation of the material properties of silk proteins in order to facilitate development of applications. - Initiated development of field portable sensing platforms for explosives detection. - Initiated studies on environmental effects on marine invertebrate biofouling. Neural, Sensory and Biomechanical Systems- - Continued research efforts focused on developing bio-inspired sensors, vehicles and systems for local Intelligence, Surveillance and Reconnaissance (ISR), Weapons of Mass Destruction (WMD) detection, personnel protection and affordability. Research elements include advances in microfabrication, biological materials, processing techniques, robustness and efficiency of systems. - Continued research in elucidation of mechanisms of fish electric sense and near field low frequency acoustic perception. - Continued research on bacterial/cellular controllers for nano/micro-systems.					
FY 2016 Plans: Medical Sciences:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Undersea Medicine- - Continue all efforts of FY 2015, less those noted as completed above. Biomedical Sciences and Environmental Physiology- - Continue all efforts of FY 2015, less those noted as completed above. - Initiate research in partnership with the Army to study regenerative medicine (Armed Forces Institute for Regenerative Medicine II (AFIRM II)). - Initiate research to investigate novel mechanisms to manage the mammalian circadian system for optimized health and performance. - Initiate research to develop strategies for nerve cell regeneration. Biological Sciences Naval Biosciences- - Continue all efforts of FY 2015, less those noted as completed above. - Initiate research on tubeworm adhesion science using molecular biology tools. Life Sciences and Bioengineering- - Continue all efforts of FY 2015, less those noted as completed above. Neural, Sensory and Biomechanical Systems- - Continue all efforts of FY 2015, less those noted as completed above.					
FY 2017 Base Plans: Medical Sciences Undersea Medicine- - Continue all efforts of FY 2016, less those noted as completed above. Biomedical Sciences and Environmental Physiology - Continue all efforts of FY 2016, less those noted as completed above. - Initiate research to investigate novel mechanisms to manage the mammalian circadian system for optimized health and performance. Combat and Operational BioMedicine					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2016, less those noted as completed above. - Initiate efforts to study injury mechanisms induced by underwater blast. - Initiate efforts to study bioderived systems to produce fieldable therapeutics. Biological Sciences Naval Biosciences - Continue all efforts of FY 2016, less those noted as completed above. - Initiate synthetic biology research in bioelectronics and information processing. Life Sciences and Bioengineering - Continue all efforts of FY 2016, less those noted as completed above. Neural, Sensory and Biomechanical Systems - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: OCEAN SCIENCES	77.654	80.618	70.450	0.000	70.450
Description: Efforts include: littoral geosciences and optics; marine mammals and biology; physical oceanography and prediction; and ocean acoustics. Accomplishments and plans described below are examples for each effort category. Accomplishments and plans described below are examples for each effort category. Increase in 2016 is the result of initiation of several Department Research Initiatives in several mission impacting oceanographic processes. Decrease in 2017 is reflected by the decrease in investment in core Physical Oceanography. Decrease in 2017 is reflected by the decrease in investment in core Physical Oceanography. ***FY 2015 Accomplishments:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Littoral Geosciences and Optics - Continued efforts to investigate the effects of oceanic biota on the propagation and inversion of multifrequency acoustical energy. - Continued investigations of sources and properties of light scatter within the coastal ocean. - Continued to investigate and characterize the impact of riverine sources of optically-important matter on underwater visibility, navigation, and surveillance. - Continued effort to understand the extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing. - Continued programs to estimate optical properties of coastal ocean water from above-surface sensing, using in situ data for validation. - Continued studies to predict tidal flat evolution in coastal/riverine/estuarine systems. - Continued incorporation of improved understanding of tropospheric and stratospheric bulk exchanges, air-sea interface, boundary layer interface, coastal ocean dynamics, gas hydrate accumulation, and biological responses into atmospheric and ocean prediction models and tactical aids. - Continued development of prediction models for distributaries deltaic coastal environments. - Continued field, modeling and remote sensing studies of currents, waves, sediment transport and bathymetric evolution of river mouth and inlet environments. - Continued investigations of radar, hyperspectral and electro-optical remote sensing signatures in littoral environments. - Continued development of a new method of data assimilation, adjointless 4D-Var through a combination of theoretical analysis and numerical simulations to develop the method and estimate its efficiency with respect to the traditional 4D-Var scheme as well as to use it to generate a sensitivity analysis for targeted observations. - Continued the effort to identify and isolate the dynamical processes that control the structure and variability of the Kuroshio and Ryukyu Current using a combination of numerical model simulations and observations and, explore their interactions between the Ryukyu Island passages. - Continued studies of Coupled Human-Landscape Interactions in Low-lying Coastal Environments. - Continued studies of data-assimilative modeling for coupled nearshore-riverine systems. - Continued the effort to understand and quantify the impact of land fluxes of freshwater and dissolved bio-optical constituents upon the diurnal and small-scale (days, meters to microstructure) coastal upper ocean response to atmospheric forcing. - Completed the development of a numerical model system (composite of new and existing process models and data bases) and compare with observations, as well as use it to simulate future scenarios to quantify importance of seafloor carbon to the global carbon cycle now, and in the future.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated research efforts to observe, understand, and predict the many intertwined geophysical processes which are present on the inner shelf. Marine Mammals and Biology - Continued field trials of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals. - Continued new efforts on tracking of marine mammals using data fusion based on tags and remote sensing. - Continued new efforts to examine physiology of marine mammals in situ and to predict consequences of physiological and auditory stress to populations. Physical Oceanography and Prediction - Continued field studies/modeling to predict propagation and effect on acoustics of non-linear internal waves in the western Pacific. - Continued development of a ship wave radar driven wave model to allow high resolution studies of near surface ocean processes and to support Sea Basing. - Continued design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies. - Continued field programs that demonstrate persistent monitoring and measurement of environmental structures using gliders. - Continued workshops to define science needs for Sea Basing. - Continued an integrated modeling and field experiment on determining custom self-learning wave databases and forecast systems/ship-movement and engineering systems for Sea Basing. - Continued an Estuarine-Littoral Processes Interaction field study in muddy and tidal flat dominated regimes including a data assimilative prediction capability. - Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. - Continued studies of internal waves and strait dynamics emphasizing field studies in the Celebes, Philippine, and Sulu Seas. - Continued studies to understand how to sample ocean processes with gliders and other autonomous and remote sensing systems to support tactical oceanography. - Continued to develop state of the art numerical model assimilation and initialization techniques, improved physical parameterizations, air-sea interactions, and fidelity for atmospheric and ocean prediction systems. - Continued development of expert system methods to characterize and predict Riverine/estuarine systems to support Naval Special Warfare, Marine Expeditionary Forces and new Riverine units.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. - Continued studies of ocean and wave response to typhoons and monsoons in the Western Pacific. - Continued studies of how to predict the 'full battle space environmental cube' using networked sensors and multiply coupled ocean/wave/atmosphere/acoustic prediction systems to provide Seabase and Fleet/Force protection. - Continued extensive 3-year field program on prediction of internal waves. - Continued extensive internal wave field program off the New Jersey Shelf; field work will coincide with and complement the Shallow Water Acoustics program. - Continued an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models. - Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. - Continued the field and modeling experiments to determine the lateral dispersion and maxing parameterization needed to understand model turbulence and to model ocean circulation. - Continued an effort to understand the dynamics that govern spiciness variability, its impact on ocean circulation, and the competing roles temperature and salinity have on ocean density and sound speed structure evolution. - Continued a field and modeling effort to understand and predict the generation and variability of western boundary currents in the Pacific Ocean. - Continued a field and modeling effort to understand the coupled physical processes that result in the propagation of the air-sea mode known as the Madden-Julian Oscillation in the Indian Ocean. - Continued a field and modeling program to investigate the structure and circulation of the South China Sea and oceanographic variability along the coast of Vietnam. - Continued studies of the coupled atmosphere-ocean-cryosphere-wave physics from the submesoscale to decadal climate scales to permit development of new global coupled modeling systems. - Continued studies of changes in the Arctic oceanography, meteorology and cryosphere and associated processes to allow permit development of new prediction models for the Arctic. - Continued arctic research to develop a new generation of ocean-ice-atmosphere dynamic prediction models, including process studies involving remote sensing and in-situ observations. - Continued collaborative studies with Vietnam to observe and model oceanographic processes along the Vietnamese shelf. - Continued field experiments using autonomous vehicles to observe topographically-generated currents and turbulence around islands in the Western Pacific Ocean.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research efforts related to the development of an Earth System Prediction Capability to enable improvements in extended range environmental forecasts. - Continued the effort to understand the relative importance of key physical processes governing the attenuation of wave energy in the marginal ice zone (MIZ). Study results will contribute to improved understanding of these processes for applications in spectral wave and general circulation models (GCMs). - Initiated research efforts to observe, understand, and predict the evolution of the Marginal Ice Zone in the Arctic Ocean. - Initiated in situ, airborne, and remote sensing observational efforts to inform scientific studies of the physical environment in the Arctic region. - Initiated research on integrated Arctic System Models to enable improved forecasts of the operational environment on lead times from hours to months in the Arctic domain. - Initiated an investigation into the changing surface conditions of the Arctic Ocean, resulting from observed reductions in sea ice cover. Ocean Acoustics - Continued analysis of deep-water acoustic transmissions made in the North Pacific to understand the scattered sound field due to ocean volume variability and bathymetric features. - Continued a field and modeling effort to simultaneously study shallow-water medium fluctuations and develop time reversal communications using adaptive channel equalizers. - Continued shallow-water, shelf-break measurements and analysis to characterize the effects of the ocean water column and seabed variability on low- and mid-frequency acoustic propagation and scattering. - Continued a field and modeling effort to establish the capabilities of underwater acoustic communications for FORCEnet and persistent undersea surveillance. - Continued the development and testing of geo-acoustic inversion and extrapolation methods. - Continued investigations into quantifying, predicting and exploiting uncertainty in acoustic prediction models. - Continued research to develop complex analytic equations that couple oceanographic modes, both horizontal and vertical, to their corresponding frequency-dependent acoustic modes to give direct acoustic prediction capability. - Continued research to quantify uncertainty in acoustic field computations for multi-scale ocean environments using novel approaches involving Bayesian prediction and polynomial chaos expansions to embed environmental uncertainty into multiscale ocean dynamics and acoustic propagation. - Continued data collection and analysis of deep water ambient noise with emphasis on the Philippine Sea. - Continued reverberation and clutter modeling studies. - Continued investigation of acoustic propagation in the Arctic.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued soft sediment geoacoustic inversion studies with an emphasis on the Gulf of Mexico.					
FY 2016 Plans: Littoral Geosciences and Optics - Continue all efforts of FY 2015, less those noted as completed above. Marine Mammals and Biology - Continue all efforts of FY 2015, less those noted as completed above. Physical Oceanography and Prediction - Continue all efforts of FY 2015, less those noted as completed above. - Initiate research on extreme currents and highly variable flow generated by flow encourntering abrupt topography in the Western Pacific. - Initiate research on the structure and variability of the Northern Arabian Sea circulation using autonomous, unmanned sampling systems in order to provide critical basic understanding. Ocean Acoustics - Continue all efforts of FY 2015, less those noted as completed above. - Initiate geoacoustic inversion studies with an emphasis on the New Jersey and Arctic Shelves.					
FY 2017 Base Plans: Littoral Geosciences and Optics - Continue all efforts of FY 2016, less those noted as complete. - Complete studies of Coupled Human-Landscape Interactions in Low-lying Coastal Environments. - Initiate research efforts to observe, understand and predict coastal land-air-sea interactions and identify needed improvements in operational databases and coupled land-air-sea modeling resolutions, formulations and implementations. - Initiate research efforts to model the time-varying shallow-water acoustical environment on HPC resources and to evaluate these models with field data and underwater remote sensing systems. Marine Mammals and Biology - Continue all efforts of FY 2016. Physical Oceanography and Prediction - Continue all efforts of FY 2016, less those noted as complete.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete studies of internal waves and strait dynamics emphasizing field studies in the Celebes, Philippine, and Sulu Seas. - Complete studies of ocean and wave response to typhoons and monsoons in the Western Pacific. - Complete workshops to define science needs for Sea Basing. - Complete extensive 3-year field program on prediction of internal waves. - Complete? extensive internal wave field program off the New Jersey Shelf; field work will coincide with and complement the Shallow Water Acoustics program. - Complete the field and modeling experiments to determine the lateral dispersion and maxing parameterization needed to understand model turbulence and to model ocean circulation. - Complete an effort to understand the dynamics that govern spiciness variability, its impact on ocean circulation, and the competing roles temperature and salinity have on ocean density and sound speed structure evolution. - Initiate a modeling and autonomous observation study of the Northern Arabian Sea using floats, gliders, and drifters. - Initiate field experiments to investigate changes in Arctic stratification and circulation and related physical processes in the Beaufort and Chukchi Seas. - Initiate a multidisciplinary field effort to characterize and understand air-sea-land interactions over the Maritime Continent in the western Pacific and the impact on intra-seasonal variability and extended-range prediction. Ocean Acoustics - Continue all efforts of FY 2016, less those noted as completed above. - Complete research to develop complex analytic equations that couple oceanographic modes, both horizontal and vertical, to their corresponding frequency-dependent acoustic modes to give direct acoustic prediction capability. - Complete research to quantify uncertainty in acoustic field computations for multi-scale ocean environments using novel approaches involving Bayesian prediction and polynomial chaos expansions to embed environmental uncertainty into multiscale ocean dynamics and acoustic propagation. - Completed soft sediment geoacoustic inversion studies with an emphasis on the Gulf of Mexico. - Initiate geoacoustic inversion studies with an emphasis on the New Jersey and Artic Shelves. ***FY 2017 OCO Plans:*** N/A					
Title: SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH	46.266	48.422	46.115	0.000	46.115

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: Science and Engineering Education and Career Development activities include DON participation in science fairs, summer research interns/fellows at Navy laboratories, graduate fellowships for individuals expected to become members of the engineering faculty at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs), and curricular enrichment programs. It is centered on Naval S&T efforts supporting Science, Technology, Engineering and Math (STEM). Outreach includes the encouragement, promotion, planning, coordination and administration of Naval Science and Technology. Funding also supports ONRG International Science Program whose mission is to search the globe for emerging scientific research and advanced technologies to enable the Office of Naval Research and the Naval Research Enterprise to effectively address current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future naval missions and capabilities. This is accomplished through PHD-level Associate Director scientists located in Asia, Europe and South America collaborating with international organizations and researchers through grants in innovative basic research, and establishing quality, relevant connections between international science and technology (S&T) centers of excellence and DON, DOD, and other US Government organizations. The direct impact of this investment is to capitalize on international basic research during unprecedented and dynamic global interdependence, increasing the ability to solve DON S&T challenges through shared knowledge and technologies with partners during a time of budget constraints. Additionally, this investment builds global S&T awareness to reduce the risk of potential technological surprise, and supports theater security cooperation goals to sustain cooperative relationships with an expanding set of international partners to enhance global security. The funding increase in 2016 is the result of significant emphasis in the Science, Technology, Engineering and Mathematics (STEM), HBCU and YIP initiatives. Funding decrease in FY 2017 results from decreased PE level funding availability resulting in lower investment levels in each major category of SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH. ***FY 2015 Accomplishments:*** Science, Technology, Engineering and Math (STEM) - Continued awarding prizes at 400 regional high school science fairs and four national competitions For Inspiration and Recognition of Science and Technology (FIRST), Junior Science and Humanities Symposia (JSHS), and Association for Unmanned Vehicle Systems International (AUVSI).					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued supporting high school summer interns at Navy laboratories Science and Engineering Apprentice Program (SEAP). - Continued supporting undergraduate/graduate students as summer research interns at Navy laboratories Naval Research Enterprise Internship Program (NREIP). - Continued providing graduate fellowship support to HBCU engineering faculty candidates. - Continued funding Young Investigator Program (YIP) research grants. - Continued inspiring, engaging, educating and employing exceptional candidates to sustain and enhance the naval research enterprise. - Continued funding for the following educational and outreach efforts: Youth Exploring Science (YES), American Society of Materials (ASM) Teacher Camp, Expanding Your Horizon (EYH), Forest Partners, and Sally Ride Science, plus SeaPerch, FIRST, and BotBall robotics efforts. - Continued support for SciGirls, Navy GEMS (Gains in the Education of Mathematics and Science), STEM Literacy for Navy recruits, Business-Higher Education Forum (BHEF), and the Gulf Coast Initiative. - Continued new projects to further teacher development and Grades 13/14 STEM degree retention. - Continued new effort on undergraduate retention in STEM majors at Minority Serving Institutions. - Continued new effort for teacher training in STEM for schools in underserved communities. - Continued new computer science programs for female undergraduates. - Continued expansion of internships to underserved students. - Continued Masters in Systems Engineering program at a minority institution in partnership with Assistant Secretary of the Navy (Research, Development and Acquisition). - Continued to refocus STEM outreach and education efforts towards demonstrated Navy and Marine Corps workforce needs and away from areas of responsibility delegated to the National Science Foundation, the Department of Education, and the Smithsonian Institution. - Continued to emphasize and expand the NREIP and SEAP summer internship programs. International Outreach - ONR Global - Continued international outreach support through ONR Global that provides a conduit for new scientific areas on the international front and promotes foreign sources of research important to the Naval mission.					
FY 2016 Plans: Science, Technology, Engineering and Math (STEM) - Continue all efforts of FY 2015. International Outreach - ONR Global					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** Science, Technology, Engineering and Math (STEM) - Continue all efforts of FY 2016. International Outreach - ONR Global - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Title: SENSORS, ELECTRONICS AND ELECTRONIC WARFARE (EW) ***Description:*** Efforts include the basic research portions of: Sensing, diagnostics, and detectors; navigation and timekeeping; nanoelectronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra-Red (EO/IR) electronics; EO/IR electronic warfare; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; and RF electronic warfare. Accomplishments and plans described below are examples for each effort category. Funding decrease in FY2016 is the result of Nanoelectronics effort moving to the 0601153N R-2 activity Mathematics, computer, and Information Sciences (MC&IS). Funding increase in 2017 is the result of overall PE funding level increase. ***FY 2015 Accomplishments:*** - Continued monolithic integration of multifunctional materials to enable passive devices and sensors into wide bandgap semiconductor circuits. - Continued investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms. - Continued investigation of ultra-high speed logic and multiple-quantum-well devices with a goal of >500 gigahertz (GHz) samplers, in support of mixed signal circuits for receiver analog-to-digital converters (ADC's). - Continued program to extend device performance and architectures to frequencies approaching terahertz (THz).	53.730	46.459	46.907	0.000	46.907

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued program to incorporate Magnesium Diboride (MgB2) tunnel junctions into simple electronic logic structures. - Continued study to determine if the coupling between spins in quantum dots mediated by the virtual excitons is sufficiently strong for use in solid state implementations for quantum information. - Continued program on advanced epitaxial growth for novel Si-based detector applications. - Continued development of a blind adaptive beamforming approach for the High Frequency (HF) radar case and compare with both the conventional and traditional approaches. - Continued development of approaches for probability of detection for deterministic signals in stationary noise and quantify for non-stationary noise. - Continued development of electromagnetic ultra-near-field holography. - Continued development of sensitive miniature fluxgate magnetometers. - Continued projects to explore physical behavior of full arrays of nanoscale devices for logic, memory, and imaging. - Continued a program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays. - Continued a program on the control of deleterious defects in silicon carbide (SiC). - Continued a program on the study of Quantum Dots and their application to coherent wave function control and quantum information. - Continued a program on the tailoring of the optical, structural and electronic properties of semiconductor quantum wires. - Continued a program to demonstrate non-volatile memory, based on spin-torque Magnetic Random Access Memory (MRAM), with switching speed > 1 GHz and write currents small enough (<1 mA) to be driven by superconducting Rapid Single Flux Quantum (RSFQ) logic. - Continued a program to determine if the newly invented Reciprocal Flux Quantum Logic in fact delivers 2x higher speeds with 5x fewer Josephson junctions and power, while using the same underlying devices so that single chip hybrid circuits between it and the dominant RSFQ logic are feasible. - Continued demonstrations of tunable analog filters made in a digital Nb device foundry. - Continued work on optical manipulation of ultra-cold atoms. - Continued investigation of temporal-spatial noise shaping circuits and architectures for high power digital-to-analog conversion with objectives of doubling spectral bandwidth, reduction of element density (15%), and extension of multidimensional Nyquist limits to both linear and planar arrays. - Continued the evaluation and assessment of hardware-compatible space-time algorithms for Digital Signal Processor (DSP) applications to Transmit/Receive (T/R) arrays.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research to improve mixed signal III-V device and circuit modeling with objectives of achieving a 30 dB dynamic range improvement for complex circuits containing over 100,000 devices. - Continued project to explore graphene based nanoelectronic devices. - Continued program in chip-scale quantum architectures. - Continued project to reduce heat transfer through electrical leads in cryogenic packaging. - Continued project to explore development of devices, sigma delta and time encoder circuits for near THz switching with objectives of enabling analog and digital conversion at millimeter wave frequencies. - Continued high-sensitivity magnetometry using quantum logic. - Continued materials studies of low temperature regenerator (high thermal capacity) materials and/or controlled flow microstructures with the goal of improving energy efficiency of cryocoolers. - Continued research into fundamental concepts and mathematics for digital array architectures. - Continued research to apply carbon nano-tube technology to acoustic sensing. - Continued research to investigate two-dimensional electron gases in perovskite oxide heterostructures. - Continued project to investigate self-assembled one-dimensional GaN channels in AlGaN/GaN structures. - Continued spin-based electronics research. - Continued graphene physics and bandgap engineering research. - Continued work on spin properties of graphene. - Continued research effort to determine the most appropriate tunnel barrier for MgB2 Josephson junctions. - Continued an effort to grow low defect density, high purity epitaxial 4H-SiC at high growth rates suitable for high power electronic device applications. - Continued design, construction, and testing of sonic crystals that can be tuned to have specific acoustic properties. - Continued effort to create a physics-based understanding of epitaxial oxides and insulators for use in applications for advanced electronics. - Continued investigation into stabilizing in-phase coherent state of coupled systems for coherent power generation. - Continued high output impedance solid state device technologies and materials. - Continued effort to fabricate functionalized micro-opto-mechanical systems for the measurement of micromechanical photothermal spectra of adsorbed chemical vapor analytes. - Continued research effort on chemical synthesis and bandgap tailoring in graphene nanoribbons. - Continued research on spin dynamics in Group IV semiconductors and related device concepts. - Continued research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution. - Continued studies of the physics origin of noise and behavioral fluctuations in superconducting circuits, especially analog to digital converters, and incorporate the understanding into computer aided circuit simulators.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued studies of the generation and recombination dynamics of non-equilibrium quasiparticles associated with digital switching events in superconducting logic. - Continued investigation of metamaterials with embedded active devices to better understand multidimensional signal processing from RF through THz frequencies. - Continued effort on nuclear optical frequency standard in Thorium 229. - Continued studies of intraband transitions in wide bandgap quantum wells. - Continued studies of the use of non-linear optical (phonon-photon interactions) phenomena as a method of cooling to cryogenic temperatures. - Continued effort to investigate statistical representations of target and signal techniques. - Continued studies of chemical vapor deposition (CVD) of graphene on copper. - Continued research on defect engineering and characterization in graphene. - Continued studies of how to prevent flux trapping and diagnose its occurrence in complex superconducting circuits and to design real time expert measurement systems in general for testing of new designs defined in VHSIC (Very High Speed Integrated Circuits) Hardware Description Language (VHDL). - Continued MgB2 Josephson junction work with first tests of 10 device logic cells to determine likely clock speeds of this new materials technology. - Continued high output impedance solid state amplifier technologies. - Continued program of ultraprecise gravitational measurements using atom interferometers. - Continued research on graphene based high performance flexible electronics. - Continued research on DNA based carbon nanotube sorting and placement. - Continued investigation of electrical stress characterization and Gallium Nitride transistor stability. - Continued development of a path-integral-based theory of wave propagation in bounded, disordered media. - Continued effort to develop multiple layered semiconductor quantum dots for infrared optical applications. - Continued research on characterization and control of graphene edge effects. - Continued research on electronic functionality in DNA nanostructures. - Continued research on chemical functionalization and self-assembly of graphene nanostructures. - Continued studies of how best to densitify superconducting circuits using new third generation Nb devices including what new layers devoted to resistors, filters, power distribution or wiring would provide the greatest system benefit. - Continued research on correlated electron materials for high performance electronic devices. - Continued effort to study novel oxide materials with high electron densities for high performance transistors. - Continued research on synthesis of electronic Boron Nitride films. - Continued research on defect characterization of single layer Boron Nitride. - Continued studies of analog intelligent nanoelectronics computational architecture.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research on new class of superconductors or devices in which competition between superconducting and magnetic ordering is involved. - Continued research on multi-THz electromagnetic devices lying within the intersection of high-speed electronic materials, photonic materials and active metamaterials. - Continued research on semiconductor nanowire array based transistors operating in the quantum capacitance limit for highly linear RF electronic devices and photonic nanoresonators. - Continued research on 2D materials other than graphene. - Continued research on spin properties in topological insulators. - Continued research on chemical synthesis of carbon nanostructures. - Continued research towards detecting and manipulating Majorana fermions in condensed matter systems. - Continued studies of topological insulator materials and novel device concepts exploiting properties of transport in their protected electronic state. - Continued efforts to improve the sensitivity of superconducting quantizers, mechanisms to achieve >20 GHz in-building wireless (IBW) in analog to digital converters, and explore origins of non-linearities in quantizers. - Continued studies of whether superconducting qubits can act as controllable sources of microwave entangled photons and whether these plausibly have application to quantum radar. - Continued study of active control of biomolecular binding on surfaces. - Continued search for sustainable replacements for semiconductors and strong magnets. - Continued study of sensing, selection and control of marine microbes. - Continued effort to develop techniques for the atomic layer deposition of high-quality dielectric films on semiconductor surfaces with extremely low interface state densities. - Continued effort to determine the feasibility and develop a greater understanding of defect science in SiC epitaxial layers on low offcut substrates suitable for power electronic applications. - Continued fundamental investigation onto the synthesis and material properties of graphene, boron nitride and other two dimensional materials; identify potential exploitation avenues. - Continued development of the method of moments solvers for millimeter wave region targets - Continued development of phase-only pattern synthesis for transmit arrays. - Continued development of a new theory of inference for statistical signal processing. - Continued research to control quantum dot excitations by using acoustic phonons. - Continued development of mathematical and numerical tools to understand stochastic prediction and control of delay coupled dynamical systems. - Continued effort to develop novel Interfacial Misfit (IMF) & Selective Area Pillar (SAP) techniques for molecular beam epitaxy (MBE) growth of non-lattice matched III-Sb alloys with low defect densities & favorable band alignments for a new generation of IR optical devices.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued effort to develop mid-, far-infrared and terahertz nanophotonic optical components using optic phonon modes within polar dielectrics. - Continued research on optical and plasmonic properties of graphene in infrared (IR) and terahertz (THz) spectral regions. - Completed efforts on alternative tunnel barriers for Niobium (Nb) electrode Josephson junctions for third generation digital devices. - Initiated effort to maintain the ten (10) femto-second jitter produced by high speed long Josephson junction (LJJ) clocks as these pulses propagate to their point of use in coherently sampling multiple ADC and devise a Josephson junction based way of phase locking a LJJ clock to an external master clock. - Initiated non-equilibrium k-space transport studies. - Initiated research on micro plasma based materials, devices, and circuits.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Transfer studies of analog intelligent nanoelectronics computational architecture. - Transfer research on optical and plasmonic properties of graphene in infrared (IR) and terahertz (THz) spectral regions. - Transfer research on 2D materials other than graphene. - Transfer research on chemical synthesis of carbon nanostructures. - Transfer research towards detecting and manipulating Majorana fermions in condensed matter systems. - Transfer studies of topological insulator materials and novel device concepts exploiting properties of transport in their protected electronic state. - Transfer research on spin dynamics in Group IV semiconductors and related device concepts. - Transfer research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution. - Transfer research on defect engineering and characterization in graphene. - Complete research on duel-STM characterization of graphene film. - Complete studies of chemical vapor deposition (CVD) of graphene on copper. - Complete research on spin properties in topological insulators.					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete research on heterojunction bipolar transistors with diamond collectors. - Complete research on optical modulators using vanadium oxide. - Complete research on phosphorene field-effect transistors. - Complete research on transistors based on lanthanum-doped barium tin oxide.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate research on chalcogenide-based phase-change materials for photonics. - Initiate research on improved thermal conductivity and contact resistance of germanium telluride for RF switches. - Initiate research exploiting non equilibrium k-space transport in electronic devices for high efficiency signal generation and information processing. - Initiate research exploiting avalanche transport phenomena in wide bandgap materials and devices. ***FY 2017 OCO Plans:*** N/A					
Title: WEAPONS ***Description:*** Efforts include: undersea weaponry; energetic materials and propulsion; expeditionary operations (communications, materials for forensic sensing, landmine detection, human sensory enhancements, lightweight power sources and information efficiency); counter directed energy and applied electromagnetics. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. Accomplishments and plans described below are examples for each effort category. Increase from 2016 to 2017 results from increased PE level funding availability resulting in higher investment levels in each major category of Weapons. ***FY 2015 Accomplishments:*** Undersea Weaponry - Continued conducting basic research related to critical S&T (including vehicle control, maneuverability, and stability) associated with the development of High-Speed Supercavitating Vehicles (HSSV). - Continued expansion of the Navy Undersea Research Program (NURP) Program to provide a further infusion of educated and career minded scientists and engineers in support of the National Naval Responsibility (NNR) for Undersea Weapons Research. - Continued computer code refinements and investigation of supercavitating vehicle dynamics and instability. - Continued evaluation of viable synthesis methodologies and characterization of candidate explosive ingredients suitable for undersea weapons applications.	17.562	18.209	18.252	0.000	18.252

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued studies metalized explosives, lattice deformation of crystalline explosives, high thermal conductivity nanocomposites for vehicle arrays, microplasma fuels reforming and biomimetric propulsion mechanisms for underwater vehicles exploiting flutter instability. - Continued validation of hydroacoustics models and test and evaluate acoustic array signal processing algorithms. - Continued study on propulsion and its interaction with supercavitating cavity, and control surfaces. - Continued acoustic concepts formulation and modeling for low-noise bio-inspired propulsion systems. - Continued new coating concepts for corrosion and anti-fouling protection of UUVs. - Continued high energy density power system research for under water vehicles. - Continued concept development on inversion of swarm dynamics for underwater tactical applications. - Continued development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments. - Continued an Otto Fuel II characterization study for undersea weapons. - Continued basic research related to cavity stability, vehicle control, maneuverability, stability associated with the development of high-speed, supercavitating vehicles. - Continued new, and continue on-going, research in fuzing phenomenology, reactive materials, high oxygen constituents and insensitive munitions and use of these technologies in advanced warhead concepts. - Completed efforts in high-oxygen constituents and insensitive munitions. - Completed Otto Fuel II characterization study for undersea weapons. Energetic Materials and Propulsion - Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus. - Continued exploring the use of quantum mechanics and molecular dynamics to provide fundamental properties for energetic materials to predict initiation/detonation criteria for insensitive munitions applications. - Continued investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells. - Continued investigation of multi-tube multi-nozzle Pulse Detonation Engines (PDEs) and multi-tube common nozzle PDEs. - Continued investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates. - Continued investigation of novel initiation techniques, including optimized injection parameters, and integrated single tube operation for PDEs. - Continued Advanced Energetics research in reactive, explosive, and propulsive energetic materials, including high energy ingredient synthesis & characterization, and fundamentals of initiation and decomposition					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
mechanisms, to tailor energy release processes in order to achieve substantial performance gains and/or enhanced survivability in harsh environments. - Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications. - Continued to develop organometallic-based highly energetic ingredients. - Continued efforts to explore alternative fuel concepts for Naval applications to include hydrogen, synthetic diesel, and biodiesel. - Continued development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater PDEs). - Continued implementation of new & nanostructured materials design concepts for direct energy conversion and waste energy conversion. - Continued investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming). - Continued studies to determine the best investment of technologies for Unmanned Undersea Vehicle (UUV) Guidance and Control (G&C). - Continued hydroacoustics models and experiments to reduce the self-noise on cavitator acoustic array. - Continued acoustic signal processing algorithms for HSSV guidance and control. - Continued development of new concepts for underwater power generation. - Continued development of non-lethal undersea warheads for Overseas Contingency Operations. - Continued development of PDE for underwater applications. - Continued new thrust on the design, synthesis and characterization of high energy dense oxidizers. - Continued structure property relationship studies on advanced propellant systems and high blast energetic compositions. - Continued synthesis and characterization of cluster complexes between reactive metals and energetic oxidizers and explosives. - Continued research and development for hypersonic propulsion system technologies for increased range and speed, improved stealth and maneuverability, reduced emissions and signatures, lower noise, wider operational envelopes and turndown ratio. - Continued research into coulombic explosives via unique electronic and structural properties of atomic clusters not observed in bulk. - Continued development of a new methodology coordinating both theoretical and synthetic chemistry to maximize molecular design and predicted molecule stabilities facilitating insight into the next generation of energetic materials.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research to develop ability to synthesize and quantitatively predict energetic material performance from first principles of quantum chemistry. - Continued research and development on aircraft, fuels and rocket propulsion system technologies for increased range and speed, improved stealth and maneuverability, reduced emissions and signatures. - Continued an investigation that focuses both theoretical and synthetic processes to maximize molecular design and crystal morphology for new insensitive munition (IM)-compliant commodity energetic material ingredients. Expeditionary Operations - Continued investigation of catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide fuel cells. - Continued basic materials research to explore and improve high strain and stress rate performance of high performance fibers, armor inserts, and structural materials. - Continued basic research into automated reasoning and data fusion for distributed surveillance. - Continued fundamental chemistry and materials science research to advance water purification technologies. - Continued basic research to advance electrochemical energy conversion and storage. - Continued a Vehicle Autonomy effort focused on unmanned and autonomous systems to displace the operator from hazardous conditions/environments, lighten the load of individual Marines, and provide greater warfighting capability. - Continued a new effort to research peer-to-peer mixed initiative planning to allow unmanned autonomous systems to collaborate and improve their common operating picture without having to have a human in-the-loop. - Continued Distributed Trust Models effort to determine USMC S&T gaps hindering dominance in cyberspace. - Initiated development of collection strategies based on cutset sensor topologies in order to provide enhanced situational awareness with sparse sampling. Counter Directed Energy - Continued investigating the most promising physics, science, and mathematic solutions to protect naval assets against directed energy threats. - Continued establishing the basic science and technology issues relevant to the propagation of directed energy in the atmosphere and its interaction with sensors, electronics and structural materials. - Continued assessment of theoretical constructs for directed energy (DE) systems detection and geolocation. - Continued investigation into the susceptibility of critical naval electronic components to electromagnetic radiation. - Continued development of courseware for Counter Directed Energy (CDEW) for use at the U.S. Naval Academy and the Naval Postgraduate School.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued performance of laboratory experimentation on laser and High Power Microwave protection methods for future naval aviation systems and platforms. - Continued development of suitable metamaterial samples which provide electromagnetic shunting and conduct laboratory testing with laser and microwave systems. - Continued testing of unmanned systems DE protection methods. Applied Electromagnetics: - Continued program to conduct basic research and theoretical analysis in electromagnetic phenomena in the spectrum from microwaves to visible light. Areas of research will be in microwave directed energy, optical directed energy (lasers), terahertz sources, and related nanometer-scale electronics and sensors.					
FY 2016 Plans: Undersea Weaponry - Continue all efforts of FY 2015, less those noted as completed above. - Complete new coating concepts for corrosion and anti-fouling protection of UUVs. - Complete computer code refinements and investigation of supercavitating vehicle dynamics and instability. Energetic Materials and Propulsion - Continue all efforts of FY 2015, less those noted as completed above. - Initiate hypersonic aerodynamics, aerothermodynamics and high temperature materials research focused on challenges resulting from unique Navy platform constraints. Expeditionary Operations - Continue all efforts of FY 2015, less those noted as completed above. Counter Directed Energy - Continue all efforts of FY 2015, less those noted as completed above. Applied Electromagnetics - Continue all efforts of FY 2015, less those noted as completed above.					
FY 2017 Base Plans: Undersea Weaponry - Continue all efforts of FY 2016, less those noted as completed above.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Energetic Materials and Propulsion - Continue all efforts of FY 2016, less those noted as completed above. Expeditionary Operations - Continue all efforts of FY 2016, less those noted as completed above. - Complete a Vehicle Autonomy effort focused on unmanned and autonomous systems to displace the operator from hazardous conditions/environments, lighten the load of individual Marines, and provide greater warfighting capability. -Complete investigation of catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide fuel cells. - Initiate Dynamical Information Processing for Autonomous Systems. - Initiate expeditionary basic research efforts in computer science, human-social-cultural interactions and data science related to distributed systems. Counter Directed Energy - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: BASIC RESEARCH CHALLENGE ***Description:*** The ONR Basic Research Challenge (BRC) program was established in 2008 to competitively select and fund promising research programs in new areas not addressed by the current basic research program. In the past, the Basic Research Challenge Program has been integrated into the legacy R2 Activities to illustrate its alignment with the mainstream Naval research disciplines, but with this update BRC is being identified as its own R2 Activity to call attention to the significance it provides to new areas of Naval importance. The program stimulates new, high-risk basic research projects in multidisciplinary and departmental collaborative efforts, and funds topics that foster leading edge science and attract new principal investigators and organizations. Basic Research Challenge awards are for a period of four years. Topics are submitted by ONR program officers and are selected for BRC awards by ONR's director of research. Basic Research Challenge award topics are then issued as a broad agency announcement. Decrease from 2016 to 2017 results from lower PE level funding availability that will be invested in yet to be evaluated Challenge proposals	20.666	20.794	19.082	0.000	19.082

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
FY 2015 Accomplishments: - Continued research into the science of autonomy. - Continued research into de-centralized on-line optimization. - Continued research into carbon molecular electronics. - Continued research into co-prime sensor array signal processing: a new framework for reduced complexity sensing. - Continued research into understanding and characterizing intuition for more effective small unit decision making training technologies. - Continued research into couplings of ocean to space of ionospheric drivers from below novel electronic devices based on coupled phase transitions. - Continued research into biologically inspired flow field computation for sensing and control of ground vehicles. - Continued research into reduced order representations for design: development of optimized algorithms for multi-physics based models. - Continued research into multi-scale nonlinear mechanisms and effects associated with coupling weak energy into composite explosive compounds. - Continued research into integration of advanced analysis with materials research. - Continued research into towards active control of noise from hot supersonic jets. - Completed research into biologically inspired intelligent metamaterials. - Completed research into computing with natural language. - Completed research into the microphysics of a liquid solid gas interaction. - Completed research into acoustical uncertainty due to marine mammals and fish. - Initiated competition for new BRC awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoN research areas. Approximately four high priority research topics will be identified to solicit proposals. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those completed in that year. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those completed in that year. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	434.398	451.553	422.748	0.000	422.748

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601153N / *Defense Research Sciences*	**Project (Number/Name)** 0000 / *Defense Research Sciences*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Defense Basic Research seeks to improve the quality of defense research conducted predominantly through universities and government laboratories. It also supports the education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in an academic environment. Initial research focus is generally conducted in an unfettered environment because of the nature of basic research, but as more is learned and applications emerge, individual research projects take on a more applied focus. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. Example metrics include a biporous wick structure for thermal management of power electric modules capable of removing 900 watts per square centimeter which was recently developed by an academia/industry team. The National Research Council of the National Academies of Science and Engineering's congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / *Defense Research Sciences*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	51.684	55.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	106.684

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase	51.684	55.000
FY 2015 Accomplishments: Expanded and continued basic research efforts to support Navy and Marine Corps needs in the following areas: Autonomous Systems; Command, Control, Communications and Computers (C4); Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).		
FY 2016 Plans: Expand and further basic research efforts to support Navy and Marine Corps needs in the following areas: Autonomous Systems; Command, Control, Communications and Computers (C4); Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).		
Congressional Adds Subtotals	51.684	55.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Congressional Interest Items not included in other Projects.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602114N / *Power Proj Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	94.944	87.223	41.371	-	41.371	39.925	45.953	50.344	52.517	Continuing	Continuing
0000: *Power Proj Applied Research*	0.000	94.944	68.723	41.371	-	41.371	39.925	45.953	50.344	52.517	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	18.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.500

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on high energy lasers, Electromagnetic Railgun (EMRG) development, Hyper Velocity Projectiles (HVP), high speed weapon propulsion, and electro-optic/infrared (EO/IR) sensor technologies.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	95.753	68.723	30.624	-	30.624
Current President's Budget	94.944	87.223	41.371	-	41.371
Total Adjustments	-0.809	18.500	10.747	-	10.747
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	18.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.784	0.000			
• SBIR/STTR Transfer	-1.593	0.000			
• Program Adjustments	0.000	0.000	10.907	-	10.907
• Rate/Misc Adjustments	0.000	0.000	-0.160	-	-0.160

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602114N *I Power Proj Applied Research*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	0.000	13.500
Congressional Add: *Force Protection Research*	0.000	5.000
Congressional Add Subtotals for Project: 9999	0.000	18.500
Congressional Add Totals for all Projects	0.000	18.500

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602114N / *Power Proj Applied Research*	Project (Number/Name) 0000 / *Power Proj Applied Research*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Power Proj Applied Research*	0.000	94.944	68.723	41.371	-	41.371	39.925	45.953	50.344	52.517	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses the technology issues involving the Navy's capability to project naval power on the broad seas and in the littoral regions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: DIRECTED ENERGY	40.128	26.885	10.956	0.000	10.956

Description: The goal of this activity is to develop Directed Energy (DE) technology for Navy applications. The DE program addresses the requirements of future Navy combatants to provide ship defense against the emerging threats that are proliferating throughout the Navies of the world. The Directed Energy portion of this activity consists of two elements. The first element involves applied research and development of technologies supporting advanced accelerators with applications to directed energy weapons.

FY 2015 to FY 2016 decrease in funding is due to completion of the Solid State Laser - QRC program as well as a continued realignment of Free Electron Laser (FEL) activities.

FY 2016 to FY 2017 decrease in funding is due to Solid State Technology Maturation Program (SSL-TM) program entering its fabrication and testing phase.

FY 2015 Accomplishments:
Directed Energy and Accelerator Research:

-Continued to develop the most promising component technologies such as normal conducting and super conducting RF electron beam injectors, advanced high power cathode technologies, high power compact amplifiers, and advanced mirrors, coatings and optical components capable of handling the significantly higher energies for potential alignment in a Free Electron Laser.

Solid State Laser - Technology Maturation (SSL-TM):

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Continued the development of technologies suitable for a solid state laser weapon system, including technologies for maritime beam director, targeting and laser subsystems, which are capable of supporting future Navy missions to defeat small boat swarms, UAV swarms, and provide potential ISR disruption and/or defeat. This work supports future prototype developments and will include laser subsystem (potentially both slab and fiber solid state systems) and required beam director scientific studies. The focus of the effort will be to support the development and advancement of future Navy Solid State Laser prototypes, including the development of lethality studies and atmospheric characterization. These scientific studies are critical to understand and support missions identified for a layered defensive capability, in the maritime environment, which shall include robust modeling and simulation of atmospheric absorption and turbulence. -Conducted lethality testing for notional solid state laser designs. This will include scientific studies of laser erosion, pitting, and ablation of various target materials for improved modeling and simulation that will support development of the governing technical requirements for a beam director and targeting system capable of performing Navy surface ship self-defense missions. -Continued studies of atmospheric absorption and turbulence, suitable to evaluate notional maritime beam director subsystems, and including studies in adaptive optics for improved lethality performance in low altitude, maritime surface conditions. These scientific studies are critical to understanding the impact of boundary layer and sea-water-air turbulent mechanics on future laser weapons systems and interfaces. -Continued trade studies on innovative solid state laser subsystems designs, based off industry available technologies or those technologies identified by the High Energy Laser Joint Technology Office (HEL JTO). These investments will be considered "break through" type of investments, which require additional scientific study to determine their potential for near term capability improvements in a future naval prototype system. -Continued scientific studies on laser subcomponents, including laser pump diodes and laser gain media, which have the potential to support future acquisition programs, but are based on solid state laser technologies. Efforts in this area will focus on emerging commercial technologies and government sponsored research, which are suitable for use in a maritime domain. Research and technology developments will include advancements suitable for use by either solid state slab or solid state fiber optic laser subsystems - and which if matured, would enable rapid scientific advancements and improve specific systems performance against key performance parameters. -Continued scientific trade studies of notional predictive avoidance systems, which examine the control interfaces between sensors and future prototypical naval laser weapons, which would provide an inherent "safe-arm" function for the projecting of laser power at long range (potentially beyond typical visible, line of sight distances.) Of particular concern is the designs for safety in future laser weapons to halt laser energy					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
propagation, while performing Navy surface ship self- defense missions, and avoid inadvertent illumination of non-threat forces (e.g. friendly sensors or platforms.) - Conducted component and subcomponent laboratory tests. Applied Electromagnetics for High Power Weapons -Completed the development of Gallium Nitride as an advanced nonlinear optic material. ***FY 2016 Plans:*** Directed Energy and Accelerator Research: -Continue all efforts of FY 2015 unless noted as completed above. Solid State Laser - Technology Maturation (SSL-TM): -Continue all efforts of FY 2015 unless noted as completed above. -Preliminary Design Review (PDR) for Tactical Laser Core Module (TLCM) planned during 2016 ***FY 2017 Base Plans:*** Directed Energy Research: - Continue all efforts of FY 2016 unless noted as completed above Solid State Laser - Technology Maturation (SSL-TM): - Continue all efforts of FY 2016 unless noted as completed above. - Conduct Critical Design Review (CDR) for Tactical Laser Core Module (TLCM) planned during FY 2017 ***FY 2017 OCO Plans:*** N/A					
Title: HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES	3.886	3.776	3.813	0.000	3.813
Description: The high speed weapons work in this activity is focused on demonstrating propulsion and vehicle technologies for Mach3+ to Mach8 capable weapons. This work includes technologies associated with high acceleration capable projectile structures, high temperature and high strength materials to enable projectiles to survive high speed launch environment, improved thermal prediction methodologies and test techniques, wide dynamic pressure adaptable projectile controls and non-explosively launched lethal mechanisms. The high speed projectile technologies are intended to support long range Naval Surface Fire Support weapons.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
FY 2015 Accomplishments: -Continued technology maturation of advanced airframes and controls, high G-force components and miniaturization of electronics. -Continued effort to develop advanced guidance and control technologies for high speed weapons. -Continued high temperature capable thermal management, insulator and ablative technology investigations. -Continued high speed propulsion and integrated airframe technology development to enhance system range, responsiveness and reliability. -Continued investigations into advanced material solutions to high speed airframes and air systems operating in maritime environments. -Transition the Hyper Velocity Projectile (HVP) program to an FNC. -Initiated high speed hypersonic weapons technology program to provide exploratory development of enabling very long range hypersonic boost-glide missiles and hypersonic ship-launched projectiles. -Initiated development of advanced computational and experimental techniques for hypersonic boundary layer transition. -Initiated High Temperature thermal management research. -Initiate Ultra-high temperature materials research for hypersonic leading edges and nose tips. ***FY 2016 Plans:*** -Continue all efforts of FY 2015 unless noted as completed above. ***FY 2017 Base Plans:*** -Continue all efforts of FY 2016 unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES	3.849	4.505	5.755	0.000	5.755
Description: This activity describes Navy Science and Technology (S&T) investments in the areas of EO/IR devices and advanced sensors and includes investment/performance in the technology areas of EO/IR, Electronic Warfare, and Communications. FY 2016 to FY 2017 increase is due ramp-up of EW Sensor Technology. ***FY 2015 Accomplishments:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Electronic Warfare: -Initiated development of novel photovoltaic and autonomous soaring technology to enable long range EW sensor delivery systems -Continued development of advanced fuel cell technology for UAS to increase on-station time of EW sensors. -Continued efforts for Unmanned Aerial System (UAS) Based EW: The objective is to develop a System of Systems (SoS) able to artificially create the appearance of a realistic naval force to many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing battle space confusion to adversary surveillance and targeting systems both above and below water, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. Technology developments will include reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective acoustic countermeasures (CM), and Multiple Input/Multiple Output Sensor/ CM (MIMO S/CM) for false force generation to both above and below water sensors. - Continued development of ultra-low noise uncooled nanotechnology infrared sensors. - Continued development of nanoatomic sensor nonvolatile memories. - Continued development of electronic field of view and zoom imagers. - Continued the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification. - Continued development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats. - Continued effort to develop mid & long wave IR focal plane arrays using graded-band gap W-type-II. Superlattices with much higher detectivity than that of state-of-the-art HgCdTe (MCT). - Initiated development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system. -Initiated development of a water assisted take-off process for electronic warfare sensors. -Initiated development of advanced fuel cell technology for UAS to increase on-station time of EW sensors. Electro Optic/Infrared - Continued development of next generation IR focal plane sensor and countermeasures to defeat it. - Continue research to apply manifold modeling and optimal control techniques to airborne EO/IR sensor systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Electronic Warfare: - Initiated development of methodology to concatenate nanoparticle structures for spectral control of obscurant material - Continued development of next generation IR focal plane sensor and countermeasures to defeat it. - Continued research to apply manifold modeling and optimal control techniques to airborne EO/IR sensor systems.					
FY 2016 Plans: -Continue all efforts of FY 2015 unless noted as completed above. Electronic Warfare - Continue development of novel photovoltaic and autonomous soaring technology to enable long range EW sensor delivery systems Electro Optic/Infrared - Complete development of structured dielectric elastomers for electromechanical devices and deformable optics. - Complete development of magneto-optic materials and ultra-high sensitivity, room-temperature magnetic field sensors.					
FY 2017 Base Plans: Electronic Warfare - Continue ramp-up development of novel photovoltaic and autonomous soaring technology to enable long range EW sensor delivery systems -Complete development of advanced fuel cell technology for UAS to increase on-station time of EW sensors. -Continue development of methodology to concatenate nanoparticle structures for spectral control of obscurant material Electro Optic/Infrared -Complete development of next generation IR focal plane sensor and countermeasures to defeat it. -Complete research to apply manifold modeling and optimal control techniques to airborne EO/IR sensor systems.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: STRIKE AND LITTORAL COMBAT TECHNOLOGIES	0.757	0.737	0.909	0.000	0.909

Description: The focus of this activity is on those technologies that will support Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore.

FY 2015 Accomplishments:
Increased Capability Against Moving and Stationary Targets:
-Continued the development and demonstration of new Electronic Protection (EP) techniques that can discriminate advanced jamming false targets from true targets and also suppress false targets so that true targets can be readily detected.
-Complete development of multi-static electronic protection techniques against advanced jamming systems.

Enhanced Weapon Technologies:
-Continue three new products to expand current Counter Air / Counter Air Defense capabilities by providing improved range and end-game maneuverability while decreasing Time-of-Flight. Specific tasks to begin design and development phase are: Counter Air Advanced Medium-Range Air-to-Air Missile (AMRAAM) Improvements / Counter Air Defense / Improvement / High Speed Components.
-Continue development and apply emerging technologies that support delivery of Technology Oversight Group approved FNC enabling capabilities structured to close operational capability gaps in power projection; package emerging power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period; and mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars.

Strike Accelerator:
-Continue Strike Accelerator program. This effort will provide an advanced airborne capability to accurately identify targets using Advanced Target Recognition (ATR). These capabilities are utilizing the F/A-18 E/F, AESA (Active Electronically Scanned Array) Radar and ATFLIR (Advanced Targeting Forward Looking Infrared) sensors.

Multi-Target Laser Designator:
- Continue research for advanced optical techniques to defeat SWARM attacks.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Selectable Output Weapon: -Continue Selectable Output Weapon Sea Strike Project High Energy Fiber Laser System: -Continue development an advanced laser beam control, pointing mechanism and power subsystem to support an airborne laser weapon system. This system will provide the detection and defeat of current and future threats. ***FY 2016 Plans:*** -Continue all efforts of FY 2015 unless noted as completed above. ***FY 2017 Base Plans:*** -Continue all efforts of FY 2015 unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: ELECTROMAGNETIC GUNS ***Description:*** This activity is the Electro Magnetic (EM) railgun program that is focused on developing the technology to launch a long range projectile from Navy ships. EM railgun is being considered for multi-mission applications including USMC Naval Surface Fire Support, anti-surface warfare (ASUW) and ship self defense from missiles and small boat threats. FY 2015 to FY2016 decrease is due to the completion of pulsed power development and fabrication required to support repetitive rate testing. FY 2016 to FY 2017 decrease is due to the completion of majority of long lead barrel buys with continued barrel testing required. ***FY 2015 Accomplishments:*** -Continued additional next generation pulsed power fabrication as part of a multi-module, multi-year build to increase full scale rep rate capability from 20MJ to 32MJ muzzle energy capability. -Continued effort to understand the technology required to launch hypervelocity projectiles in only a 4 meter long barrel at 10 rounds per minute. -Continued launcher development.	46.324	32.820	19.938	0.000	19.938

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Continued material, physics and thermal property research for single shot launchers, pulsed power and projectiles for 32MJ muzzle energy launch; and initiated assessments from next generation, rep rate, and operational environments. -Continued IPT and Bore Life Consortium collaborations for 32 MJ launchers. -Continued material applications and component design assessments for next generation repetitive fires. -Continued development of modeling and simulation capability to support bore life development and testing for rep rate bore life development assessments. -Continue pulsed power development and fabrication required to support repetitive rate testing. ***FY 2016 Plans:*** -Continue all efforts of FY 2015 unless noted as completed above. -Complete pulsed power development and fabrication required to support repetitive rate testing. ***FY 2017 Base Plans:*** -Continue all efforts of FY 2016 unless noted as completed above. -Complete majority of long lead barrel buys with continued barrel testing required. -Complete effort to understand the technology required to launch hypervelocity projectiles in only a 4 meter long barrel at 10 rounds per minute. -Complete additional next generation pulsed power fabrication as part of a multi-module, multi-year build to increase full scale rep rate capability from 20MJ to 32MJ muzzle energy capability. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	94.944	68.723	41.371	0.000	41.371

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 0000 / *Power Proj Applied Research*

E. Performance Metrics

This PE develops early components technologies that can be integrated into weapon systems that meet warfighter requirements. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments). The metrics used to evaluate 6.2 programs are necessarily less precise than those used in 6.3 programs.

The metrics for this PE can be divided into two categories: technological and organizational/functional. Technological metrics address the success of the work performed. The primary technological metrics used in this PE involve laboratory experiments/tests demonstrating proof of the concept for the technology. This demonstration is frequently a hand-assembled functioning breadboard of the concept. The organizational/functional metrics applied to this PE include: transition of the technology to advanced development in a 6.3 PE and applicability of the technology to documented warfighter problems or requirements. Successful implementation of these categories would result in the application of a pass/fail metric and further evaluation for possible transition to a 6.3 development/demonstration program.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602114N / *Power Proj Applied Research*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	18.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.500

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** Additional funds will be utilized towards researching efforts to develop high energy weapons. These could potentially include Electromagnetic Railgun (EMRG) development and directed energy initiatives. Increased investments in the Electro Magnetic (EM) railgun would go towards the further development of a weapon which could be considered for multi-mission applications including USMC Naval Surface Fire Support, anti-surface warfare (ASUW) and ship self-defense from missiles and small boat threats. Funds used towards the development of Directed Energy (DE) technologies for Navy applications will go towards addressing requirements of future Navy combatants to provide ship defense against emerging threats that are proliferating throughout the Navies of the world.	0.000	13.500
Congressional Add: Force Protection Research ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** Investments in the Electro Magnetic (EM) railgun would go towards the further development of a weapon which could be considered for multi-mission applications including USMC Naval Surface Fire Support, anti-surface warfare (ASUW) and ship self-defense from missiles and small boat threats. Funds used towards the development of Directed Energy (DE) technologies for Navy applications will go towards addressing requirements of future Navy combatants to provide ship defense against emerging threats that are proliferating throughout the Navies of the world.	0.000	5.000
Congressional Adds Subtotals	0.000	18.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602114N / *Power Proj Applied Research*	**Project (Number/Name)** 9999 / *Congressional Adds*

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Interest Items not included in other Projects.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602123N *I Force Protection Applied Res*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	159.556	178.616	158.745	-	158.745	164.678	156.832	161.216	163.361	Continuing	Continuing
0000: *Force Protection Applied Res*	0.000	136.125	154.916	158.745	-	158.745	164.678	156.832	161.216	163.361	Continuing	Continuing
9999: *Congressional Adds*	0.000	23.431	23.700	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	47.131

A. Mission Description and Budget Item Justification

The efforts described in this program element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability. This is accomplished by improvements in platform offensive performance, stealth, and self-defense.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	163.660	154.963	146.800	-	146.800
Current President's Budget	159.556	178.616	158.745	-	158.745
Total Adjustments	-4.104	23.653	11.945	-	11.945
• Congressional General Reductions	-	-0.047			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	23.700			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.331	0.000			
• SBIR/STTR Transfer	-3.773	0.000			
• Program Adjustments	0.000	0.000	14.480	-	14.480

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602123N *I Force Protection Applied Res*			
• Rate/Misc Adjustments	0.000	0.000	-2.535	-	-2.535

Congressional Add Details ($ in Millions, and Includes General Reductions)

	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	4.061	3.700
Congressional Add: *Alternative Energy Research*	19.370	20.000
Congressional Add Subtotals for Project: 9999	23.431	23.700
Congressional Add Totals for all Projects	23.431	23.700

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602123N / *Force Protection Applied Res*	Project (Number/Name) 0000 / *Force Protection Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Force Protection Applied Res*	0.000	136.125	154.916	158.745	-	158.745	164.678	156.832	161.216	163.361	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability by virtue of improvements in platform offensive performance, stealth, and self-defense.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: AIRCRAFT TECHNOLOGY	52.311	68.537	65.452	0.000	65.452
Description: The Aircraft Technology activity develops technologies for reduced observables technology and enhanced capability of naval aviation aircraft platforms in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. It also develops new Naval air vehicle concepts and high impact, saleable naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tilt rotorsystems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. Variable Cycle Advanced Technology (VCAT) will identify and mature critical, relevant variable/adaptive cycle propulsion system technologies for the next generation carrier-based Tactical Aircraft (TACAIR)/Intelligence, Surveillance and Reconnaissance(ISR) systems. Autonomous Aerial Cargo/Utility System (AACUS) will develop advanced autonomous capabilities to enable rapid resupply of distributed forces in the short term. The Sea-Based Aviation National Naval Responsibility (SBA NNR) Structures and Materials program will develop the next generation structural capability and material response science for aircraft technology in fixed and rotary wing, manned and unmanned airframe technology to achieve reduced weight, increased durability, strength, streamlined manufacturability, reduced life-cycle cost and maintenance/readiness gaps improvements. Program payoffs include increased availability/readiness, reduced sustainment requirements, fatigue/loads life enhancement, reduced weight and improved range, and advanced prognostics design tools.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
These efforts addresses unique attributes to propulsion and power technologies for Naval Aviation, as well as those having higher importance to Naval Aviation and some that are more pervasive to all of military aviation. Related basic research efforts are addressed under 0601153N. The funding increase from FY 2015 to FY 2016 is due to the initiation of the joint Tern program and an increase in AACUS activities as the program enters phase 3. The funding decrease from FY 2016 to FY 2017 is due to maturation of AACUS technology applied research effort. ***FY 2015 Accomplishments:*** -Continue new efforts on high confidence/Safe Autonomous Control in naval environments and on supervisory control of decentralized heterogeneous UAS. -Continue SBA NNR related projects in Virtual Ship/Aircraft Dynamic Interface, Manned/Unmanned Handling Qualities and Control, Automated Deck Operations, High Lift Aerodynamics and Vertical/Short Takeoff and Landing (V/STOL) Operations. -Continue applied research efforts under the Sea-Based Aviation National Naval Responsibility Propulsion thrust area. -Continue development of rotorcraft/VTOL systems automated launch and recovery technology. -Continue mixed-mode mechanical/environmental failure prediction research. -Continue advanced composite durability technology. -Continue material degradation risk prediction and operational environment-driven materials selection methods. -Continue demonstration of initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS). -Continue the advanced technology demonstration portion of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts will begin with major engine manufactures and system contractors to develop/mature the highest priority, long-lead propulsion system technologies, including variable/ adaptive cycle engine components, for next generation carrier-based TACAIR/ISR systems. - Continue VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts through completion. - Continue to explore and evaluate future aircraft concepts and their associated enabling technologies. - Continue development of survivability/reduced observables technology. Metrics are classified.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate new efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned air systems/units. - Initiate airplane launch and recovery component and subsystem technology developments to enable medium size long endurance, long range UAVs to be launched and recovered on short deck ships. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, unless noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	2.507	2.532	2.527	0.000	2.527
Description: Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral electro-optical (EO), infrared (IR), radio frequency (RF), electro-magnetic (EM), visual and acoustic or chemical sensors/ biosensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multispectral detection and distribution of specific threat information. ***FY 2015 Accomplishments:*** Sensors & Associated Processing: -Continued Electrochemical sensors for the distributed, remote detection of explosives -Continued efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. -Continued efforts in biomimetic signal processing: panoramic periscope for submarines and temporal pattern recognition for Systems for Security Breaching Noise Detection. -Continued efforts in bioinspired quiet, efficient and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics. -Continued studies to develop catalytic activity profile of bioactive coatings against chemical agents.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Continued design and initiated fabrication of coatings to degrade both, chemical and biological agents. -Continued efforts to design microfabricated system for 3-color fluorescence measurements using integrated waveguides. -Continued effort to develop new, highly selective, preferential oxidation catalysts for the generation of power from the reformate gas purification process. -Continued effort to develop aspheric gradient index optics. - Completed development of distributed environmental microsensors for analyte dectection. - Completed a capability to examine via analysis and modeling protytype electronic attach concepts against radars in expanded spectral bands. - Initiated effort to develop an implosion-resistant hydrogen storage technology for use in undersea fuel cells. - Initiated development of wide area standoff detection of explosives ***FY 2016 Plans:*** Sensors & Associated Processing: - Continue all efforts of FY 2015, unless noted as completed above. ***FY 2017 Base Plans:*** Sensors & Associated Processing: - Continue all efforts of FY 2016, unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: ADVANCED ENERGETICS ***Description:*** Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems for both defensive and offensive applications. Efforts include: development of new fuels, oxidizers, explosive ingredients and formulations; and reliable simulation tools and diagnostics to develop and design superior-performance, and/or reduced-vulnerability systems tailored to specific warfighter missions. ***FY 2015 Accomplishments:*** - Continued process research and development of Ammonium Nitrotetrazolate-2N-oxide (AONT).	5.052	5.408	5.339	0.000	5.339

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue the processing optimization design of material compositions for Reactive Material explosive fragment applications. - Continued optimization and refinement studies of Poly NitratoOxetane (3-PNO) process for solid rocket motor propellants. - Continued the development of a reliable chemical scale-up and material specification process techniques. - Continued ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, letality models, and experiments). - Continued Advanced Energetics research in development and evaluation of advanced explosive/propellant/ reactive ingredients and formulations for the next generation higher performing systems. - Continued non-traditional energy conversion studies with columbic and cluster material investigations. - Continued Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. - Continued proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts. - Continued Advanced Energetics research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads. - Continued Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application - Continued research in technology development for the next generation reactive material warhead concepts formulations, material properties, and energy release experiments for highly reactive materials, high density reactive materials and novel reactive structural materials. Transition application specific target interaction, lethality modeling and ordnance specific experiments and demonstrations to Electromagnetic Rail Gun, PE 0603114N. - Continued development and evaluation of energetic ingredients and formulations for next generation higher performance applications. Concluded scale-up development and testing. - Continued the processing optimization design of material compositions for Reactive Material explosive fragment applications. - Continued ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, lethality models, and experiments)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued the development of a reliable chemical scale-up and material specification process techniques. - Completed Studies on MTX-1 (1-[(2E)-3-(1H-tetrazol-5-yl)triaz-2-en-1-ylidene] methanediamine), an additive to percussion primers. - Completed Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. - Completed process optimization of Ammonium Tetrakis (3,5-Dinitro-1,2,4-Triazolyl) Borate (ATDTB). - Initiated research on new caged nitramines - Initiated process research and development of 1,1'-Diamino4,4',5'5'-Tetranitro-2,2'-Biimidiazole (DATNBI) - Initiated process research and development of 1-Fluoro-4,5-Dinitroimidazole. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, unless noted as complete above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, unless noted as complete above. - Initiate electric on/off propulsion system studies for advanced solid and liquid rocket compositions - Initiate process research and development of Dihydroxylammonium Dinitramino Azoxy Furazan (DDAF) - Initiate process research and development of Ammonium-3,4,5,-trinitropyrazolate (ATNPz) - Complete ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, lethality models, and experiments) - Complete process research and development of 1,1'-Diamino4,4',5'5'-Tetranitro-2,2'-Biimidiazole (DATNBI) - Complete process research and development of 1-Fluoro-4,5-Dinitroimidazole. ***FY 2017 OCO Plans:*** N/A					
Title: SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E) ***Description:*** Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), and advanced naval power systems. Signature reduction addresses electromagnetic, infrared, and acoustic signature tailoring, both topside and underwater.	71.788	73.888	80.882	0.000	80.882

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Hydromechanics addresses hydrodynamic technologies, including the signature aspects of the hull-propulsor interaction and maneuvering. Distributed intelligence for automated survivability addresses both the basic technology of automating machinery control systems, as well as, distributed control of systems utilizing autonomy for mission context based reconfiguration. Unmanned Sea Surface Vehicle applied research includes short-term motion forecasting for recovery of USSVs on a host ship in higher sea states and determination of slamming loads on high-speed planing hulls for structural weight reduction. Advanced naval power systems efforts address electrical and auxiliary system and component technology to provide improvement in energy and power density, operating efficiency and recoverability from casualties. Advanced Naval Power efforts include: developing technologies to improve warfighting capability with more energy efficient systems; mitigate adverse impacts of alternative fuel on Naval platforms and equipment; and utilizing the Electric Ship Research and Development Consortium (ESRDC) efforts to develop modeling and simulation tools to provide critical design & operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, reduce risk of new technology insertion and address the national shortage of electrical power engineers. Long Endurance UUV technologies will deliver to the Office of Naval Research modular fuel cell systems for UUVs, including practical systems demonstrations, and a path forward for future developments. It will also keep the US Navy at the forefront of advanced electric propulsion technologies. The funding increase from FY 2015 to FY 2016 is due to the initiation of a new Leap Ahead effort called Medium Displacement Unmanned Surface Vehicle (MDUSV) program.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The funding increase from FY 2016 to FY 2017 is due to the ramping up of the MDUSV program and the Applied Research Challenge (ARC) effort. ***FY 2015 Accomplishments:*** Survivable Platforms - Reduced Signatures: - Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines. - Continued Alternating Current (AC) propagation experiments. - Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques. - Continued development of quiet control surface design tool based on control surface flow noise studies. - Continued IR and radar detectability prediction capability. - Continued surface ship super-conductive degaussing with laboratory demonstration loop for Electromagnetic (EM) field accuracy measurements and control methods. - Continued testing on Advanced Electric Ship Demonstrator (AESD) to assess energy propagation and acoustic radiation mechanisms and to develop mitigation concepts for surface ships. - Continued Improved Corrosion Related Magnetic (CRM) Field Prediction Model to design compensation systems to reduce ship's CRM signature. - Continued assessment of ship bi-static Radar Cross Section (RCS). - Continued large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion. - Continued experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction. - Continued development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures. - Continued investigation into hull treatment concepts for acoustic signature/vibration control for surface ships. - Continued development of signature modeling approaches for electric actuation and alternate electric drive system architectures. - Continue development of Low Probability Intercept (LPI) technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems. - Continued advanced EM modeling tools development and validation. - Continued modeling of hydroacoustics of turbulence-propulsor interaction.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue joint effort with UK/MoD on adhesively joined aluminum in lieu of welding of marine structures and thus reduce cost. - Continued joint effort with the Netherland Royal Navy (NLRN) on adhesive joined composite to metals in lieu of bolting of marine structures and thus reduce cost for topside structures. - Continued efforts on shock mitigation and shock diversion for ship hulls to reduce cost of machinery mounts and equipment, based on successful results from the Explosion Resistant Coatings (ERC) helmets for protection against Traumatic Brain Injury (TBI) - Continued utilization of condition-based maintenance systems for platform underwater signature assessment. - Continued development of signature monitoring and management capability of a surface ship propulsion system for underwater acoustic signatures. - Continued development of global optimization of damped structures. - Continued development of non-intrusive sensing method to measure component acoustic signatures. - Continued to develop improved processing techniques for acoustics experiments. - Continued development of a prediction and monitoring tool for underwater signatures. - Completed mmWave Signatures measurement to identify key signature characteristics. - Completed IR assessment of two advanced treatments. - Completed first of a series of IR validation experiments and critical sensitivity analysis. - Completed development of advanced RF metamaterials for platform signature control. - Completed next generation deckhouse integration technology development. Survivable Platforms - Hull Life Assurance: - Continue efforts on combinations of highly rate-sensitive materials through experiment and modeling for extreme hyper velocity threat conditions. - Continued development of global surface wave measurement capability for ship models. - Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy). - Continued development of structural analysis codes describing failure mechanism of sandwich composites. - Continued Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia. - Continued composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures. - Continued effort on an advanced class of polymers as a follow-on to current ERC for application against advanced threats. - Continued Payload Implosion and Platform Damage Avoidance efforts.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of advanced analytical, numerical and experimental methods in support of platform signature reduction. - Continued effort on exploitation of polymers for the deflection and dissipation of shock wave impact on ship and submarine hull structures. - Continued development of lightweight low-cost protection system for specific platforms for protection against specific large threats). - Continued development of lightweight protection system for vehicles (MTVR) for protection against specific small arms and IEDs for the Explosion Resistant Coatings (ERC) program. - Continued Ship modifications using blisters for application to DDG51 Flight III to gain larger displacement for AMDR and at the same time achieve higher fuel efficiency. Survivable Platforms - Distributed Intelligence for Automated Survivability: - Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems. - Continued research into advanced HM&E system reconfiguration approaches, including agent-based control systems and algorithms, and model-based reasoning. - Continued demonstration of Genetic Algorithm(s) for determining optimal distributed system control strategy. - Continued development of Survivability Analysis Algorithms Operable on a Total Ship Modeling Environment. - Continued the transition of the small scale hardware-in-the-loop demonstrator to the academic community for challenge problem formulation. - Continued demonstration of the developed model based reasoning control algorithms on full scale hardware test beds. - Continued development of underwater signature modeling. Advanced Platforms - Advanced Platform Concepts and Designs: - Continued validation of asymmetric hull forms with experimental data. - Continued development of analytical models to further define submarine modular hull concepts. - Continued development of reliability based design and structural analysis code development. - Continued development design tools for integrated antenna and composite topside. - Continued circulation control analysis for three-dimensional flow effects. - Continued aperstructures microwave communication system. - Continued concept for Ultra High Frequency (UHF)/Very High Frequency (VHF) aperstructures opportunistic array (Advanced Hull-form Inshore Demonstrator - AHFID).					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of methods for determining reliability and vulnerability of aluminum ship structures. - Continued large scale demonstration efforts of advanced mitigation technologies. Advanced Platforms - Hydromechanics: - Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback). - Continued the validation of circulation control and advanced control surfaces with experiments. - Continued to investigate improved maneuvering simulation capability for submarines. - Continued numerical prediction method(s)of waterjet cavitation. - Continued modeling and simulation of rough-wall boundary layer noise. - Continued development of podded propulsor design/analysis tools. - Continued prediction and validation of damaged stability and capsize. - Continued non-body-of-revolution tool development for advanced submarine configurations. - Continued the multi-platform interaction analysis and tool development. - Continued modeling of performance of composite propellers in extreme maneuvers. - Continued cavitation erosion modeling on compliant surface. - Completed waterjet efforts, including two-phase waterjet development and RANS code development and validation efforts. - Initiated a research on design/analysis methods of ice-capable propellers. - Initiated a research on the effect of propeller on bubbly flows. Advanced Naval Power Systems: - Continued effort to integrate front-and back diamond with high current GaN power switches for advanced thermal management. - Continued SIC GTO thyristor designs and testing apparatus to increase the turn-on di/dt and reliability for pulsed power. - Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonai-electrical-power system that reconfigures within 10 milliseconds.- Continued designing software for the system manager for the Universal Control Architecture (UCA). - Continued development of thermal management technology for shipboard power distribution. - Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued improvements in electrical component and device technology allowing a reduction in motor propulsion and motor controllers weight and volume. - Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation. - Continued studies of alternative cooling systems for future shipboard radar systems. - Continued control surface actuator project focused on the technologies needed to define the design space for control surface actuators supporting submarines. - Continued development of automated HVAC system architectures for future Naval platforms. - Continued ship service fuel cell development. - Continued program to develop and demonstrate 3 - 50 kW class solid oxide fuel cell onboard mobile power generation capabilities having compatibility with future logistics fuels to enable rapid recharge of batteries and direct power for C4ISR equipment. - Continued analytical model and reduced scale component development of power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers focusing on closing technology gaps associated with Alternative Integrated Power System (IPS) Architectures. - Continued studies of advanced heating, ventilation, and air-conditioning architectures, including studies of alternative (nonvapor-compression) refrigeration systems and concepts for waste heat reuse, to enhance ship cooling and provide thermal energy storage. - Continued research into the development of fuel chemistries, materials, and energy conversion technologies for optimal performance in Naval power systems. - Continued development of robotic Hull BUG and coating technologies to reduce hull biofouling over current Navy operating conditions which will reduce drag and provide significant power/fuel/cost savings. - Continued development of fuel cell components needed to make robust, compact, lightweight fuel cell systems for use in unmanned vehicles. - Continued development of low cost, light weight, flexible solar cells. - Initiated effort to make significant impact in high voltage power electronics technology to enable compact power converters, medium voltage distributed power architectures, new weapons and sensor systems for Navy and Marine applications. Surface Ship & Submarine HM&E Applied Research: - Continued efforts to implement the results from hybrid composite blisters /appendages and their effect on ship drag resistance and fuel saving performance, motion and stability in ship models to verify computations and adapt shapes of appendages.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued to increase emphasis of the Science Advisor engagement within the joint S&T community across DOD, which will focus on addressing the operational and strategic needs of the Fleet. - Continued applied research into short-term motion forecasting for recovery in higher sea states. - Continued applied research into determination of slamming loads on high-speed planing hulls for structural weight reduction. - Initiated the ONR Applied Research Challenge (ARC) to stimulate new, high-risk applied research projects in areas not currently addressed by the current ONR core applied research programs. - Initiated efforts to implement the results from hybrid composite blisters/appendages and their effect on ship drag resistance and fuel saving performance, motion and stability in ship models to verify computations and adapt shapes of appendages. Advanced ASW Surveillance: - Initiated development of Long Endurance UUV technologies. Counter Improvised Explosive Devices: - Continued efforts to expand counter-improvised explosive devices (C-IED) enhancement to support urgent operational needs. - Continued research to analyze and understand enemy threat organizations and networks (both cultural networks and IT networks) - Continued research in directed energy weapons with the goal of reducing size, weight, and power requirements for systems in the detection and neutralization of IEDs. - Continued research in the mitigation of CIED effects (blast, blunt trauma, ballistics) on personnel. - Completed effort to develop transparent armor using flawless glass. - Completed effort on the studies of antennas for high powered microwaves and radio frequency applications. - Initiated research in Route Reconnaissance and Clearance methodologies to provide standoff detection, neutralization, and marking of buried and surface laid, on and off route, pressure plate, command wire and radio frequency initiated explosive obstacles using directed energy and mechanical means on autonomous or semi autonomous platforms Signature reduction - Initiated study of graphene based magnetic tunnel junctions					
FY 2016 Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Survivable Platforms - Reduced Signatures: - Continue all efforts of FY 2015. - Initiate planning at-sea experiments to determine principal offenders for small craft airborne and underwater acoustic signatures. - Initiate development of high fidelity airborne acoustic propagation and detection model for surfzone and littoral detection of small craft. - Initiate development of radar absorbing ballistic composite materials for small craft hull and superstructures. Survivable Platforms - Hull Life Assurance: - Continue all efforts of FY 2015, unless noted as completed above. Survivable Platforms - Distributed Intelligence for Automated Survivability: - Continue all efforts of FY 2015, unless noted as completed above. Advanced Platforms - Advanced Platform Concepts and Designs: - Continue all efforts of FY 2015, unless noted as completed above. - Initiate activities in understanding platform modification for greater access in polar environments. Advanced Platforms - Hydromechanics: - Continue all efforts of FY 2015, unless noted as completed above. - Initiate efforts to model platform performance and stability as well as propulsor performance in ice environments. Advanced Naval Power Systems: - Continue all efforts of FY 2015, unless noted as completed above. - Complete effort to integrate front- and back-side diamond with high current GaN power switches for advanced thermal management. - Complete SiC GTO thyristor designs and testing apparatus to increase the turn-on dI/dt and reliability of SiC GTOs for pulsed power. Surface Ship & Submarine HM&E Applied Research: - Continue all efforts of FY 2015, unless noted as completed above.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Medium Displacement Unmanned Surface Vessel (MDUSV) program applied research supporting a highly autonomous control and payloads supporting mine warfare, anti-submarine warfare and electronic warfare. Counter Improvised Explosive Devices: - Continue all other efforts of FY 2015, unless noted as completed above. Applied Research Challenge (ARC): - Continue all base program efforts initiated in FY 2015 including network information sciences, long-range high-resolution imaging, ocean surface scatter in RF propagation, wake measurement technologies, thermal management systems, high power control modules for ship application, decision support / uncertainty analysis for operational environments, and reactive composite materials. Signature reduction - Continue all efforts of 2015, unless noted as completed above.					
FY 2017 Base Plans: Survivable Platforms - Reduced Signatures: - Continue all efforts of FY 2016, unless noted as completed above. - Complete large scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion - Complete investigation into hull treatment concepts for acoustic signature/vibration control for surface ships. - Complete development of signature modeling approaches for electric actuation and alternate electric drive system architectures. - Complete utilization of condition-based maintenance systems for platform underwater signature assessment. - Complete development of non-intrusive sensing method to measure component acoustic signatures. Survivable Platforms - Hull Life Assurance: - Continue all efforts of FY 2016, unless noted as completed above. - Complete Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia - Complete composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Explosion Resistant Coatings (ERC) effort with TTCP countries. - Initiate development of testing methodologies to validate computational codes and constitutive models for glassy materials. Survivable Platforms - Distributed Intelligence for Automated Survivability: - Continue all efforts of FY 2016, unless noted as completed above. Advanced Platforms - Advanced Platform Concepts and Designs: - Continue all efforts of FY 2016, unless noted as completed above. - Initiate activities in understanding platform modification for greater access in polar environments. Advanced Platforms - Hydromechanics: - Continue all efforts of FY 2016, unless noted as completed above. - Initiate efforts to model platform performance and stability as well as propulsor performance in ice environments. Advanced Naval Power Systems: - Continue all efforts of FY 2016, unless noted as completed above. - Complete effort to integrate front- and back-side diamond with high current GaN power switches for advanced thermal management. - Complete SiC GTO thyristor designs and testing apparatus to increase the turn-on dI/dt and reliability of SiC GTOs for pulsed power. - Complete development of robotic Hull BUG and coating technologies to reduce hull biofouling over current Navy operating conditions which will reduce drag and provide significant power/fuel/cost savings. Surface Ship & Submarine HM&E Applied Research: - Continue all efforts of FY 2016, unless noted as completed above. Counter Improvised Explosive Devices: - Continue all efforts of FY 2016, unless noted as completed above. - Complete efforts to expand counter-improvised explosive devices (C-IED) enhancement to support urgent operational needs.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete research to analyze and understand enemy threat organizations and networks (both cultural networks and IT networks) - Initiate research and development of modular, reconfigurable, integrated multi-modal stand-off detection and neutralization of explosive hazard (IED & Mines) system. Applied Research Challenge (ARC): - Continue all base program efforts initiated in FY 2016 including network information sciences, long-range high-resolution imaging, ocean surface scatter in RF propagation, wake measurement technologies, thermal management systems, high power control modules for ship application, decision support/uncertainty analysis for operational environments, and reactive composite materials. ***FY 2017 OCO Plans:*** N/A					
Title: NAVAL RESEARCH ENTERPRISE	4.467	4.551	4.545	0.000	4.545
Description: The IAR R2 activity was stood up in FY 2013 as the Naval Research Enterprise (NRE) to consolidate all NRE related IAR investments. Projects funded in this R2 Activity are intended to be approximately 2-3 years in length. Based on historical trends approximately 30% of these projects will turn over each year. The Naval Research Enterprise (NRE) encompasses the Independent Applied Research (IAR) efforts focused on solving a wide range of Naval Science and Technology (S&T) fleet issues utilizing unique Naval Warfare Center (WC) laboratory capabilities. Efforts under this activity address the full spectrum of the DON S&T Strategic Plan technology using focus areas which engage Naval aviation, sea surface, undersea, space, weapons, communication, information, and human systems. The IAR Program provides participating WCs with in-house funding for applied research to support the execution of their assigned missions by: -Developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems. -Promoting the hiring and development of talented new scientists and engineers (S&E) with the insurance of proper mentoring with senior personnel. -Encouraging collaboration with universities, private industry, and other Navy and Department of Defense laboratories. Funded projects are chosen through rigorous internal competition by each WC's selection committee and typically last two to three years. IAR projects are generally designed to promote investment in high-risk/high-					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
payoff research and also allow young S&Es to manage Navy relevant research projects. A limited number of successful efforts developed under the In-House Laboratory Independent Research (ILIR) basic research Program Element 0601152N are matured and further developed under the IAR program with the goal of transitioning these technologies to the warfighter. ***FY 2015 Accomplishments:*** - Continued research for the repair and repair process of Navy aircraft and ship alloys such as titanium and high-strength low-alloy steels, composites, and metamaterials. - Continued research for highly accurate autonomous unmanned undersea vehicles (UUV) communication and navigation. - Completed research for the repair and repair process of Navy aircraft and ship alloys such as titanium and high-strength low-alloy steels. - Completed research for warfighter performance predictions utilizing cognitive information and other human factors to enhance training experience and outcome. - Completed research on the effects of CMAS (Sand Dust) in Ceramic Matrix Composites (CMCs) to characterize CMAS and CMAS/salt effects in gas-turbine grade engine environments. - Completed research on the development and characterization of exploding ink. - Completed research on advanced submarine air purification. - Completed research on large-eddy simulations of advanced propulsion technology for UAV weapon systems. - Completed research on a metamaterial-based buoyant cable antenna with non-uniform loading. - Completed research of a bioluminescence system for submerged vehicles. - Inititated FY 2015 projects. ***FY 2016 Plans:*** - Continue all efforts of 2015, less those noted as completed above. - Complete all two year efforts started in FY 2015 and three year efforts started in FY 2014. Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE: - Complete research on Bio-inspired Broadband Sonar System for High-resolution Acoustic Imaging Applications. - Complete research on Advanced Infrared Suppressor. - Complete Determining R-45M Prepolymer Characteristics that Optimize Propellant Cure and Mechanical Properties.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Development of Novel Propellants and Explosives Using Resonant Acoustic Mixing (RAM) Technology. - Complete study of the Electromagnetic Probability-of-effect Assessment Tool (EMPAT) for High-Power HERO/ EMV Test and Evaluation . - Complete Examination of Human Performance Characteristics using Eye-tracking and 3D Motion Capture Gaze Supported Gestures. - Complete research on Extended Object Tracking in Clutter with Exploitation of Doppler Measurements and Multi-Scan Detection Clustering. - Complete Research on Geospatial and Temporal Anomaly Detection using Scalable Cloud-Based Algorithms - Complete Improving Damage Tolerance Thresholds and Energy Absorption Capacities in Laminated Woven Composites using Crimp Imbalance and Crimp Imbalance Gradients - Complete Nondestructive Evaluation (NDE) Enhanced Accelerated Life Testing (ALT). - Complete Synthesis and Characterization of Novel Reactive Materials by Mechanical Alloying. - Complete Smoothed Particle Applied Mechanics research. - Initiate FY 2016 projects. ***FY 2017 Base Plans:*** - Complete FY 2015 IAR projects which were three years in duration. - Continue IAR projects initiated in FY 2016. - Initiate FY 2017 IAR projects that are intended to be approximately three years in length. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	136.125	154.916	158.745	0.000	158.745

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

E. Performance Metrics

This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs. Efforts funded in this PE also include energy programs in support of SECNAV energy goals and efforts in support of the Ohio Replacement program.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602123N / *Force Protection Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	23.431	23.700	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	47.131

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase	4.061	3.700
FY 2015 Accomplishments: -Continued and expanded on-going competitive award efforts that improve lithium-ion battery safety, including non-flammable electrolytes and safer cell technology, to enable broader adoption for a variety of Navy applications. -Continued and expanded on-going competitive award efforts organo-polymer materials for capacitive energy storage and low-cost photovoltaic materials and devices.		
FY 2016 Plans: -Continue promising energy storage and power generation research that supports the program goal. -Expand the portfolio of materials and architectures to address Naval needs through additional competitive awards.		
Congressional Add: Alternative Energy Research	19.370	20.000
FY 2015 Accomplishments: - Continued microgrid analyses at Naval Facilities in Hawaii to increase energy security for critical infrastructure and to determine capabilities needed for effective base-to-utility interconnect under conditions of high-penetration of renewables. - Commissioned a new hydrogen fueling station at Marine Corp Base Hawaii (MCBH). - Continued heat exchanger material corrosion evaluation and process control evaluations for Ocean Thermal Energy Conversion (OTEC) systems. - Provided Naval Facilities with sea-water air condition (SWAC) cost and performance analysis using new modeling tools. - Continued development of sophisticated hydrodynamic tools for design of high performance, high efficiency hull forms for naval ships and craft. - Continued evaluation of grid frequency control techniques using grid frequency response and battery state-of-charge algorithms for lithium-titanate battery system, demonstrating 40% reduction in frequency variability on grid with high-penetration of wind power, and initiated similar battery approaches at grid locations with high-penetration of photovoltaics.		

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
- Completed evaluation of General Motors Equinox Fuel Cell Electric Vehicles (FCEVs) for non-tactical vehicle use at Naval Facilities in Hawaii. - Initiated support for wave energy system environmental characterization and modeling. - Initiated hydrogen fuel cells research for operations in harsh environments including unmanned vehicles. - Initiated support for energy storage technologies to mitigate the impact of renewables on grid stability. ***FY 2016 Plans:*** - Continue microgrid analyses at Naval Facilities in Hawaii to increase energy security for critical infrastructure and to determine capabilities needed for effective base-to-utility interconnect under conditions of high-penetration of renewables. - Continue heat exchanger material corrosion evaluation and process control evaluations for Ocean Thermal Energy Conversion (OTEC) systems. - Continue development of sophisticated hydrodynamic tools for design of high performance, high efficiency hull forms for naval ships and craft. - Continue support for wave energy system environmental characterization and modeling. - Continue hydrogen fuel cells research for operations in harsh environments including unmanned vehicles. - Continue support for energy storage technologies to mitigate the impact of renewables on grid stability. - Complete evaluation of grid frequency control techniques using grid frequency response and battery state-of-charge algorithms for lithium-titanate battery system, demonstrating 40% reduction in frequency variability on grid with high-penetration of wind power, and initiated similar battery approaches at grid locations with high-penetration of photovoltaics.		
Congressional Adds Subtotals	23.431	23.700

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Congressional Interest Items not included in other Projects.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602131M *I Marine Corps Lndg Force Tech*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	44.629	51.643	51.590	-	51.590	53.936	57.036	57.036	51.036	Continuing	Continuing
3001: *Marine Corps Landing Force Tech*	0.000	44.629	45.643	51.590	-	51.590	53.936	57.036	57.036	51.036	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare. This PE also directly supports Expeditionary Force 21 (EF 21), which is now the Marine Corps' capstone concept that establishes the vision and goals for USMC S&T over the next 10 years and provides a plan for guiding the design and development of the future force. One third of the Marine Corps operating forces will be forward deployed. These forces will be task-organized into a greater variety of formations, capable of operating from a more diverse array of ships dispersed over wider areas, in order to meet the Combatant Commanders' security cooperation and partner engagement requirements. In the event of crises, those forces will be able to composite these distributed formations into larger, cohesive naval formations. This presents both challenges and opportunities for USMC S&T. Expeditionary Force 21 will inform future decisions regarding how the Marine Corps will adjust organizational structure to exploit the value of regionally focused forces. A fixed geographic orientation will facilitate Marine Commanders and their staffs with more frequent interactions with theater- and component-level organizations, establishing professional bonds and a shared sense of the area's challenges and opportunities. Expeditionary Force 21 provides the basis for future Navy and Marine Corps capability development to meet the challenges of the 21st Century. The vision for Expeditionary Force 21 is to provide guidance for how the Marine Corps will be postured, organized, trained, and equipped to fulfill the responsibilities and missions required around the world. Through Expeditionary Force 21, the Marine Corps intends to operate from the sea and provide the right sized force in the right place, at the right time.

This PE is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts, Technology Assessment and Roadmapping, and the Littoral Combat/Power Projection (LC/PP) FNC. The primary objective of this PE is to develop and demonstrate the technologies needed to meet the Marine Corps unique responsibility of training and equipping the Marine Air/Ground Task Force (MAGTF) for Expeditionary Maneuver Warfare. In the post-September 11 world, irregular warfare (IW) has emerged as the dominant form of warfare confronting the United States, its allies and its partners; accordingly, this PE has been structured to account for distributed, long-duration operations, including unconventional warfare, counterterrorism, counterinsurgency, and stabilization and reconstruction operations. IW emphasizes the use of indirect, non-conventional methods and means to subvert, attrite, and exhaust an adversary, or render irrelevant, rather than defeat him through direct conventional military confrontation. IW is now institutionalized in Marine Corps planning, investment, and capability development. This PE provides the knowledge base to support Advanced Technology Development (6.3) and is the technology base for future expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command (MCCDC) and responds

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602131M *I Marine Corps Lndg Force Tech*

directly to the Marine Corps Science and Technology (S&T) process as well as supporting related Littoral and Expeditionary Maneuver Warfare capabilities developed by the Navy's Mission Capability Program. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The FNC program explores and demonstrates technologies that enable Sea Strike, Sea Shield, Sea Basing, FORCEnet and Force Health Protection pillars, Space, Naval Expeditionary Maneuver Warfare and the Enterprise and Platform Enablers. The FNC program comprises Enabling Capabilities (ECs) which develop and deliver quantifiable products (i.e., prototype systems, knowledge products, and technology improvements) in response to validated requirements for insertion into acquisition programs of record after meeting agreed upon exit criteria within five years. The core 6.2 program also supports Discovery and Invention (D&I) and Innovation and Transformation (I&T). Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by the Sea Power 21 Pillars, as well as enable Ship to Objective Maneuver (STOM), Persistent Intelligence, Surveillance and Reconnaissance and Overseas Contingency Operations (OCO). The Marine Corps Service Campaign Plan (MCSCP, guided by the Commandant's Planning Guidance, is the lens through which USMC S&T priorities are acted upon to guide the future development of the Total Force.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	45.782	49.001	49.590	-	49.590
Current President's Budget	44.629	51.643	51.590	-	51.590
Total Adjustments	-1.153	2.642	2.000	-	2.000
• Congressional General Reductions	-	-0.065			
• Congressional Directed Reductions	-	-3.293			
• Congressional Rescissions	-	-			
• Congressional Adds	-	6.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.153	0.000			
• Rate/Misc Adjustments	0.000	0.000	2.000	-	2.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Cyber Research*	0.000	6.000
Congressional Add Subtotals for Project: 9999	0.000	6.000
Congressional Add Totals for all Projects	0.000	6.000

Change Summary Explanation

Technical: Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602131M *I Marine Corps Lndg Force Tech*

Schedule: Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602131M / *Marine Corps Lndg Force Tech*	Project (Number/Name) 3001 / *Marine Corps Landing Force Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3001: *Marine Corps Landing Force Tech*	0.000	44.629	45.643	51.590	-	51.590	53.936	57.036	57.036	51.036	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is organized into nine activities, which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts, Technology Assessment and Roadmapping; and the Littoral Combat/Power Projection (LC/PP) FNC. The seven Expeditionary Warfighting Areas support the Discovery and Invention (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: FIREPOWER	4.781	5.027	6.550	0.000	6.550
Description: This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: Fuze, fire control, launch/ propulsion, lethality, and accuracy. The FY2016 to FY2017 increase in the Firepower Activity is for the increased efforts in High Reliability Dual Purpose Improved Conventional Munitions (DPICM) Replacement (HRDR) to include projectile integration, lethality enhancement, fuze setting integration and aerodynamic and aerospace technologies. ***FY 2015 Accomplishments:*** - Continued development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space. - Continued investigation of the scalability of variable effects conventional munitions and gun technology for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare. - Continued development of precision fires engagement technologies, to include trajectory shaped 81mm mortars, 83mm missiles, and smaller precision munitions. - Continued design and development of lightweight technologies to provide individual Marines enhanced capabilities to detect and identify man-sized targets at least out to the maximum effective ranges of their individual weapons, during all conditions (daylight, limited visibility, & darkness), by integrating multiple optics capabilities into a single system. - Continued Semi-Autonomous Fires Technology.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view. - Continued Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions. - Continued Caseless, Lightweight, Low-volume Round (CLLVR) to develop lightweight, small caliber ammunition for individual, crew served, and remotely mounted weapons. - Continued Disruptive Energetic Materials (DEM) to exploit nano-energetics developments for significant enhancement of explosive yield per warhead mass and volume. - Completed development of collaborative fires coordination technologies. - Completed expanded efforts in lightweight weapons and ammunition (crew served weapons, small arms ammunition, and packaging), to include Caseless (CL) Ammunition. This includes priority USMC fires efforts in Micro-electromechanical Systems (MEMS) Safe and Arm (S&A), to develop a Military Standard (MilStd) 1316 compliant S&A for incorporation into developmental precision 81mm mortar munitions and MEMS Initiation Safety Device (ISD), to develop MilStd 1901A compliant igniters for current and developmental weapons propulsion systems as well as a Revolutionary Target Effects project, to develop conventional warhead concepts for breaching specific urban targets. - Completed Targeting & Engagement and Precision Target Location efforts that include Non-Magnetic Azimuth Sensing (NMAS) Technology by transitioning to the AIM Future Naval Capability project. - Completed (E&D) portion of NMAS Technology development to reduce size, weight and power (SWaP) while increasing performance by transitioning to the AIM Future Naval Capability project. - Completed Hypervelocity Gun Propulsion project, to investigate hypervelocity gun technologies for Marine expeditionary weapons systems as possible artillery, tank main gun, and/or naval surface fire support replacement systems. - Completed Advanced Sensors Applications (ASA) to develop Short Wave Infrared (SWIR) imagers for guided munitions seekers.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Complete Disruptive Energetic Materials (DEM) to exploit nano-energetics developments for significant enhancement of explosive yield per warhead mass and volume.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space. This program will transition to the Future Naval Capabilities program. - Initiate High-Reliability Dual Purpose Improved Conventional Munitions (DPICM) Replacement (HRDR) to develop high-reliability sub-munitions fuzing technologies. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions. - Initiate development of concept for thin film materials to thermally mask equipment and munitions and provide counter rocket, artillery, and mortars (C-RAM) capability for future munitions. - Initiate development of concepts for a 155mm mortar or self-propelled Howitzer that would utilize existing stockpiles of 155mm artillery ammunition. ***FY 2017 OCO Plans:*** N/A					
Title: FORCE PROTECTION	5.294	5.567	6.090	0.000	6.090
Description: This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Explosive Hazard avoidance, detection, breaching/neutralization, marking and analysis; Air Defense/Counter Rocket, Artillery, and Mortars; Counter tactical surveillance and targeting, and technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast, ballistic and blunt impact threats. ***FY 2015 Accomplishments:*** - Continued development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO) (Transitioned from Maneuver activity). - Continued development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection (Transitioned from Maneuver activity). - Continued technology development programs to address force protection personal protective equipment capability gaps (Transitioned from Maneuver activity).					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event. - Continued the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform from an effort that was initiated in FY 2011 due to an urgent operational need. - Continued a program to determine the feasibility to detect and neutralize anti-helicopter mine threat. - Continued the refinement and improve current suite of advanced biomechanical instrumentation to assess potential reductions of Warfighter mobility and functionality caused by PPE systems. - Continued the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass). - Continued program to study the fundamental sciences of homemade explosives due to urgent operational needs. - Continued broad based material (ceramics, fiber and fiber re-enforced plastics) studies so that significant weight reductions (greater than 50%) can be achieved. - Continued studies to improve ballistic and blast armor material and systems models so that novel concepts can be evaluated and material property characteristics which provide the necessary improvements can be identified prior to significant monetary investments. - Continued modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters. - Continued a program to develop modular mission packages for the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Continued a program to study the use of autonomous vehicles in the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Completed a study regarding the feasibility of detecting and locating sniper weapons using the return of their unique radar signatures that was initiated in FY 2011 due to operational urgency. - Completed spectral signature classification efforts for Mine Counter Measure (MCM) applications (Transitioned from Maneuver activity). - Completed the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame. - Completed a scientific study of laser technology readiness, performing technology roadmapping, and conducting system level simulations. This effort was initiated in FY 2011 due to an urgent operational need.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
This effort continues in FY 2012 and will assess the suitability of lasers on the battlefield and drive future HEL technology investment plans and support the acquisition process. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete a program to study the fundamental sciences of homemade explosives due to urgent operational needs. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event. - Complete the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc.) from a moving platform. - Complete the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass). - Initiate the study of technologies to enable detection of explosive hazards and surveillance/targeting systems in complex environments such as jungles and the littoral environment. ***FY 2017 OCO Plans:*** N/A					
Title: FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING	1.309	1.426	1.532	0.000	1.532
Description: This activity supports the planning and integration of technology development efforts across the entire PE. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced warfighting are developed and validated. Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this PE. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant technology investment strategy is developed and used to guide out-year technology development efforts. ***FY 2015 Accomplishments:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued planning and integration of technology development efforts to meet imposing security threats that challenge our Nation. - Continued a careful analysis of trends that can identify emerging changes in the security environment that are likely to have significant implications for U.S. ground forces. The output will be used to reduce risk and hedge against the surprises that will inevitably occur. - Continued a review and assess the Marine Corps' required surface connector capabilities specifically exploring promising and relevant research, technologies, capabilities and opportunities by which the Marine Corps can anticipate and identify potential solutions that meet the service's surface connector requirements. - Completed assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad. - Completed assessments in Asymmetric/Irregular Warfare and Distributed Operations. - Completed a Cargo Unmanned Aerial study focused on Ship-to-Objective Maneuver (STOM) and developmental technologies for expeditionary operations, to include ground autonomous capabilities. - Completed an assessment of the S&T impacts of the Marine Corps concept of force employment to meet the need for counterinsurgency and building partnership capacity. How the Marine Corps will support the National Defense Strategy (NDS) and multinational efforts in the Global War on Terrorism/Long War will have long-term S&T impacts. - Completed an assessment of Unmanned Ground Systems Affordability, Experimentation and Rapid Prototyping Investments and formulate a USMC S&T future strategy. - Completed an effort focused on the suitability of lasers on the battlefield and formulated future High Energy Laser technology investment plans that support the acquisition process. - Initiated a technology assessment for a Cyber/Electronic Warfare Coordination Cell (CEWCC) to enable seamless integration of kinetic and non-kinetic fires during expeditionary operations.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Complete a careful analysis of trends that can identify emerging changes in the security environment that are likely to have significant implications for U.S. ground forces. The output will be used to reduce risk and hedge against the surprises that will inevitably occur. - Initiate a review and assessment of Expeditionary Force 21. This new USMC concept describes how the Marine Corps must deploy and operate, and what force attributes will be required. This study will describe Expeditionary Force 21 implications for S&T. Nested directly under Cooperative Strategy 21 (Naval Strategy),					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Expeditionary Force 21 covers a 10-year planning horizon that informs, and is informed by, other USMC concepts and documents. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete a technology assessment for a Cyber/Electronic Warfare Coordination Cell (CEWCC) to enable seamless integration of kinetic and non-kinetic fires during expeditionary operations. ***FY 2017 OCO Plans:*** N/A					
Title: HUMAN PERFORMANCE, TRAINING AND EDUCATION	4.829	5.078	4.920	0.000	4.920
Description: This activity addresses the applied research effort of the Human Performance Training and Education thrust (HPT&E). The HPT&E thrust investment profile is directed at two technology investment areas, Warrior Resilience, and Decision Making and Expertise Development. The funding aligned to Warrior Resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Those funds aligned to Decision Making and Expertise Development refers to training and education technologies and methodologies that accelerate the development and improve the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. ***FY 2015 Accomplishments:*** - Continued studies into next generation physical performance enhancement methodologies and technologies (enhanced warfighter psycho-physical performance). - Continued research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems. - Continued the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert. - Completed research into a multi-modal framework for assessing stress resiliency; develop, test and evaluate non-contact, video and audio-based human response measures for use in detecting degree and type of stress for eventual integration into a resiliency training program. - Completed research into methodologies for assessing training and for training adaptability, identifying key salient components of adaptive behavior for Warfighter tactical tasks; research into the development of a					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
generalized framework for adaptive behavior that can be applied to any appropriate tactical task, and the creation of methodologies for training interventions that demonstrates the feasibility of using virtual training experiences to accelerate the development of adaptive decision-making expertise. - Completed evaluations of asymmetric distributed learning techniques for distributed operations, language, and cultural training. - Completed additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations). - Completed a Mind-Body Integration Systems effort to improve team training by developing and validating Electroencephalogram (EEG) (and other physiological and performance measures) for use in assessing team performance, coordination, and cohesion in training environments. - Completed Advanced Mobile Assessment and Field Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile, rugged tools, algorithms, and models. - Completed additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit. - Completed development of team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise. - Completed development of team training/immersive approaches towards language and culture training that incorporate foundational learning theories and other advanced educational methods. - Completed development of squad-level team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise. - Completed development of field team performance mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise. - Completed research into cold tolerance biomarkers for the individual warfighter. - Completed research into Acclimatization Strategies for Optimized Performance at Altitude, drawing on findings from previous research done in the field. - Completed research into mobile brain imaging to enhance warfighter performance. - Completed research into haptic solutions for immersive training environments. - Completed research into skills retention technologies, advancing the Smart Tutoring System. - Completed research into tools for distributed training (trend analysis). - Completed research into the architecture for stress, performance, inoculation, resilience, and endurance (ASPIRE); development of an inductive framework of stressors, stress proneness, and stress resilience, while					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
also building an actionable, deductive counterpart of these stress variables that will ultimately include an operational taxonomy of stress resilience components, combined with an integrated stress resilience framework. - Initiated research into the effects of glucose administration to mitigate stress reactions in trauma patients. - Initiated design and development of an automated functional movement screening system to provide a low cost accurate solution for fit-for-duty evaluations and injury prevention training. - Initiated development of statistical methods for measuring small unit decision making (SUDM), using previous work on developing assessments of small unit decision making (e.g., Levels of Mastery), and provide a series of training sessions on statistical modeling to enable ground work to be laid by SUDM projects to also use statistical modeling. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Initiate research into automated simulation content generation via a field worn sensor suite. - Initiate research for establishing optimal training intervals for improvement in physical performance and warrior mindset. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert. - Complete development of statistical methods for measuring small unit decision making (SUDM), using previous work on developing assessments of small unit decision making (e.g., Levels of Mastery), and provide a series of training sessions on statistical modeling to enable ground work to be laid by SUDM projects to also use statistical modeling. - Initiate the use of augmented reality technologies into tactical decision making tools to support information dominance requirements. ***FY 2017 OCO Plans:*** N/A					
Title: INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)	2.751	2.893	3.160	0.000	3.160
Description: This activity develops ISR technologies for applications in future intelligence, surveillance, and reconnaissance. Technologies being pursued enhance situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes biometrics for expeditionary operations, complete future automation of options and persistent surveillance in support of distributed operations. ***FY 2015 Accomplishments:*** - Continued development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. - Continued development of low power consumption urban sensing technologies. - Continued development of tagging, tracking and locating technologies to monitor adversary movement. - Continued development of information on demand technologies to provide the warfighter with the right information at the right time. - Continued development of urban sensing technologies to detect weapons at distance. - Continued development of advanced tactical sensor technologies to improve unit awareness. - Continued development of distributed information architecture technologies. - Continued development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2. - Continued Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks. - Continued efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor. - Continued development of adaptable enemy course of action engine to manipulate adversary decisions. - Continued efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform. - Continued development of capabilities to integrate socio-cultural models of human behavior with the ability to forecast the processes of decision making through predictive forecasting models. - Continued efforts to derive high resolution models of human networks statistically, with associated behavior attributes. - Continued work on specific nanomaterial triggers and receptors.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued work on new optical taggants with improved producibility. - Continued research in automated techniques to establish the reliability of data from human and machine sources. - Continued technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization. - Continued research on the development of networked, ultra low power, long life and smart ground sensors. - Continued research to develop algorithms that can disambiguate complex network graphs containing millions of sparsely characterized nodes. - Continued development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across a highly distributed data architecture. - Completed development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes. - Continued research in deep machine understanding of information requirements relevant to amphibious warfare. - Continued research in characterizing patterns of life from persistent track data. - Continued research on technologies needed to enable multi-INT sensors to collaborate in real time on complex fusion tasks. - Continued a project to enable the synchronized planning and management and ISR assets given a set of disparate mission information requirements. - Continued effort to represent disparate data as a reduced feature vector. - Completed new Sensor Fields efforts such as Nanotechnology Enabled Witness Fields, development of sensors that provide near real time decision support to distributed operations by detecting specific interactions, and nanotechnology efforts which offer the potential to revolutionize tactical sensors. To enable this capability, nanomaterials that change state in the presence of another nanomaterial will be developed. - Completed development of approach to model and expose enemy networks, actions, and reactions through statistical models with techniques for probabilistic forecasting of behaviors of interest, with consideration for open source information and conventional intelligence data sources. - Completed development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology. - Completed work on influencing, disrupting, and stimulating behavior by fusing high resolution models of decisions with models of human networks. This includes work to provide an accurate decision tool to the warfighter that is relevant to irregular warfare, and development of tools to enable robust facial recognition in poor conditions and difficult environments.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed development of model based adversarial decision making stimulus and manipulation that will assist in the influence of decisions made by adversaries to our benefit. - Completed development of own force decision aids based on imprecisely-specified multi-attribute utility theory. - Completed the development of automated workflow managers enabled by the semantic representation of tasks and resources. - Initiated research in analytics for limited and isolated computational environments to enable advanced analytic capabilities to be available on expeditionary lightweight computing platforms. - Initiated research on technologies needed to produce products from multi-modal information in response to information requirements by leveraging cloud data access capabilities. - Initiated research on technologies needed to tailor information delivery to warfighters based on mission context and user preferences. - Initiated research in representing the content of large data stores in a way that allows remote and accurate searching against data indexes to be enabled. - Initiated research on collapsing networks inferred from disparate data sources.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Complete development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. - Complete development of tagging, tracking and locating technologies to monitor adversary movement. - Complete development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2. - Complete research on the development of networked, ultra low power, long life and smart ground sensors. - Complete research on technologies needed to tailor information delivery to warfighters based on mission context and user preferences.					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete work on specific nanomaterial triggers and receptors. - Complete development of urban sensing technologies to detect weapons at distance. - Complete work on new optical taggants with improved producibility. - Complete development of low power consumption urban sensing technologies. - Complete development of information on demand technologies to provide the warfighter with the right information at the right time.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor. - Complete research in automated techniques to establish the reliability of data from human and machine sources. - Complete development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across highly distributed data architecture. - Complete research on the automated deconfliction and fusion of multi-intelligence tracks on movers of interest, enabled by a rich maritime ontology and active wiki technology. - Complete research in characterizing patterns of life from persistent track data. - Complete research on collapsing networks inferred from disparate data sources. - Complete research in representing the content of large data stores in a way that allows remote and accurate searching against data indexes to be enabled. - Initiate effort to mature machine vision classifiers to the detection of specific objects from airborne video. - Initiate effort to represent graph based representations of the information content of a cloud that can be shared over limited bandwidths between clouds. - Initiate effort to develop advanced query capabilities on no-SQL data bases. - Initiate effort to develop novel analysis capabilities applicable to open source data. ***FY 2017 OCO Plans:*** N/A					
Title: LITTORAL COMBAT/POWER PROJECTION ***Description:*** This activity addresses the applied research associated with the Marine Corps participation in the Department of the Navy's (DoN) Science and Technology Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the DoN Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are generated by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The funding is aligned with the Naval challenges associated with projecting power despite anti-access and area denial, specifically the Sea	10.404	8.613	10.825	0.000	10.825

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Shield, Power and Energy, FORCEnet, and the Naval Expeditionary Maneuver Warfare warfighting capability gaps. The funding profile reflects the alignment of the FNC program investments into Enabling Capabilities (ECs); ECs respond to priority Naval warfighting capability gaps. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The FY2015 to FY2016 decrease in the Littoral Combat/Power Projection activity is due to a FY2016 Congressional reduction. Accordingly, the Future Naval Capabilities within the activity will be re-phased and amended appropriately to accommodate the delta. The FY2016 to FY2017 increase in the FNC Activity is due to the FY2016 Congressional reduction and will realign the activity to its original programming levels in FY2017. ***FY 2015 Accomplishments:*** - Continued development of wide area surgical and persistent surveillance technologies. - Continued development of the Ground Based Air Defense On-the-move high energy laser demonstrator. - Continued development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager. - Completed development of integrated vehicle self-defense system to defeat incoming RPGs. - Completed transparent urban structure "see thru the wall", image and mapping technologies development. - Completed development of an integrated, company level, Urban Sensor Suite. - Completed detect and identify facilities technology development. - Completed decision aids technology development. - Completed development of Modular Scalable Effects weapons technologies. - Completed development of tactical urban breaching technologies. Due to required program necessities resourcing of continued development of tactical urban breaching technologies has been realigned to PE 0603640M. - Completed development of individual Warfighter protection technologies. - Completed development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. - Complete development of the Fuel Efficient Medium Tactical Vehicle Replacement (FE MTVR) Enabling Capability (EC). - Initiated development of an azimuth and inertial navigation system. - Initiated development of spectral and reconnaissance imagery for tactical exploitation (SPRITE)-(EMW-FY14-01)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated limited development of Target Processing Center (TPC) sensor correlation and fusion technology; specifically, context fusion, and radar fusion and false track mitigation. - Initiated development of technologies to enable the exchange of actionable information at the tactical edge; specifically, actionable information tactical applications, data conditioning and network adaptive communication services. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete development of an azimuth and inertial navigation system. - Complete development and transition of EFV obstacle detection capability to EFV Direct Reporting Program Manager. - Complete development of the Expeditionary Fighting Vehicle obstacle detection (EFVODS) capability. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Continue development of Densified Propellant Fire From Enclosure/Enclosed Space(DP FFE/CS)enabling capability; specifically the analysis to incorporate tungsten into the SMAW Block 2 rocket motor propellant to decrease the detrimental effects of launch back-blast and over-pressure in confined spaces. (Effort was previously funded by PE 0602750N FY16). - Initiate development of Advanced Topcoat System - Ground Vehicle Enabling Capability (EPE-FY16-01); specifically the chemical analysis to develop a high performance, zero-isocyanate Chemical Agent Resistant Coating (CARC) system that provides enhanced corrosion resistance and improved operational functionality on ground vehicle platforms. - Initiate the development of a high reliability distributed fuzing system for the 155mm DPICM projectile. ***FY 2017 OCO Plans:*** N/A					
Title: LOGISTICS	4.387	5.725	5.833	0.000	5.833
Description: This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into four pillars: efficient and responsive force sustainment, planning					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
and directing logistics operations, logistics demand reduction, and fleet maintenance. These pillars are thoroughly integrated and perpetually related in execution The FY 2015 to FY 2016 funding increase is due to the acceleration and early completion of the logistics C2 systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka: Transportation Exploitation Tool). ***FY 2015 Accomplishments:*** - Continued development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices. - Continued applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems (Note: This also includes development of alternative human load carrying concepts to lighten the load carried by the Marine and reduce structural damage to the human body). - Continued applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment. - Continued the development of logistics IT systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka: Transportation Exploitation Tool). - Continued development of high efficiency, rugged, and inexpensive solar photovoltaic energy harvesting technologies. - Continued development technologies to facilitate cargo transfer across intra-theater logistics connector vehicles, to include advanced material handling equipment as well as asset tracking and reporting technologies. - Continued the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield. - Completed advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced, lightweight, portable power applications. - Completed advancement of a solid oxide fuel cell capable of directly oxidizing liquid logistic fuels such as JP-8, thus eliminating the necessity for both reforming and sulfur removal pre-processing of the fuel. - Completed applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy. - Completed applied research toward an extremely high specific energy, metal-air primary battery and research toward an advanced electrochemical ultracapacitor based on down-selection of prior research approaches.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed applied research into electrochemical methods of converting diverse hydrocarbon fuels to electrical energy. - Initiated operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies. - Initiated development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain. - Initiated the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices. - Initiated the development of energy scavenging technologies to minimize wasted thermal, RF, kinetic, and other energy on the battlefield.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Complete the development of logistics C2 systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka: Transportation Exploitation Tool). - Complete development of high efficiency, rugged, and inexpensive solar photovoltaic energy harvesting technologies. - Complete development technologies to facilitate cargo transfer across intra-theater logistics connector vehicles, to include advanced material handling equipment as well as asset tracking and reporting technologies.					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices. - Complete applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems - Complete applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment. - Complete the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield. - Complete operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain. - Complete the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices. - Complete the development of energy scavenging technologies to minimize wasted thermal, RF, kinetic, and other energy on the battlefield. - Initiate the development of stochastic studies to model and insert Additive Manufacturing into the Naval Supply Chain. - Initiate the development of a project to investigate the complex physical processes occurring associated with complex geometries when using laser directed energy metal deposition processes with titanium alloys. - Initiate the development of a project to investigate the feasibility and attributes of the wireless transfer of power technologies for dismounted Marines. ***FY 2017 OCO Plans:*** N/A					
Title: MANEUVER	6.757	6.985	7.950	0.000	7.950
Description: The Maneuver thrust area focuses on the development of technologies that will increase the warfighting capabilities and effectiveness of the Marine Air-Ground Task Force (MAGTF). This thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Emphasis on survivability technologies includes defeat of small arms, IEDs, mine blast, and RPGs. Efforts also continue in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system's performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the program manager insight and guidance into pursuing future technologies. Finally, this technology thrust area also seeks to develop technologies to enhance combat vehicle crewman effectiveness and situational awareness through the incorporation of advanced autonomous vehicle functions. The FY2016 to FY2017 increase in funding is due to a FY2016 Congressional reduction (-$1.293M). The reduction in FY2016 requires re-phasing of the initiation of technology development programs to address expeditionary maneuver capability gaps.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
FY 2015 Accomplishments: - Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor. - Continued mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs. - Continued efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility. - Continued efforts addressing advanced suspension systems with ride height adjustment capabilities, adjustable ride quality capabilities, rollover prevention, and load equalizing systems to enhance tactical mobility and survivability. - Continued efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility. - Continued technology development programs to address maneuver capability gaps in survivability such as an advanced seat technology effort to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover. - Continued technology development programs to address maneuver capability gaps in Mobility such as a Vehicle Stability effort to improve/increase vehicle performance characteristics such as reducing vehicle rollover tendencies. - Continued efforts in advanced perception and context-based reasoning aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO). - Continued the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles. - Continued lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms. - Continued survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles. - Continued non-GPS localization technologies such that autonomous vehicles can navigate in areas where satellite data is inaccessible. - Continued the development of technologies that enable vehicle component modularity and reduce life cycle costs. - Continued mobility technologies that enable improved vehicle agility and stability.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued Advanced Mobility efforts in Future Fuel Alternatives and Advanced Propulsion and Suspension Technologies to improve vehicle fuel efficiency through improvements in drive train and engine efficiencies and alternative fuels capabilities to enhance tactical mobility. - Continued development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability. - Continued the development of technologies that sustain vehicle components longer and reduce life cycle costs. - Continued the development of autonomous technologies automating behavior generation and enabling adaptive behavior using virtual environments. - Continued technology development programs to address expeditionary maneuver capability gaps. - Completed survivability efforts in advanced blast mitigation to develop solutions that mitigate injuries to vehicle occupants, while reducing the weight burden, thereby enhancing tactical mobility and survivability. - Initiated the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies. - Initiated the development of autonomous technologies transcribing vision-based perception data in order to be understood by a context-based reasoning system enabling adaptive behavior. - Initiated the development of autonomous technologies by enhanced human machine interface (HMI) through gestures and natural language understood by unmanned ground systems (UGS). - Initiated survivability technologies to provide reduction in the probability of detection in a given background. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete the development of autonomous technologies transcribing vision-based perception data in order to be understood by a context-based reasoning system enabling adaptive behavior. - Complete development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Initiate technology development programs to address expeditionary High Water Speed capability gaps. ***FY 2017 OCO Plans:*** N/A					
Title: COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4) ***Description:*** This activity supports S&T investment in Command and Control and is focused in three main areas: (1) Implementing the FORCEnet concept; (2) Developing decision support systems that enable warfighters to take advantage of the FORCEnet and MAGTF C2, and tactically extend Net-Enabled Command	4.117	4.329	4.730	0.000	4.730

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total

and Control (NECC) for shared situational awareness; and (3) Providing effective combat identification of enemy combatants, friendly forces, and non-combatants. FORCEnet is the operational construct and architectural framework for naval warfare in the information age that integrates warriors, networks, command and control, and weapons into a networked, distributed, combat force that is scalable across all levels of conflict from the seabed to space, and from sea to land. The Marine Corps instantiation of FORCEnet is Marine Air Ground Task Force Command and Control (MAGTF C2), with technologies to exchange data and information with, and among, distributed tactical forces. Activities in this program area provide technologies for secure, robust, self-forming, mobile communications networks and distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of an appropriate common picture. Marine Corps specific efforts include power management, low detectability, size and weight constraints, and interoperability within the joint environment.

FY 2015 Accomplishments:
- Continued development of urban/restricted environment communications technologies.
- Continued Adaptable Antennas, Self-Adapting Radio Prototype and RF Technologies efforts.
- Continued Cognitive Networking and Trusted Computing Technology efforts.
- Continued a distributed, Cyber Technology development effort.
- Completed Dynamic Cosite Mitigation, Sensing Comms and Blue Force Tracking efforts.
- Completed new efforts in Over-the-Horizon Communications, which include the development of an airborne, software-defined communications, networking, Electronic Signals Intelligence (ELINT) and Electronic Warfare (EW) capability.
- Initiated a meta-material antennas effort.
- Initiated an Electro-Magnetic Technologies effort.

FY 2016 Plans:
- Continue all efforts of FY 2015, less those noted as completed above.
- Complete a distributed, Cyber Technology development effort.

FY 2017 Base Plans:
- Continue all efforts of FY 2016, less those noted as completed above.
- Complete a meta-material antennas effort.
- Complete an Electro-Magnetic Technologies effort.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602131M / *Marine Corps Lndg Force Tech*	**Project (Number/Name)** 3001 / *Marine Corps Landing Force Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Advanced Expeditionary Cyber Technology efforts. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	44.629	45.643	51.590	0.000	51.590

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare and Combating Terrorism. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602131M / *Marine Corps Lndg Force Tech*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

A. Mission Description and Budget Item Justification

These Congressional Cyber funds will be used to develop a multi-disciplinary science and technology strategy addressing dynamic cyber defense and Expeditionary cyberspace operations in support of distributed Naval Expeditionary Warfighters. This will be accomplished through examination of prototyping and developing technology capabilities for Expeditionary Cyberspace Operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Cyber Research	0.000	6.000
FY 2015 Accomplishments: N/A		
FY 2016 Plans: - Initiate a multi-disciplinary science and technology effort addressing dynamic cyber defense and tactical cyberspace operations.		
Congressional Adds Subtotals	0.000	6.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Deliverables include a multi-disciplinary science and technology strategy addressing dynamic cyber defense and Expeditionary Cyberspace Operations.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602235N *I Common Picture Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	44.874	42.538	41.185	-	41.185	37.916	38.165	38.333	38.500	Continuing	Continuing
0000: *Common Picture Applied Research*	0.000	44.874	42.538	41.185	-	41.185	37.916	38.165	38.333	38.500	Continuing	Continuing

Note

N/A

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&T investments.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	43.533	42.551	42.646	-	42.646
Current President's Budget	44.874	42.538	41.185	-	41.185
Total Adjustments	1.341	-0.013	-1.461	-	-1.461
• Congressional General Reductions	-	-0.013			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.008	0.000			
• SBIR/STTR Transfer	-0.667	0.000			
• Program Adjustments	0.000	0.000	-0.904	-	-0.904

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy				Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602235N *I Common Picture Applied Research*			
• Rate/Misc Adjustments	0.000	0.000	-0.557	-	-0.557

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602235N / *Common Picture Applied Research*	Project (Number/Name) 0000 / *Common Picture Applied Research*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Common Picture Applied Research*	0.000	44.874	42.538	41.185	-	41.185	37.916	38.165	38.333	38.500	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (20 January 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&T investments.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: COMMUNICATION AND NETWORKS	7.370	6.975	7.194	0.000	7.194
Description: The overarching objective of this activity is to develop high throughput dynamic wireless communications and network technologies critical to the mission performance and robustness of naval communications for widely dispersed, mobile air, land, surface and submerged platforms. These platforms are often size, weight and power (SWaP) limited, and will operate under constraints of cluttered RF spectrum, harsh electro-magnetic interference (EMI) and Beyond Line Of Sight (BLOS) conditions. The technical payoff is increased network data rates, interoperability across heterogeneous radios, dynamic bandwidth management, and greater mobile network connectivity. The operational payoff is that warfighters from the operational command to the tactical edge have near real-time access to information, knowledge and decision-making necessary to perform their tasks, including coalition and allied forces. Emphasis is on tactical edge communications and networks to fully realize net-centric warfare, bridging the Global Information Grid (GIG) and the 'disadvantaged user', e.g., small-deck combatants, submarines, unmanned vehicles, distributed sensors and ground units in urban and radio frequency (RF) challenged environments. The current specific objectives are:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
a) Radios and Apertures: Develop technologies for high band radio, electrically-small and actively scanned antennas, addressing critical issue of radio spectrum bandwidth efficiency, spectrum contention and clutter, agile frequency communications with dynamic spectrum access, all-digital front-end with wide dynamic range, power amplifier efficiency, multipath effects, saltwater propagation and BLOS communications. Develop algorithms and signal processing for space-time-frequency diversity communications, including measures for electronic protection, such as low-intercept, antijam waveforms and modulation. Develop affordable antenna technologies for small size and weight, high radiation efficiency, and wideband operation with rapid beam-steering. Develop alternatives to RF communications in airborne and terrestrial environments as well as high data rate underwater communications for undersea warfare (distributed sensor netting, unmanned underwater vehicle data exfiltration, submarine Communications at Speed and Depth) using electro-optic/infra-red (EO/IR) technologies. Develop secure, high bandwidth communications systems and the exploitation of existing and emerging network protocols that will avail development of new, Low Earth Orbit (LEO) based data transport mechanisms. b) Tactical Networking and Network Control/Management: Develop advanced networking techniques for robust, highly dynamic environments; interoperable networks for secure communications and protocols, bandwidth and network management techniques that manage and allocate bandwidth across tactical and theater levels in support of net-centric operations. Develop rapidly auto-configuring and self-organizing networks with efficient and survivable routing, secure authentication, mobility management and Quality-of-Service guarantee, while optimizing network resources. Address low bandwidth, synchronization and reliability for Service Oriented Architecture (SOA)/middleware architecture in both mobile ad-hoc networks (MANET) and infrastructure-based Internet Protocol (IP) backbone networks. Develop cognitive network planning and operations engines whose criteria are based directly on mission objectives, while self-adapting and managing the spectrum allocation and radio resources in such a way that network operations, SOA community of interest, and computer network defense are integrated to form a single common tactical network picture that requires a minimum of human intervention and skill. Develop technology for improving tactical edge networking and for improving voice communications. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Radios and Apertures: - Continued development of blue-green receiver and detector technologies with greater sensitivity, while reducing size, weight, power, and/or cost.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued design and development of electronic protection for HF communications. - Continued development of integrated metamaterial antennas for ship and ground platforms. - Continued demonstration of high peak power, short pulse operation of fiber lasers in blue-green region. - Continued technologies to improve spectrum co-existence of military waveforms with commercial communications (e.g., overlay/underlay techniques, interference cancellation, machine learning and reasoning algorithms for distributed spectral awareness/management, etc.). - Continued development of low cost approaches for electronic beam steering and multi-beam RF systems. - Completed blue-green fiber laser technology development for space-based submarine communications. - Completed novel fiber technology that enables tunable, energy-scalable emissions at a user-defined/desired wavelength, particularly in the blue-green spectral range. - Completed development of low intercept and low probability of detection (LPD), jam resistant communications/ networks for distributed nodes. - Completed development of optical wavefront modulation techniques and optical phased array beam steering methods for terrestrial EO/IR Lasercomm. - Completed use of novel metamaterials and metastructures that enable conformal antenna designs with ultra-wideband performance. - Completed program for a novel blade antenna payload for wideband Ku/UHF communications that is light weight, has lower power consumption, and is very low cost. - Initiated development of technologies to enable troposcatter communications on the move with reduced size, weight, and power antennas. - Initiate development of blue-green filter technologies with wide field of view, narrow bandwidth, and reduced size, weight, complexity, etc. Tactical Networking and Network Control/Management: - Continued design and development of cognitive netops for tactical communications. - Continued dynamic routing mechanisms that focus on robust data delivery -- in near real time -- under harsh networking conditions (i.e.,intermittent connectivity, limited throughput, etc.). - Continued development of techniques and algorithms to manage resources of tactical networks in a manner consistent with Commander's Intent. - Completed development of cognitive networking, cross-layer optimization protocols for light SOA for tactical networks. - Completed development of effort to improve secure voice by developing secure voice technology that can interoperate between tactical and strategic networks.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed program that leverages topology discovery, content modeling, and resource scheduling to support content management functions at the Tactical Edge. - Completed managing and controlling functions within a protected routing core at the Tactical Edge. - Initiated development of techniques and algorithms to ensure end-to-end delivery of data across undersea networks with large delays and multi-modal communications.					
FY 2016 Plans: Radios and Apertures: - Continue all efforts of FY 2015 less those noted as complete. - Complete development of integrated metamaterial antennas for ship and ground platforms. - Complete demonstration of high peak power, short pulse operation of fiber lasers in blue-green region. - Complete development of blue-green receiver and detector technologies with greater sensitivity, while reducing size, weight, power, and/or cost. Tactical Networking and Network Control/Management: - Continue all efforts of FY2015 less those noted as complete. - Complete design and development of cognitive netops for tactical communications. - Initiate the development of software-defined networking capabilities for tactical platforms.					
FY 2017 Base Plans: Radios and Apertures: - Continue all efforts of FY 2016 less those noted as complete. - Complete design and development of electronic protection for HF communications. - Initiate the development of novel antenna technologies for communications with small satellites. - Initiate the development of optical technologies for tracking and communications with small satellites. - Initiate the development of interference alignment and chaotic waveform techniques for secure communications. - Initiate development of MEMS enabled reflectarray phased array antennas. Tactical Networking and Network Control/Management: - Continue all efforts of FY 2016 less those noted as complete. - Complete development of techniques and algorithms to ensure end-to-end delivery of data across undersea networks with large delays and multi-modal communications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate development of performance-aware dynamic communication protocols (including multicast with network coding) that adapt to varying network conditions and application requirements. ***FY 2017 OCO Plans:*** N/A					
Title: APPLIED INFORMATION SCIENCES FOR DECISION MAKING ***Description:*** The goal of this activity is to develop enablers for decision making and mission execution, to achieve battlespace superiority. It focuses on the development of algorithms and software technologies that identify and integrate informational content from multiple sources, leading to decision aids that support user-cognitive processes. Because persistent sensors are generating massive amounts of data, the focus is on technologies that not only integrate information from diverse sources, but also provide indications of information significance in ways that support the user's decision needs, regardless of location and operational situation. To achieve this, it must be possible to automate understanding of the battlespace by identifying objects, determining relationships among the objects, assessing intent, and automatically generating courses of action with associated risks and uncertainty. Effort will also be devoted to developing technology for increasing assurance and security for C3 information systems and technology for improving information discovery and information presentation in such systems. The Nano Electronics Technology activity is focused on developing ultra-low power, higher performance computing devices and components that are based on novel functionalities of nanometer scale materials and are enabled by improved understanding of nanomaterials, new devices and circuit design concepts, as well as new architectures uniquely suited for nanoscale systems. The current specific objectives are: a) Data Understanding: Develop automated, image and signal intelligence understanding tools based on rigorous mathematical and statistical methods that lead to improved change detection, improve object and activity detection and recognition capabilities, context and scene understanding, and inferring of the threat levels to support decision making and persistent and adaptive surveillance. b) Information Integration: Develop innovative methods for combining traditional and non-traditional data from sensors and disparate sources to provide the best estimate of objects, events, and conditions in the battlespace, in terms of their identity, associated error or uncertainty, context, impact, while inferring relationships and their intentions.	23.922	23.931	25.225	0.000	25.225

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
c) Data Analytics (Formerly titled: Mission Focused Autonomy (MFA)): Develop proactive situational awareness and rapid decision making applications and analytics with information PUSH as well as PULL, where joint human controlled and automated analytic processes can collaboratively work together to solve tactical and strategic problems within a multi-level, secure environment. Areas addressed include the following elements: a) access to enterprise level structured and unstructured data repositories and automated search and discovery of evidence collected across these heterogeneous databases; b) analytics that automate the ability to infer the meaning of evidence that is discovered; c) structured process (hypothesis or argument) that provides context in order to constrain and guide the search and analytic techniques toward goals that are focused on proving the hypothesis right or wrong; d) knowledge repository that maintains pedigree and state of hypothesis satisfaction or refutation; e) Collaborative environment wherein all analytic participants can share the state of hypothesis satisfaction and collectively contribute evidence data to solve the common problem. Develop rigorous and efficient methods for building sophisticated situational models, and develop automated reasoning techniques to categorize and recognize situations under a variety of conditions leading to methods that predict situations under different settings including capabilities to address growing cyber-related threats. d) Resource Optimization: Develop automated decision tools based on mathematically rigorous techniques (e.g., mathematical optimization) that support decision-making to ensure the best use of scarce and/or expensive resources, achieving optimal allocations for large complex scenarios, including ones that contain uncertainty, in drastically reduced amounts of time. Develop methods that support decision making in networked sensor management and allocation to ensure sensor assets are deployed in an optimal, or near optimal, manner. e) Cyber Defense (Formerly titled Trusted Systems & Networks): Develop tools and methods to securely handle information without exposing intelligence information about the networks or systems to adversaries. f) Nanoscale Electronics: To develop novel nanometer scale (feature size near or below 10nm) logic/memory devices and related circuits and architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters. g) Quantum Information Sciences: Conduct research supporting the efficacy of a free space optical quantum key distribution that would operate in a maritime environment. Understand the implications of imperfect hardware implementations upon the vulnerability of the known protocols. Develop new protocols and encoding schemes					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
that lead to robust performance with high throughput. Conduct research that leads to an understanding of, and develop methods that compensate for atmospheric effects. Funding increase from FY16 to FY17 is a result of increased research in Cyber Defense. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Data Understanding: - Continued development of algorithms for extraction of information from Light Detection and Ranging (LIDAR) and Radar. - Continued efforts to develop an automated tool to improve checkpoint security by identifying accents of non-native English speakers. - Continued development of methods for integration of low-level image processing and high-level knowledge for simultaneous image segmentation and object recognition, and visual reasoning for image understanding. - Continued development of 3D image processing for object recognition and meaningful change detection. - Continued development of modular, interactive, intelligent, video-based surveillance systems. - Continued methods for building sophisticated visual knowledge bases, development of methods for visual reasoning and integrating them in image/video understanding, and development of methods for image description. - Completed development of electronic protection techniques for long range emitter classification systems. Information Integration: - Continued development of methods for analysis and integration of text with imagery and video. - Continued development of methods for analysis of structured and unstructured data. - Continued development of algorithms and tools for information representation of unstructured data and structured data in such a way that shared concepts/relationships in disparate data sets can be automatically compared, matched, or associated, and in a way that can facilitate and improve information fusion. - Continued development of algorithms and tools for information fusion of heterogeneous data for classification and reconstruction based on high level features inherent in each data source, with the goal of forming a more complete picture of battlespace environment.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of algorithms and tools for discovering and extracting higher-level features -- objects, events, patterns, intents, relationships, anomalies -- from various data types in support of future asymmetric warfare. - Continued research to extend user interfaces for immersive simulation to enable users to better express themselves through non-verbal communications. - Initiated research into designing more resilient networks that better adapt to disruption and change by developing new analytical models and methodologies for characterizing network node relationships to improve prediction of statistical communication performance and structural relationships within dynamic ad hoc networks. Data Analytics (Formally Titled Mission Focused Autonomy (MFA): - Continued bringing capability into a multi-level security environment. - Continue automating current set of time critical reports to ensure timely decision making that is informed by forensics data. - Continued efforts to develop a task scheduler for unmanned aerial system operators that reflects operator workload. - Continued research in mission-focused autonomy and reasoning methods; expanded autonomy from simple platform. kinematics to include all-source information exploitation and surrounding cultural and social influences. - Initiated integrating this analytic environment into parallel Navy Tactical Cloud environment. Resource Optimization: - Continued development of methods for selecting sensors and platforms for search and surveillance operations in a theater, allocating the selected sensors and platforms to specific missions, operating the allocated sensors during a mission, and fusing the information from the sensors and other sources. - Continued development of optimization-based decision aids for resource allocation, such as those required for mission planning at the strategic, operational, and tactical level. Cyber Defense: (formally Trusted Systems & Networks) - Continued development of anti-tamper methods that are capable of lengthy operation in unattended and un-powered environments, have very high probability of tamper detection and very low probability of false alarm, and remain undetected in the host system. - Continued development of automated tools that identify and mitigate potential software vulnerabilities, such as tools that analyze code as it is being written, vulnerability-aware compilers that automatically enhance code security, and techniques for enhancing the client-side security of web applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed development of theory, methods, and tools for model-driven, component-based construction and automatic verification of software systems. - Initiated research into better protecting DoD systems by developing methods and tools that are applicable both to source and binary code for the detection and mitigation of attacks in commercial-off-the-shelf (COTS) software that exploit vulnerabilities in the Windows platform. Nanoscale Electronics: - Continued effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes. - Continued new research in graphene synthesis and device concepts. - Continued effort to develop the synthesis, fabrication and testing of graphene-based electromechanical structures and devices. - Continued work on graphene-based devices and circuits for low power flexible electronics. - Continued research on graphene-organic hybrid materials interfaces and device structures. Quantum Information Sciences: - Initiated free-space Quantum Key Distribution applied research program for secure communication. ***FY 2016 Plans:*** Data Understanding: - Continue all efforts of FY 2015, less those noted as completed above. - Initiate efforts for reconstructing events from a loose network of heterogeneous cameras. Information Integration: - Continue all efforts of FY 2015, less those noted as completed above. - Complete research to extend user interfaces for immersive simulation to enable users to better express themselves through non-verbal communications. - Furthering research into designing more resilient networks that better adapt to disruption and change by developing new analytical models and methodologies for characterizing network node relationships to improve prediction of statistical communication performance and structural relationships within dynamic ad hoc networks. Data Analytics (Formerly Titled: Mission Focused Autonomy (MFA)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts from FY 2015, less those noted as completed above. - Initiate Maritime domain awareness toolkit development for small vessel tracking. - Initiate cyber information awareness decision tools for hull, mechanical and electrical security for Naval vessels. Resource Optimization: - Continue all efforts from FY 2015, less those noted as completed above. Cyber Defense: - Continue all efforts from FY 2015, less those noted as completed above. - Initiate development for methods and tools for semi-/fully- automated software model extraction and online program execution monitoring toward achieving adaptive and resilient computing system. - Furthering research into better protecting DoD systems by developing methods and tools that are applicable both to source and binary code for the detection and mitigation of attacks in commercial-off-the-shelf (COTS) software that exploit vulnerabilities in the Windows platform. Nanoscale Electronics: - Continue all efforts from FY 2015, less those noted as completed above. Quantum Information Sciences: - Continue all efforts from FY 2015, less those noted as completed above.					
FY 2017 Base Plans: Data Understanding: - Continue all efforts of FY 2016 less those noted as complete above. - Complete efforts to develop an automated tool to improve checkpoint security by identifying accents of non-native English speakers. Information Integration: - Continue all efforts of FY 2016, less those noted as completed above. - Complete research into designing more resilient networks that better adapt to disruption and change by developing new analytical models and methodologies for characterizing network node relationships to improve prediction of statistical communication performance and structural relationships within dynamic ad hoc networks.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Data Analytics (Formally Titled Mission Focused Autonomy (MFA): - Continue all efforts of FY 2016, less those noted as completed above. - Complete efforts to develop a task scheduler for unmanned aerial system operators that reflects operator workload. Resource Optimization: - Continue all efforts of FY 2016, less those noted as completed above. Cyber Defense: - Continue all efforts of FY 2016, less those noted as completed above. - Furthering research into better protecting DoD systems by developing methods and tools that are applicable both to source and binary code for the detection and mitigation of attacks in commercial-off-the-shelf (COTS) software that exploit vulnerabilities in the Windows platform. Nanoscale Electronics: - Continue all efforts from FY 2016, less those noted as completed above. Quantum Information Sciences: - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: MULTI-SOURCE INTEGRATION AND COMBAT IDENTIFICATION	2.969	3.818	2.863	0.000	2.863
Description: This activity addresses theater air and missile defense (TAMD), and responds to warfighter needs for rapid, high confidence Combat Identification (CID) of air and missile threats at long range, using real time and non-real time threat attributes and intelligence information. Funding decrease from FY16 to FY17 is a result of the completion of activities related to associative learning. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity: ***FY 2015 Accomplishments:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of a new radar signature analysis technique based on nonlinear dynamics. - Continued development of coordinated, multi-platform, multi-component waveforms. - Continued development of a real-time, electronic warfare support, de-interleaving capability. - Continued development of advanced communications emitter identification. - Continued to develop and demonstrate Multiple Input Multiple Output (MIMO) radar concepts and technology using High Frequency (HF) Skywave radar. - Continued development of electronic protection techniques for long range emitter classification systems. - Continued development of Associative Learning signal classification framework to provide robust automatic target recognition. - Completed development of unique tactical feature derivation of modern surveillance systems. - Initiated development of methodology to incorporate EM vector sensors in USVs to enable HF signal detection and geolocation. - Initiated development of advanced 2D array geometries and signal processing techniques to expand the operational envelope of surface wave HF radar.					
FY 2016 Plans: - Continue all efforts of FY 2015 unless noted as complete. - Furthering development of methodology to incorporate EM vector sensors in USVs to enable HF signal detection and geolocation. - Furthering development of advanced 2D array geometries and signal processing techniques to expand the operational envelope of surface wave HF radar.					
FY 2017 Base Plans: - Continue all efforts of FY 2016. - Furthering development of methodology to incorporate EM vector sensors in USVs to enable HF signal detection and geolocation. - Furthering development of advanced 2D array geometries and signal processing techniques to expand the operational envelope of surface wave HF radar. - Complete development of Associative Learning signal classification framework to provide robust automatic target recognition.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: TACTICAL SPACE EXPLOITATION	6.457	5.782	5.903	0.000	5.903
Description: The Tactical Space Exploitation initiative explores the application of new space craft technologies on small, light-weight and low-cost satellites, to enhance naval warfighting capabilities by taking advantage of the global access, revisit and connectivity provided by orbital platforms. a) Spacecraft Technology: Affordable, expendable payload and bus technologies will be developed, which will serve as building blocks for future responsive space systems: payloads, bus technologies and significant space robotic technologies that address on-orbit inspection, servicing, repair and assembly, and mission-life extension. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity: ***FY 2015 Accomplishments:*** Spacecraft Technology: - Continued program to use chemical release from satellites launched into selected low-Earth orbits to de-populate intense trapped electrons in radiation belts following a low-altitude nuclear explosion in space. - Continued effort to develop technologies using autonomous, bi-dexterous manipulation for close proximity operations in space. - Continued developing the underlying fluid transfer technologies for steerable radiators that will enable spacecraft thermal radiators to be pointed away from the sun. - Continued developing a proof-of-concept, reliable, touch sensitive skin for robotic arms, with emphasis on space applications, and the associated fault detection and model identification algorithms required to utilize it. - Continued developing the ability to artificially generate and maintain a dust layer in the near earth plasma environment to induce enhanced drag on space debris, aiming toward debris mitigation. - Continued effort to develop the key advanced technologies leading to robust use of space-based electrodynamic propulsion, which will enable spacecraft that perform large scale maneuvers fuel-free, and more cheaply than is currently possible. - Continued effort to design and develop a novel miniature radiation displacement damage sensor that will accurately					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
measure the impact of displacement damage in a space environment. - Continued efforts to develop a novel actuator and associated control laws that will enable lighter weight architectures for spaceflight robot arms, thereby dramatically reducing size, weight, complexity, and cost of spaceflight robotic manipulators. - Continued efforts to quickly assimilate tracking data of orbiting debris and space objects, while simultaneously shrinking position uncertainties, in order to create more room to operate in space. - Completed effort to develop a self-contained, space-based plasma impedance probe innovative sensor that will be easy to mount and field on any space platform, which will provide reliable early warning of hazardous spacecraft charging. - Initiated efforts to radically reduce thermionic cathode temperature and power by developing the capability for rapid 3D printing of complex cathode parts using the new low-temperature emitter C12A7. - Initiated efforts to develop and demonstrate a low power, radiation-hard micro-satellite receiver on a chip which has wide dynamic range and a flexible architecture.					
FY 2016 Plans: Spacecraft Technology: - Continue all efforts of FY 2015 unless noted as complete. - Continued efforts to radically reduce thermionic cathode temperature and power by developing the capability for rapid 3D printing of complex cathode parts using the new low-temperature emitter C12A7. - Continued efforts to develop and demonstrate a low power, radiation-hard micro-satellite receiver on a chip which has wide dynamic range and a flexible architecture. - Complete effort to design and develop a novel miniature radiation displacement damage sensor that will accurately measure the impact of displacement damage in a space environment. - Complete effort to develop the key advanced technologies leading to robust use of space-based electrodynamic propulsion, which will enable spacecraft that perform large scale maneuvers fuel-free, and more cheaply than is currently possible.					
FY 2017 Base Plans: Spacecraft Technology: - Continue all efforts of FY 2016 unless noted as complete. - Furthering efforts to radically reduce thermionic cathode temperature and power by developing the capability for rapid 3D printing of complex cathode parts using the new low-temperature emitter C12A7. - Furthering efforts to develop and demonstrate a low power, radiation-hard micro-satellite receiver on a chip which has wide dynamic range and a flexible architecture.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Complete efforts to develop a novel actuator and associated control laws that will enable lighter weight architectures for spaceflight robot arms, thereby dramatically reducing size, weight, complexity, and cost of spaceflight robotic manipulators. - Complete efforts to quickly assimilate tracking data of orbiting debris and space objects, while simultaneously shrinking position uncertainties, in order to create more room to operate in space. ***FY 2017 OCO Plans:*** N/A					
Title: INFORMATION SECURITY RESEARCH ***Description:*** The overarching objective of this activity is to protect the Navy and the Joint information infrastructure from hostile exploitation and attack. This activity transfers from PE 0603235N effective FY 2013 to focus on applied research in information security. The current specific objectives are: a) Network Situation Awareness & Security: Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities. b) Network Traffic Analysis and Assessment: Develop methods for conducting network traffic analysis; monitoring and assessing network status and health; identifying new capabilities to analyze network vulnerabilities and attacks; and providing situational awareness of network assets and operations. c) Information Assurance: Develop and measure the effectiveness of Information Assurance (IA) protective solutions and improve the quality and level of certification of information assurance software. The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. Beginning in FY15, efforts identified under "Information Security Research" will be executed in Activity- APPLIED INFORMATION SCIENCES FOR DECISION MAKING under objective Cyber Defense (Formerly titled Trusted Systems & Networks). ***FY 2015 Accomplishments:*** Network Situation Awareness & Security: - Continued development of algorithms/methods for providing attribution of threat-agents through the network/ infrastructure. Emphasis will be placed on addressing translational boundaries, cross-domains, and obfuscation techniques to avoid detection and tagging.	2.123	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued new mobile agent technology that provides network protection, thwarts botnet attacks, and provides for a resilient computational infrastructure and communications environment. Investigate new methods for subverting the control plane of the mobile code attacking the infrastructure. - Continued development of algorithms/methods for providing attribution of threat-agents through the network/ infrastructure. Building upon previous results, develop network-based techniques to provide pro-active response to attributed threat agents to mitigate attack vector and ensure mission success. - Continued investigating new methods for subverting the control plane of the mobile code attacking the network infrastructure. - Continued the development of new algorithms for taking control of bots once the control plane is compromised. - Continued development of new algorithms/techniques to characterize Navy and Marine Corps network assets in order to develop robust security mechanisms and support technologies based on criticality and mission essential operations. Network Traffic Analysis and Assessment: - Continued development of new algorithms focused on detection of nation state sponsored activities through the network infrastructure. Develop algorithms to address sophisticated malicious code techniques. - Continued algorithms to address sophisticated malicious code techniques that exploit network traffic/data that is fragmented, encrypted, and/or obfuscated using polymorphic methods, as well as techniques that transgress security perimeters and exfiltrate data. - Continued development of new algorithms that provide attack prediction and targets of opportunity. - Initiated the development of algorithms and techniques to detect stealthy protocols that enable covert communication by exploiting channels available in existing widely used protocols. Information Assurance: - Continued the development of methods and techniques to provide component repurposing/agility to flatten the attack surface from sophisticated nation-state sponsored attacks. - Initiated the development of trusted computing technologies to minimize/limit authentication/sign-on services across various network, virtual, and/or cloud environment. ***FY 2016 Plans:*** N/A ***FY 2017 Base Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A ***FY 2017 OCO Plans:*** N/A					
Title: AUTONOMOUS SYSTEMS AND ROBOTICS	2.033	2.032	0.000	0.000	0.000
Description: The Autonomous Systems and Robotics initiative explores the application of new technologies to advance capabilities in the area of robotics, autonomous systems propulsion and control, and integration of autonomous systems. Efforts will be focused on the Assistant Secretary of Defense (Research and Engineering) (ASD(R&E)) priorities in autonomous systems. The decrease from FY 2016 to FY 2017 reflects the completion of the efforts for sustainment of Autonomous Systems and Robotics initiative. ***FY 2015 Accomplishments:*** Robotics Platform Research: This addresses development of autonomous robotic systems capability to interact with and service other platforms and autonomous vehicles. Micro-Robotic Servicing - advanced highly dexterous control of extremely lightweight and flexible robotic arms, with specific application to EOD, surveillance and on-orbit servicing robotic communities. This research would extend ongoing research in lightweight robotic arms. Autonomous Refueling - development of hardware, algorithms, and sensors for hybrid rigid-compliant robotic arms in rapidly changing environments, with specific application to autonomous refueling of USVs, UAVs and UGVs while moving in their environments, advancing beyond the DARPA-sponsored "Rapid Autonomous Fuel Transfer Project".					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Low Power Micro-robotics - development of onboard sensors, control electronics, and actuators requiring very low power, with specific application to robotic missions over long durations. Advanced Manipulators and Tool-Changers - development of innovative robotic manipulators, tool changers, and associated sensors for challenging robotic manipulation tasks, with specific application to EOD and other robotic missions in difficult environments. This research would extend previous research by providing robust end effector technology and tool changing capability. The overall research outcomes will enhance DoD capability in the areas of explosive ordnance disposal, autonomous vehicle refueling, and innovative robotic arm control. Research deliverables will include hardware development in the areas of lightweight robotic arms, end effector tools and tool changers, and low power electronics and actuators. Autonomous Vehicles:- This effort will draw from current research and push the technology development to the next level to provide a leap-ahead capability in long endurance, deployable, autonomous, robotic air vehicle using fuel cell electric propulsion systems for high efficiency, even in small vehicles, which can provide robust airborne sensor capabilities for submarines, UUVs, small naval platforms and small dismounted units. Undersea Vehicles: - Funding would be used to acquire a medium sized (12.5 inch diameter) Autonomous Underwater Vehicle as an at sea test platform to advance the state of art of onboard intelligent autonomy. This medium sized UUV is readily amenable to vehicle and sensor testing in the wave pool in the Laboratory for Autonomous Systems Research facility. Subsequently, this would allow at sea testing of State of the art autonomy algorithms (e.g. goal driven autonomy, human cognitive models, Markov decision processes) that allow Navy underwater vehicles to carry out complex mission in denied areas by understanding the environment and adapting mission goals in the context of the commander's intent, with little or no human operator intervention. Autonomous Systems Integration: - To support the Assistant Secretary of Defense (Research and Engineering) (ASD(R&E)) priorities in autonomous systems, and specifically to advance the state of the art in heterogeneous teams of autonomous platforms, (including sensor networks and mobile communication nodes) that can work seamlessly with the warfighter, funding will					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602235N / *Common Picture Applied Research*	**Project (Number/Name)** 0000 / *Common Picture Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
be applied to small air platforms and militarily relevant unmanned ground vehicles to integrate sensors and advanced power sources, and to develop the autonomy software that allows the individual platforms to work together, as well as to work at a peer-to-peer level with the warfighter. This includes advanced human-robot interaction techniques and information processing and presentation techniques that reduce the warfighter's cognitive load and allows him to work with a team of autonomous systems. ***FY 2016 Plans:*** - Complete all FY15 efforts for sustainment of Autonomous Systems and Robotics initiative. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	44.874	42.538	41.185	0.000	41.185

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE supports the development of technologies that enable the transformation to network centric warfare. Net-centric operations include communications and information assurance capabilities to enable all-source data access, tailored dissemination of information to Command and Control (C2) and Intelligence, Surveillance and Reconnaissance (ISR) users across the network, and rapid, accurate decision making based on this information. The operational benefits sought are increased speed of response, accuracy, and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority.

Specific examples of metrics under this PE include:
- Increase network data rates and interoperability across heterogeneous radios; improve dynamic bandwidth management and mobile network connectivity.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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- Increase the understanding of the battlespace by the development of automated tools for extracting information from images and signals, identifying objects, determining relationships among the objects, assessing intent, and generating courses of action.
- Improve the integration of sensors, networks, decision aids, weapons, and supporting systems into a highly adaptive, human-centric, comprehensive maritime system.
- Improve integrated signals electronics packages in small, light-weight, and low-cost satellites to test new concepts for global ship tracking and two-way data exfiltration.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602236N *I Warfighter Sustainment Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	46.202	45.047	45.467	-	45.467	46.269	46.606	46.641	46.448	Continuing	Continuing
0000: *Warfighter Sustainment Applied Res*	0.000	46.202	45.047	45.467	-	45.467	46.269	46.606	46.641	46.448	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on advanced Naval materials; biocentric technologies; environmental quality; human factors and organizational design; medical technologies; and Naval training technologies. Within the Naval Transformation Roadmap, this investment maps to future transformational capabilities and the FORCEnet pillar of the Chief of Naval Operations and the Commandant of the Marine Corps vision for the future -- Naval Power 21.

The ONRG International Science Program mission is to search the globe for emerging scientific research and advanced technologies to enable the Office of Naval Research (ONR) and the NRE to address effectively the current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future Naval missions and capabilities. Within this Global mission, funding for the Naval Science Advisor Program ensures the Fleet/Force (F/F) helps shape the Department of the Navy (DoN) investment in Science and Technology (S&T), develops teaming relationships to rapidly demonstrate and transition technology, supports development of technology-based capability options for naval forces, and enables warfighting innovations based on technical and conceptual possibilities. Science Advisors provide insight into issues associated with Naval Warfighting Capabilities that influence S&T program decision making. The program develops leaders among civilian scientists and engineers in the Naval Research Enterprise (NRE). Upon completion of their tours, Science Advisors return to the NRE with first hand knowledge of the F/F, warfighting issues, and strategic decision making. The Office of Naval Research (ONR) Science Advisor program enables continuous communication and collaboration between the warfighters, the technical community, and strategic development commands.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602236N *I Warfighter Sustainment Applied Res*			
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	46.923	45.056	46.549	-	46.549
Current President's Budget	46.202	45.047	45.467	-	45.467
Total Adjustments	-0.721	-0.009	-1.082	-	-1.082
• Congressional General Reductions	-	-0.009			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.055	0.000			
• SBIR/STTR Transfer	-0.776	0.000			
• Program Adjustments	0.000	0.000	-0.607	-	-0.607
• Rate/Misc Adjustments	0.000	0.000	-0.475	-	-0.475

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602236N / *Warfighter Sustainment Applied Res*	Project (Number/Name) 0000 / *Warfighter Sustainment Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Warfighter Sustainment Applied Res*	0.000	46.202	45.047	45.467	-	45.467	46.269	46.606	46.641	46.448	Continuing	Continuing

A. Mission Description and Budget Item Justification

Efforts in this PE focus on manpower and personnel; Naval systems training and education; human systems integration; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; and biocentric technologies.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: ADVANCED NAVAL MATERIALS	9.531	9.270	8.689	0.000	8.689
Description: Advanced Naval Materials efforts include: developing advanced, high-performance materials; developing processes to reduce weight and cost; and developing enhanced sonar transducers. ***FY 2015 Accomplishments:*** - Continued development of acceptance testing methodologies for advanced transducer, single-crystal, high-strain materials and definition of standardized materials properties and composition ranges. - Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications. - Continued development of continuous, single wall, carbon nanotube composite materials for next generation air and naval platforms. - Continued stainless steel carburization study to enhance corrosion performance. - Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials. - Continued evaluation of low temperature, carburized materials for marine application. - Continued development of coating performance and knowledge database for Naval use. - Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB). - Continued development of innovative sonar transducers based on high-strain, high-coupling, piezoelectric single crystals.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements. - Continued development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials. - Continued acoustic damping coatings for ship tank application. - Continued development of fiber-optic sensors, transducers and demodulation technology for structural health monitoring of ships and submarines. - Continued development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis. - Continued development and application of distributed fiber optic Bragg gratings for structural health monitoring of ships and aircrafts. - Continued development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems. - Continued assessment of the degree of sensitization potential of marine grade Al alloys. - Continued investigation of criteria for stable pitting of stainless steel. - Continued development of surface assessment technologies to measure surface profile and chlorine. - Continued evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges. - Continued studies on fuel cell corrosion. - Continued development of superhydrophobic surface modification technology. - Continued studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys. - Continued development of surface tolerant coating removal methods. - Continued development of processing technologies to fabricate piezoelectric single crystals into complex transducer assemblies. - Continued development of thermal management system(s) to arrest excessive heat fluxes and loads on amphibious ship by advanced Naval/USMC aircraft. - Continued development of the rational engineering design of Al-alloys for naval applications. - Continued to increase emphasis on research efforts to discover innovative fundamental technologies to shape future Naval investments and strategies, leveraging the globe to support the Sailors & Marines of today and tomorrow. - Continued research and development incorporating physics and chemistry of the materials-environment interface, with the focus on materials with melting points above 3000C. - Continued development of quantitative coasting quality assurance tools.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of advanced NDE, SHM and Prognostics Technologies for improved readiness and reliability of air and naval platforms based on new and emerging electronic and photonics materials and devices. - Continued development of advanced structural composites with improved mechanical characteristics, blast resistance, and fire resistance, for more durable and reliable structures by optimizing the resin, the fibers and the interphases with new chemistries, additives and processes. - Continued development and exploitation of new and advanced forms of carbon based nanostructures (Graphene, Nanotubes, Diamond and others) for next generation family of materials and structures with outstanding mechanical, thermal, electrical and energy applications. - Continue development of mixed metal nanopowder additives for liquid fuels. - Complete multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications. - Complete development of advanced, cost-efficient joining of titanium for >25 %weight reduction of large seaborne structures. - Initiated investigating and characterizing cellular structures via additive manufacturing - Initiate development of low AC loss high temperature superconductors for advanced power. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete investigation of criteria for stable pitting of stainless steel. - Complete acoustic damping coastings for ship tank application. - Complete development of mixed metal nanopowder additives for liquid fuels. ***FY 2017 Base Plans:*** - Continue all efforts of FY2016, less those noted as completed above - Complete development and exploitation of new and advanced forms of carbon based nanostructures (Graphene, Nanotubes, Diamond and others) for next generation family of materials and structures with outstanding mechanical, thermal, electrical and energy applications. - Complete development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements. ***FY 2017 OCO Plans:*** N/A					
Title: BIOCENTRIC TECHNOLOGIES	5.952	5.729	5.602	0.000	5.602

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: Biocentric technologies provide novel solutions for naval needs based upon the applications of bio-inspired sensors, materials, processes and systems. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; synthetic biology to produce high-value naval materials or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems. ***FY 2015 Accomplishments:*** Naval Biosciences: - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks and AUV's. - Continued development of microbial fuel cells for powering a linear sensor array - Continued study of microbial electrochemical systems for shipboard desalination/waste-to-energy conversion - Terminated studies of microbial fuel cells for shoreside or shipboard applications. - Initiated study of closed-loop microbial fuels cells - Initiated synthetic biology research on explosive-sensing plants - Initiated researched on microbial electrobiosynthesis of liquid fuels Synthetic Biology for Sensing & Energy Production: - Continued synthetic biology studies of engineered sentinel organisms for environmental surveillance - Terminate long duration, realistic field tests, and modeling studies of autonomous microbial fuel cell power systems for underwater sensor networks Life Sciences and Bioengineering: - Continued marine mammal diagnostics efforts, including immunobioassays for stress and infection detection. - Continued efforts to detect, treat, and prevent diseases in dolphins, including diabetes and kidney stones. - Completed effort to evaluate breath analysis for non-invasive diagnostics in marine mammal medicine. - Completed studies to evaluate candidate probiotics in Altantic bottlenose dolphins. - Completed studies of dolphin regenerative cells for treating a variety of pathologies and disease states in these animals. Neural, Sensory and Biomechanical Systems:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued efforts on naval biosensor to detect brain structures and blood vessels through skull bones - Continued efforts on advanced biomimetic sensing and neural control for human-robot interaction to enable effective collaboration of warfighters and autonomous systems. -Continued integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control. - Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics. - Continued efforts for bio-inspired massively parallel vision systems. - Continued studies to develop brain-based intelligent systems to support high level interaction between warfighters and autonomous systems. - Continued studies to develop electrosence and biosonar for MOC and EOD missions - Continued development of improved recombinant antibodies for biothreat agents - Initiated studies to develop electrosence and biosonar for MOC and EOD missions.					
FY 2016 Plans: Naval Biosciences: - Continue all efforts of FY 2015, less those noted as completed above. Synthetic Biology for Sensing & Energy Production: - Continue all efforts for FY 2015, less those noted as completed above. Life Sciences and Bioengineering: - Continue all efforts for FY 2015, less those noted as completed above. Neural, Sensory and Biomechanical Systems: - Continue all efforts for FY 2015, less those noted as completed above.					
FY 2017 Base Plans: Naval Biosciences: - Continue all efforts of FY 2016, less those noted as completed above. Synthetic Biology for Sensing & Energy Production: - Continue all efforts for FY 2016, less those noted as completed above. - Initiate studies of scalability of microbial liquid fuel component production via electrobiosynthesis or bioreactor methodology					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Life Sciences and Bioengineering: - Continue all efforts for FY 2016, less those noted as completed above. Neural, Sensory and Biomechanical Systems: - Continue all efforts for FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: ENVIRONMENTAL QUALITY ***Description:*** Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements. ***FY 2015 Accomplishments:*** - Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) coating systems for Navy platforms. - Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Continued field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology for reduced drag, and significant fuel savings. - Continued studies on oil emulsion issues and development of novel bilge water treatment systems on existing and new ships. - Completed efforts on improved handheld, waterborne, underwater hull cleaning technologies. - Completed efforts on ballast tank and system design optimization that minimize fuel discharges from compensated systems, minimize sedimentation in clean ballast and compensated ballast tanks, and maximize exchange of organisms during ballast tank exchanges. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:***	2.802	2.627	2.616	0.000	2.616

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: HUMAN FACTORS AND ORGANIZATIONAL DESIGN	5.329	5.124	5.063	0.000	5.063

Description: The overarching objective of this activity is the achievement of FORCEnet and Sea Power 21 goals by developing human factors principles and cognitive models for human centric design, decision support systems for collaborative decision making, and adaptive command and control structures. The CNO's new Maritime Strategy and the Commander Fleet Forces Command complementary plan to revise organization of Maritime Operations Centers (MOC) place high priority on the aforementioned FORCEnet and Sea Power 21 goals. Specific objectives focus on improving small team, platform, task force, and battle group operations by developing advanced human factors technologies for incorporation into operational systems. The goals and payoffs are to enhance human performance effectiveness; improve the timeliness and quality of decision making; develop strategies to mitigate high workload and ambiguity; reduce manning; improve situational awareness and speed of command through a deeper understanding of human capabilities and limitations; and improvement of team decision making in ad-hoc, complex problem solving scenarios. The current specific objectives are:

a) Human Computer Interaction/Visualization: Develop an understanding of the limitations of human perceptual and attentional systems in relation to maximizing user performance when interacting with complex Naval displays. A combination of computational cognitive modeling and psychological studies are employed to determine the capacity limitations on human performance that will undoubtedly have impact in reduced manning requirements, including information-rich weapons platforms. Develop technology for improving human interaction with autonomous systems and for improving virtual reality systems for training purposes.

b) Command Decision Making (CDM): This sub-project consolidates the previous Collaboration and Knowledge Interoperability (CKI) and Organizational Design and Decision Support Systems sub-projects. The CDM subproject is focused at the development of dynamic decision support systems that use automation and expert systems technology to recognize and respond to changing mission and task demands, and will therefor dynamically adapt to present appropriate information, dynamically based on planned and emergent mission requirements. This focus is explicitly intended to deliver decision support that will be more timely and responsive to rapidly evolving operational information needs. Current thrusts within the sub-project are to: 1) Conduct research on the application of cognitive theory to exploit relevant information for effective decision making; 2) Develop models that are operationally context and task sensitive, serving as the basis for a science of context driven decision making; 3) Study and apply research for the effective management of highly complex & time

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
critical decision making; 4) Develop and demonstrate decision support tools that address the timely management of risk and uncertainty in Navy Command and Control. c) Social Network Analysis: Develop computational models, algorithms and technologies for the analysis of conflict and crisis environments and the development of strategies against novel threats, such as terrorism, information warfare, and deception operations. Develop computational approaches to handling very large, social and socio-cultural information and datasets. Develop computational social science approaches to the study of factionalism in social movements and the novel approaches to crowd calming and peacebuilding for civil affairs operations and disaster response. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Human Computer Interaction/Visualization: - Continued research on audio-visual cue integration for 360-degree periscope displays. Utilize eye-tracking, sleep studies and traditional behavioral measures to characterize human performance on periscope-related tasks under a variety of physiological conditions. Command Decision Making (CDM): - Continued to develop task management algorithms applicable to agile supervisory control of teams involving human and autonomous agents. - Continued development of information infrastructure that is operational context sensitive to allow the dynamic prioritization of date based on its anticipated information value and mission criticality. -Continue research building proactive decision support tools for Command and Control. Social Network Analysis: - Continued research on socio-technical aspects of community mobilization and complex humanitarian operations, including the use of novel platforms, social networks and the impact of novel technologies on human behavior in crisis and collaborative contexts. Hybrid Human Computer Systems: Terminated					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Terminated research to address visualization and synthesis from multiple data sources to support autonomous systems and small hybrid teams. - Terminated research on human performance sources of cyber vulnerabilities of UxV systems. - Terminated research in human systems integration to reduce workload and increase operator situation awareness in command information center.					
FY 2016 Plans: Human Computer Interaction/Visualization: - Continue all efforts of FY 2015, less those noted as completed above. Command Decision Making (CDM): - Continue all efforts of FY 2015, less those noted as completed above. - Initiate Research for Navigating in Uncertainty Social Network Analysis: - Continue all efforts of FY 2015, less those noted as completed above. Command Decision Making (CDM): - Continue all efforts of FY 2015, less those noted as completed above. Social Network Analysis: - Continue all efforts of FY 2015, less those noted as completed above. - Initiate development of testbeds and tool chainsfor rapid disaster analyiss and response. - Initiate development of novel information feeds for Pacific Command. Hybrid Human Computer Systems: Terminated					
FY 2017 Base Plans: Command Decision Making (CDM): - Continue all efforts of FY 2016, less those noted as completed above. Social Network Analysis: - Continue all efforts of FY 2016, less those noted as completed above.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
-Initiate efforts on information conflicts, social-cyber behavior and hybrid warfare. ***FY 2017 OCO Plans:*** N/A					
Title: MEDICAL TECHNOLOGIES ***Description:*** This program supports the development of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments; including regenerative medicine technologies and therapeutic/restorative practices for the treatment of combat-related traumatic injuries. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not applied research related to development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee, and Joint Technical Coordinating Group (JTCG) process, to prevent duplication of effort. ***FY 2015 Accomplishments:*** Undersea Medicine: - Continued efforts to reduce operational injuries - Continued studies on decompression sickness (DCS) and arterial gas embolism (AGE), to include novel approaches to the prevention, detection and treatment of DCS/AGE, particularly by nonrecompressive methods. - Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes. - Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness. - Continued studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors. - Continued studies related to optimization of submariner health and performance. Submarine crewmembers are exposed to a variety of unique stressors including prolonged deployments, effects of altered diurnal rhythms, non-standard breathing gases, lack of sunlight, etc that can impact health and performance. - Continued research to explore novel pharmaceutical interventions for hyperbaric oxygen toxicity. - Initiate research on resuscitation therapies for near-drowning victims.	6.069	5.833	6.392	0.000	6.392

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Regenerative Medicine: - Continued program with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM II)) Noise Induced Hearing Loss: - Continued research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Continued efforts to reverse NIHL. - Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields. - Continued efforts for "stress inoculation" to mitigate the impact of exposure to stressful combat environments prior to deployment. - Continued research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies. - Continued research in prevention and treatment of Noise Induced Hearing Loss (NIHL) and tinnitus (ringing in the ears). - Continued research to improve personal protective equipment technology. Noise Induced Hearing Loss-Jet Noise: - Continued Jet Noise Reduction Project, Noise Induced Hearing Loss Program, to utilize analytical modeling and simulation tools anchored by experiment to develop and assess solutions enabling mitigation of jet induced noise from high performance tactical aircraft.					
FY 2016 Plans: Undersea Medicine: - Continue all efforts of FY 2015, less those noted as completed above. - Terminate research into improved cognitive agility for divers and diving supervisors - Terminate research into diver Human Systems Integration (displays and biometric monitoring) Regenerative Medicine: - Continue all efforts of FY 2015, less those noted as completed above. Noise Induced Hearing Loss:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015, less those noted as completed above. Noise Induced Hearing Loss-Jet Noise: - Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** Undersea Medicine: - Continue all efforts of FY 2016, less those noted as completed above. - Complete research on resuscitation therapies for near-drowning victims. Regenerative Medicine: - Continue all efforts of FY 2016, less those noted as completed above. Noise Induced Hearing Loss: - Continue all efforts of FY 2016, less those noted as completed above. Noise Induced Hearing Loss-Jet Noise: - Continue all efforts of FY 2016, less those noted as completed above. Operational Performance Sustainment: - Initiate Operational Performance Sustainment (OPS) research to determine the effects of sleep and circadian disruption on warfighter performance. OPS program will integrate predictive models of performance and demonstrate validity using operationally relevant tasks. The goal is to make predictions of performance decrements due to fatigue "actionable" for commanders at sea. ***FY 2017 OCO Plans:*** N/A					
Title: THE OFFICE OF NAVAL RESEARCH GLOBAL ***Description:*** ONR has a presence overseas, with an overarching purpose to search the globe for promising, emerging scientific research and development efforts to address the current needs of the Fleet/Forces, and investigate high-payoff technologies for future naval missions and capabilities. To accomplish this task, ONR capitalizes on global innovation and investment to solve U.S. Navy and Marine Corps science and technology	11.699	11.864	12.235	0.000	12.235

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total

(S&T) challenges, builds global S&T awareness to mitigate risk of potential technological surprise, ensures Fleet/Forces capability needs are communicated to the Naval Research Enterprise (NRE), and facilitates delivery of Naval S&T solutions to the Fleet/Forces.

FY 2015 Accomplishments:

International Science Program:

The ONR International Science Program mission is to search the globe for emerging scientific research and advanced technologies, to enable the Office of Naval Research (ONR) and the Naval Research Enterprise (NRE) to effectively address current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future naval missions and capabilities. This is accomplished through PHD-level Associate Director scientists located in Asia, Europe and South America collaborating with international organizations and researchers through grants in innovative applied research, and establishing quality, relevant connections between international science and technology (S&T) centers of excellence and DON, DOD, and other US Government organizations. The direct impact of this investment is to capitalize on international applied research during unprecedented and dynamic global interdependence, increasing the ability to solve DON S&T challenges through shared knowledge and technologies with partners. Additionally, this investment builds global S&T awareness to reduce the risk of potential technological surprise, and supports theater security cooperation goals to sustain cooperative relationships with an expanding set of international partners and to enhance global security.

Fleet/Forces Science Advisors:

The Naval Science Advisor (SA) Program under 6.2 funding ensures the Naval Fleet/Forces shape the DON investment in applied research S&T and develops teaming relationships to support and develop technology-based capability options for Naval Fleet/Forces. Funding is also dedicated to applied research efforts in support of the various Naval Fleet/Forces operational commands. The Science Advisors (SA) are a conduit between the Naval Fleet/Forces, ONR, Naval Research Lab (NRL) and the entire Naval Research and Development Establishment (NRDE).

- SA, OPNAV N2/N6 advises the Deputy CNO for Information Dominance, and Flag and SES leadership on Navy S&T programs that address information dominance; member of FNC Technical Oversight Group (TOG) Working Group which prioritizes and selects fifteen EC products that address nine FNC Pillars (i.e. FORCEnet, Sea Strike, Shield, and Basing); member of the FORCEnet IPT, Rapid Technology Transition Team, and Joint Concept Technology Demonstration Team that reviewed technology programs for the Fleet. Science Advisors

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
serve in various Operational Commands, Support Commands and OPNAV Commands. Specific examples of Fleet/Forces Science Advisors include the following: - SA, OPNAV N9, serves as the command's principal advisor and the senior representative of the DCNO on initiatives with S&T and Research and Development (R&D) organizations in government, academia, and industry. Advises on technical developments in support of platform warfighting wholeness and informs DCNO on strategic and program issues as they relate to topics in decision forums; and on S&T factors outside the normal Navy program planning process that could afford strategic opportunities or affect or disrupt existing strategies, investments and plans. - SA, Commander, Navy Air and Missile Defense Command, (NAMDC) serves as the command's principal advisor and the representative of the Commander on Integrated Air and Missile Defense (IAMD) initiatives with S&T and R&D organizations in government, academia, and industry. The SA works as part of the Third Fleet Sea Shield Fleet Collaborative Team representing NAMDC. The SA looks at the applied research and S&T aspects of IAMD and align them with the defense industry to pinpoint key requirements and emerging new technologies. - SA, Navy Warfare Development Command (NWDC), provides technical support for the generation and development of advanced warfighting concepts leading to innovative new strategies to address Navy challenges and opportunities. - SA, CNO Strategic Studies Group (SSG) fully partners in the generation of revolutionary warfighting concepts for the Navy of the future. Along with the Technology Fellows, the SA develops the SSG Fall Program which includes researching and inviting lecturers to address the SSG and developing engaging and mind-opening exploration travel for the CNO Fellows and mini exploration travel for all SSG members. - SA, Chief of Naval Operations Code N81 (OPNAV N81) focuses on disseminating the Navy's warfighting capability/risk analysis products to the broader S&T community resulting in an improved influence of requirements pull on S&T. - SA, is part of the ONR internal strategy cell membership for updating the Navy S&T Strategic Plan. - SA, Naval Mine and Anti-Submarine Warfare Command (NMAWC) works with the Commander NMAWC who is the lead for the FNC ASW sub-Integrated Program Team (IPT). The SA is directly responsible to the Commander for drafting/modifying capability gaps and enabling capabilities (EC) ideas, vetting them through the					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
sub-IPT members, incorporating modifications, and providing the final recommendation to the Commander for presentation to the Sea Shield IPT. The SA advises Commander on Navy's Tactical ASW and MIW support and countermeasures. ***FY 2016 Plans:*** International Science Program: - Continue all efforts of FY 2015, less those noted as completed above. Fleet/Forces Science Advisors: - Continue all efforts of FY 2014. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: TRAINING TECHNOLOGIES ***Description:*** Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, while deployed, and to operate effectively in the complex, highstress, information-rich and ambiguous environments of modern warfare such as asymmetric warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training. ***FY 2015 Accomplishments:*** Cognitive Science of Learning: - Continued research and assessment of advanced gaming technology for enhanced training. - Continued creation and conduct of experiments to validate automated performance assessment and after action reviews. - Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring. - Continued research in the neuro-biology of learning including integration of the role of white matter.	4.820	4.600	4.870	0.000	4.870

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of games that incorporate AI techniques to teach complex warefighter skills decision-making and problem solving. - Continued development of intelligent avatars to interact with learners from different cultural, linguistic backgrounds, and preferences. - Continued development of scenarios generators that produce integrated training (e.g., individual and collective) training. - Continued development of optimal training strategies for intelligent jobs on mobile devices (e.g., IPad). - Continued development of immersive environments for training interpersonal and leadership skills. - Continued design and conduct experiment to assess training effectiveness of intelligent tutor for training ship handling skills. - Continued development of novel psychometric approaches to assess human performance in medical/ military simulations and simulators. - Continued research in design features of medical and military simulators and simulations. - Continued field studies and user tests evaluating new features and job aiding tools. - Continued research into computational neuron-models in the design of training systems. Enhancing Warfighter Cognitive Capability: - Continued research to understand the structural relations among the latent variables of short-term memory, working memory, executive attentional control, and fluid intelligence. - Continued research to assess the improvement in recruit classification provided by the addition of measures of fluid intelligence and working memory. - Continued research to understand the role of intrinsic motivation in facilitating the transfer of working memory training to other cognitive capabilities. - Continued research to assess the efficacy of game-based brain training using hand-held (fieldable) hardware platforms. - Continued research to determine the relationship between induced gains in fluid intelligence and cognitive adaptability and agility, considered from the perspective of military decision-making. - Continued task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates. Computational Models of Human Behavior: - Continued research into game based training to more effectively enable better warfighter understanding of languages and cultures to enhance their regional expertise.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring. - Continued the integration of cognitive and neuron-computational models of human learning. ***FY 2016 Plans:*** Cognitive Science of Learning: - Continue all efforts of FY 2015, less those noted as completed above. - Initiate development of skill decay models for psychomotor, perceptual, and cognitive skills and refresher training strategies. - Initiate development of intelligent avatars to interact with learners from different cultural, linguistic backgrounds, and preferences. - Initiate development of scenarios generators that produce integrated training (e.g., individual and collective) training. Enhancing Warfighter Cognitive Capability: - Continue all efforts of FY 2015, less those noted as completed above. Computational Models of Human Behavior: - Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** Cognitive Science of Learning: - Continue all efforts of FY 2016, less those noted as completed above. Enhancing Warfighter Cognitive Capability: - Continue all efforts of FY 2016, less those noted as completed above. Computational Models of Human Behavior: - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	46.202	45.047	45.467	0.000	45.467

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602236N / *Warfighter Sustainment Applied Res*	**Project (Number/Name)** 0000 / *Warfighter Sustainment Applied Res*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

As discussed in Section A, there are a significant number of varied efforts within this PE. Each effort is measured against both technical and financial milestones. Each program effort and its projects are reviewed in depth for technical and transition performance against established goals. The Program Managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or biannual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602271N *I Electromagnetic Systems Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	102.750	114.644	118.941	-	118.941	132.104	124.886	125.284	120.756	Continuing	Continuing
0000: *Electromagnetic Systems Applied Research*	0.000	102.750	114.644	118.941	-	118.941	132.104	124.886	125.284	120.756	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan, approved by the S&T Corporate Board (20 January 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

The Electromagnetic Systems Applied Research Program addresses technology needs associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This program directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this Program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

Also included in this PE is the Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS) Innovative Naval Prototype (INP). NEMESIS technology addresses the need to generate the appearance of a realistic naval force to multiple adversarial surveillance and targeting sensors simultaneously.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602271N *I Electromagnetic Systems Applied Research*		
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	107.663	115.051	113.651	-	113.651
Current President's Budget	102.750	114.644	118.941	-	118.941
Total Adjustments	-4.913	-0.407	5.290	-	5.290
• Congressional General Reductions	-	-0.407			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.350	0.000			
• SBIR/STTR Transfer	-2.563	0.000			
• Program Adjustments	0.000	0.000	4.774	-	4.774
• Rate/Misc Adjustments	0.000	0.000	0.516	-	0.516

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602271N / *Electromagnetic Systems Applied Research*	Project (Number/Name) 0000 / *Electromagnetic Systems Applied Research*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Electromagnetic Systems Applied Research*	0.000	102.750	114.644	118.941	-	118.941	132.104	124.886	125.284	120.756	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses technology opportunities associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The project supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This project directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: ELECTRONIC WARFARE TECHNOLOGY	61.138	71.024	70.269	0.000	70.269
Description: The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Electronic Warfare (EW) systems across the entire electromagnetic spectrum (EMS) that will increase the operational effectiveness and survivability of U.S. Naval units. Emphasis is placed on passive sensors and active and passive countermeasure (CM) systems that exploit and counter a broad range of electromagnetic threats. The focus is on maintaining near perfect, real-time knowledge of the enemy; countering the threat of missiles against deployed Naval forces; precision identification and location of threat emitters; and development of technologies that have broad application across multiple disciplines within the EW mission area. This activity also includes developments to protect these technologies from external interference, and modeling and simulation required to support the development of these technologies. Also included is technology development in support of the Integrated Distributed Electronic Warfare System (IDEWS) concept. The objectives reported in prior years under this R-2 Activity have been consolidated into the current objectives described below. The current objectives are:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- EW RF Technology: Develop and demonstrate technologies in the Radio Frequency (RF) spectrum (covering frequencies from kilohertz to terahertz) that include developments in detection, signal processing and passive/ active techniques for wideband Electronic Attack (EA), Electronic Protection (EP) and the Electronic Support (ES) mission areas. - EW EO/IR Technology: Develop and demonstrate technologies in the Electro-Optic and Infrared (EO/IR) spectral domain (extending from the ultraviolet to the far infrared spectral bands) that include advances in multispectral sensors, multiband sources, beam forming/steering, and signal processing and transmission. - EW Integrated and Networked Technology: Develop and demonstrate technologies that will enable an increased situational awareness and response across the electromagnetic spectrum (EMS) with broad spatial coverage using all available EW assets to provide coordinated, adaptive and networked EW sensing, protection and attack. - Advanced EW Enabling Technologies (Formerly Titled: Electronic Warfare (EW) Roadmap): Develop classified advanced electronic warfare technology in support of current and predicted capability requirements. - Electromagnetic Maneuver Warfare Command & Control (EMC2) (FY16-FY20): Enable a battle group to work cooperatively in the EM Spectrum (EMS) to optimize Electronic Warfare (EW), Information Operations (IO), Communications (Comms) and Radar performance. EMC2 will build upon the Resource Allocation Manager (RAM) that was previously developed for single multifunction systems under the InTop program to optimize spectrum and functional use across a platform and an entire battle group. Increase in funding from FY 2015 to FY 2016 is due to added new INP Electromagnetic Maneuver Warfare Command & Control. (EMC2) The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** EW RF Technology: - Continued development of a monolithic optical chip set capable of multi-function radio-frequency signal processing for EW applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of technology to improve transmit/receive isolation by properly controlling surface currents with engineered materials. - Continued development of photonic techniques for broadband electronic surveillance systems. - Continued development of innovative high data-rate protected communications to circumvent malicious cyber-attack (Project Calliope). - Continued development of a millimeter wave Rotman Lens-based electronic attack transmitter. - Continued technology development in transmit-to-receive isolation technologies and techniques, relevant to the spectral range of 1 to 110 GHz. - Completed technology development in the areas of wideband cueing receiver concepts. - Completed development in critical receiver components that operate across the entire 1-110 GHz spectral range. - Completed technology development in high power critical EA system components that operate across the entire 1-110 GHz spectral range. - Completed development in transmitter systems (consisting of power amplifier(s), matching network, and radiating element) capable of achieving 4-10 kW or greater Effective Radiated Power (ERP) for small decoy applications or capable of being combined to achieve 100 kW or greater ERP for large platform applications across the entire 18-45 GHz frequency range. - Completed development of a process to determine direction of arrival based on multipath distortion of the received emission. - Completed development of all-optical techniques for signal processing to provide multifunction RF capability. - Completed development of a mmW Rotman Lens-based EA transmitter. - Completed development of a countermeasures technique using a new novel approach. - Completed research into determining the vulnerability of modern communications systems. - Initiated the development of Sub-System Demonstrators (SSDs) leveraging wideband RF components and sub-systems from prior DoD investments to demonstrate advanced ES and EA capabilities covering a broad range of RF frequencies in support of Navy and Marine Corps mission areas. - Initiated development of Infrared Gradient Index optics and associated SWaP advantages for multispectral imagers in a prototype system. EW EO/IR Technology: - Continued development of semiconductor-based, multi-wavelength integrated laser sources spanning multiple bands of the ultraviolet, visible, near IR, mid-wave IR, and long-wave IR.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed development of multi-wavelength integrated laser sources with optical fibers/waveguides as the lasing media. - Completed development of non-mechanical beam steering technologies to allow coherent energy to span multiple bands of the EO/IR spectrum. EW Integrated and Networked Technology: - Continued development of a Bayesian statistical framework paired with a novel stochastic algorithm to support EW probability of raid annihilation analysis. - Initiated technologies that develop new methods to represent real-time dynamic spectrum knowledge, sense and learn signal characteristics and behaviors, and to reason about threat systems and the environment to form EA strategies on-the-fly. - Initiated technologies that develop extremely high-volume processing capabilities for reconfigurable EW systems. - Initiated development of fast signal classification of coherent radar signals for use in chanelized digital transceiver systems to support rapid countermeasure response. Advanced EW Enabling Technologies (Formerly Titled: Electronic Warfare (EW) Roadmap): - Continued development of classified, advanced, electronic warfare technology in support of current and predicted capability requirements.					
FY 2016 Plans: EW RF Technology: - Continue all efforts of FY 2015 less those noted as completed above. - Complete the development of photonic techniques for broadband electronic surveillance systems. - Complete the development of innovative high date-rate protected communications to circumvent malicious cyber-attack (Project Calliope) EW EO/IR Technology: - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of semiconductor-based, multi-wavelength integrated laser sources spanning multiple bands of the ultraviolet, visible, near IR, mid-wave IR, and long-wave IR. EW Integrated and Networked Technology:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015. - Complete development of a Bayesian statistical framework paired with a novel stochastic algorithm to support EW probability of raid annihilation analysis. Advanced EW Enabling Technologies (Formerly Titled: Electronic Warfare (EW) Roadmap): - Continue all efforts of FY 2015. Electromagnetic Maneuver Warfare Command & Control (EMC2): - Initiate Wideband Airborne Multifunction System design - Initiate Low Band RF Intelligent Distributed Resource (LowRIDR) SubSystem build - Initiate Electromagnetic Warfare Command and Control system design ***FY 2017 Base Plans:*** EW RF Technology - Continue all efforts of FY 2016 less those noted completed above. EW EO/IR Technology: - Continue all efforts of FY 2016 less those noted completed above. - Initiate the development of SSDs leveraging multiband EO/IR components and sub-systems from prior DoD investments to demonstrate advanced ES and EA capabilities covering a broad range of EO/IR wavelengths in support of Navy and Marine Corps mission areas. EW Integrated and Networked Technology - Continue all efforts of FY 2016 less those noted completed above. - Complete development of fast signal classification of coherent radar signals for use in chanelized digital transceiver systems to support rapid countermeasure response. Electromagnetic Maneuver Warfare Command & Control (EMC2): - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Title: EO/IR SENSOR TECHNOLOGIES	5.340	5.913	5.314	0.000	5.314

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: The overarching objective of this thrust is to develop technologies that enable the development of affordable, wide area, persistent surveillance optical architectures, day/night/adverse weather, adaptable, multi-mission sensor technology comprised of optical sources, detectors, and signal processing components for search, detect, track, classify, identify (ID), intent determination, and targeting applications and includes developments to protect these technologies from external interference. Also included are modeling and simulation required to support the development of these technologies. Efforts will also include the development of optical RF components, infrared technologies including lasers and focal plane arrays using narrow bandgap semiconductors. The current specific objectives are: a) Optically Based Terahertz (THz) and Millimeter Wave (MMW) Distributed Aperture Systems: Develop optically based terahertz (THz) and millimeter wave distributed aperture systems for imaging through clouds, fog, haze and dust on air platforms. b) Wide Area Optical Architectures: Develop wide area optical architectures for persistent surveillance for severely size constrained airborne applications. c) Hyperspectral sensors and processing: Develop visible, shortwave IR, mid-wave IR, and long-wave IR hyperspectral sensors, along with processing algorithms to detect anomalies and targets. d) Coherent Laser Radar (LADAR): Develop and improve components for LADAR applications including fiber lasers, coherent focal planes, and advanced processing. e) Autonomous and Networked sensing: Develop algorithms and processing that supports autonomous sensing for UAV platforms and that supports networked sensing over multiple sensors and/or sensor platforms. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued the development of range-gated image reconstruction using optical phase conjugation. - Continued development of a robust imaging capability to provide situational awareness in brownout conditions during takeoff/landing operations in desert environments. - Continued miniaturization and modularization of MMW imaging system components for small platform systems. - Continued progressing the integration of spectrally agile multi-band sensors into integrated system for use in persistent and time critical surveillance. - Continued progressing the processing architecture for data analysis and fusion of multi-spectral images. - Continued development of range-gated image reconstruction using optical phase conjugation. Wide Area Optical Architectures: - Continued development of mid and long wave IR focal plane arrays using graded-bandgap, Wtype-II, superlattices with much higher detectivity than state-of-the-art Mercury Cadmium Telluride (HgCdTe,MCT) FPAs. - Continued design of read-out integrated circuits for temporally adaptive focal plane arrays. - Continued development of spectrally agile visible, near-infrared, short-wave infrared and midwave infrared imaging technology. - Continued development of super-resolution techniques in Wide Field of View Mid-Wave Infrared (WFOV MWIR) sensors. - Initiated effort to develop components, study and demonstrate optical links that allow quantum key distribution (QKD) through free space using modulating retro-reflectors (MRRs). Hyperspectral sensors and processing: - Continued integration of hyperspectral instruments onto test platforms. - Continued processing of hyperspectral data from a maritime environment. - Continued effort to develop mid-wave infrared focal plane arrays using plasmonically coupled antimonide based majority carrier barrier device structures on advanced digital readouts for ultra low size, weight, and power night-time wide area surveillance. Coherent Laser Radar (LADAR): - Continued development of fiber lasers and coherent focal plane arrays suitable for LADAR applications. - Continued effort to develop fiber-based long wave infrared agile, narrow-band and broadband laser sources for sensing and counter measure applications. - Completed fabrication and modeling of silicon photonic chips for one dimensional beam steering.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Autonomous and Networked sensing: - Continued development of algorithms and processing that supports autonomous sensing for UAV platforms - Continued development of algorithms and processing that supports networked sensing over multiple sensors and/or sensor platforms.					
FY 2016 Plans: Optically Based Terahertz (THz) and Millimeter Wave Distributed Aperture Systems: - Continue all efforts of FY 2015. - Complete the development of range-gated image reconstruction using optical phase conjugation. (FY16)					
Wide Area Optical Architectures: - Continue all efforts of FY 2015, unless noted as completed above.					
Hyperspectral sensors and processing: - Continue all efforts of FY 2015. - Complete effort to develop mid-wave infrared focal plane arrays using plasmonically coupled antimonide based majority carrier barrier device structures on advanced digital readouts for ultra low size, weight, and power night-time wide area surveillance.					
Coherent Laser Radar (LADAR): - Continue all efforts of FY 2015 less those noted as completed above. - Complete effort to develop fiber-based long wave infrared agile, narrow-band and broadband laser sources for sensing and counter measure applications.					
Autonomous and Networked sensing: - Continue all efforts of FY 2015.					
FY 2017 Base Plans: Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: - Complete development of a robust imaging capability to provide situational awareness in brownout conditions during takeoff/landing operations in desert environments. - Complete miniaturization and modularization of MMW imaging system components for small platform systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete progressing the integration of spectrally agile multi-band sensors into integrated system for use in persistent and time critical surveillance. - Complete progressing the processing architecture for data analysis and fusion of multi-spectral images. Wide Area Optical Architectures: - Continue all efforts of FY 2016 less those noted as complete above. Hyperspectral sensors and processing: - Continue all efforts of FY 2016 less those noted as complete above. Coherent Laser Radar (LADAR): - Continue all efforts of FY 2016 less those noted as complete above. Autonomous and Networked sensing: - Continue all effort of FY 2016. - Initiate development of multi-mode (spectral, polarization, temporal) imaging sensors for detecting low observable targets and for imaging through degraded visual environments. - Initiate development of extremely sensitive mmW detector technology. ***FY 2017 OCO Plans:*** N/A					
Title: NAVIGATION TECHNOLOGY	4.776	4.451	7.281	0.000	7.281
Description: The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using the GPS, non-GPS navigation devices, and atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on GPS Anti-Jam (AJ) Technology; Precision Time and Time Transfer Technology; and Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost Inertial Navigation Systems (INS). The current specific objectives are: a) GPS AJ Antennas and Receivers:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Develop anti-jam and anti-spoofer antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of emerging electronic threats. b) Precision Time and Time Transfer Technology: Develop tactical grade atomic clocks that possess unique, long-term stability and precision for the purpose of providing GPS-independent precision time, and the capability of transferring precision time via radio frequency links precision time. c) Non-GPS Navigation Technology: Develop inertial/bathymetric/gravity navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. The increase from FY 2016 to FY 2017 is due to increased funding for the Navigation and Precision Timekeeping initiative. ***FY 2015 Accomplishments:*** GPS Anti-Jam Antennas and Receivers: - Continued Precise at-Sea Ship System for Indoor Outdoor Navigation (PASSION) project. - Continued development of Military User Equipment Integrated Fault Analysis effort. - Continued and completed Anti-tamper Investigation Support. - Continued and completed System for enhanced electronic protection, electronic support and precision navigation. - Continued Cognitive Modernized GPS User Equipment (MGUE) with Chaotic Timing Signals for GPS Denied Environments project. - Complete GPS Moderized Integrated Spoofer Tracking (MIST). Precision Time and Time Transfer Technology: - Continued Evolved Global Navigation Satellite System (GNSS) Signal Monitoring Receiver Element project. - Continued developing Advanced-Development of a Miniature Atomic Clock. - Continued analysis of Code Distortion in Modernized GPS Signals on GPS Timing Receiver.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of Compact and Versatile Passively CEP (carrier envelope phase) Stabilized Optical Clock system. - Initiated Robust Ultra-Precise Time Transfer Technology project. Non-GPS Navigation Technology: - Continued Optically Transduced Inertial Navigation System (INS) Sensor Suite (OPTIMUSS) project. - Continued development of the Three-Axis Resonant Fiber Optic-based Inertial Navigation System with the accuracy of 10 milli(m)-degrees per hour and the angle random walk (ARW) of 10 milli (m)-degrees per root hour. - Continued development of Micro-Electro-Mechanical System (MEMS) Gyro effort. - Completed development of Portable Precision Celestial Navigation System. - Completed Alternative Image-based Navigation project. - Continued Embedded Sonar Aided Inertial Navigation Technology (SAINT) project. - Continued MEMS Inertial Navigation System Phase II project. - Initiated Absolute Reference Grade Cold Atom and Super Conducting Navigation project.					
FY 2016 Plans: GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2015 less those noted as completed above. - Complete Cognitive MGUE with Chaotic Timing Signals for GPS Denied Environments. - Complete Precise at-Sea Ship System for Indoor Outdoor Navigation (PASSION) project. Precision Time and Time Transfer Technology: - Continue all efforts of FY 2015. - Initiate Precision Optical Clock Technology Development Non-GPS Navigation Technology: - Continue all efforts of FY 2015 less those noted as completed above. - Complete Embedded Sonar Aided Inertial Navigation Technology (SAINT) project. - Initiate Cold Atom INS Sensor Technology Development.					
FY 2017 Base Plans: GPS Anti-Jam Antennas and Receivers: - Complete development of Military User Equipment Integrated Fault Analysis effort.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate at multi-constellation GPS receiver effort for high anti-jam and anti-spoof with wideband frontend. - Initiate research in application of advanced processing methods for robust GPS operation in challenged environments. Precision Time and Time Transfer Technology: - Continue all efforts of FY 2016. - Continued analysis of Code Distortion in Modernized GPS Signals on GPS Timing Receiver. - Continued developing Advanced-Development of a Miniature Atomic Clock. - Complete development of Compact and Versatile Passively CEP (carrier envelope phase) Stabilized Optical Clock system. - Complete Evolved Global Navigation Satellite System (GNSS) Signal Monitoring Receiver Element project. - Initiate Optical Clock development efforts for compact, deployable next generation clock technology to greatly surpass current Rubidium and Cesium standards, providing the ultimate in time holdover in GPS denied environments. - Initiate RF and Optical time transfer effort for terrestrial, surface, and airborne platforms. Non-GPS Navigation Technology: - Continue all efforts of FY 2016. - Complete Optically Transduced Inertial Navigation System (INS) Sensor Suite (OPTIMUSS) project. - Complete development of Micro-Electro-Mechanical System (MEMS) Gyro effort. - Complete MEMS Inertial Navigation System Phase II project. - Initiate hybrid velocity measuring sonar system for compact underwater and surface platforms. - Initiate development of a thermal or cold atom beam 3 axis navigator. - Initiate investigation of compact indexed inertial for airborne, weapon, or UUV platforms. ***FY 2017 OCO Plans:*** N/A					
Title: SOLID STATE ELECTRONICS ***Description:*** The overarching objective of this activity is to develop higher performance components and subsystems for all classes of military RF systems that are based on solid state physics phenomena and are enabled by improved understanding of these phenomena, new circuit design concepts and devices, and improvements in the properties of electronic materials. An important subclass are the very high frequency	9.187	9.923	12.856	0.000	12.856

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Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
(VHF), ultra-high frequency (UHF), microwave (MW), and millimeter wave (MMW) power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapon systems. Another subclass are the analog and high speed, mixed signal components that connect the electromagnetic signal environment into and out of digitally realized, specific function systems. These improved components are based on both silicon (Si) and compound semiconductors (especially the wide bandgap materials and narrow bandgap materials), low and high temperature superconductors, novel nanometer scale structures and materials. Components addressed by this activity emphasize the MMW and submillimeter wave (SMMW) regions with an increasing emphasis on devices capable of operating in the range from 50 gigahertz (GHz) to 10 terahertz (THz). The functionality of the technology developed cannot be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, operational and instantaneous bandwidth, weight, and size. Effort will involve understanding the properties of engineered semiconductors as they apply to quantum information science and technology. This activity also includes Anti-Tamper development of innovative techniques and technologies to deter the reverse engineering and exploitation of our military's critical technology and critical program information in order to impede technology transfer and alteration of system capability and prevent the development of countermeasures to U.S. systems. The current specific objectives are: a) Solid State Transistors and Devices: Develop solid state transistors and devices for high frequency analog and digital operation. b) High Efficiency, Highly Linear Amplifiers: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications. c) Superconducting Electronics: Develop components for RF systems utilizing superconducting and other technologies which are designed to deliver software defined, wide band, many simultaneous signal functionality over a wide range of frequencies, in increasingly field-ready packaging and demonstrate the ability of these components to be combined into chains to deliver superior functionality in conventional system contexts, including, but not limited to, SATCOM, Electronic Warfare (EW), signal intelligence (SIGINT), and communications. d) Control, Reception, Transmission, and Processing of Signals: Develop electronics and photonics technology that provides for the control, reception, transmission and processing of signals.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
e) Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: Develop novel nanometer scale (feature size at or below 10nm) logic/memory devices and related circuits and architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters. f) Anti-Tamper: Develope innovative techniques and technologies to deter the reverse engineering and exploitation of our military's critical technology and critical program information in order to impede technology transfer and alteration of system capability and prevent the development of countermeasures to U.S. systems. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. The increase from FY 2016 to FY 2017 is due to increased funding for the Electromagnetic Applied Research initiative. ***FY 2015 Accomplishments:*** Solid State Transistors and Devices: - Continued effort to develop and exploit reduced dimensionality transistors. - Continued effort to develop a high performance graphene base hot electron transistor. - Continued development of an integrated, tunable, frequency selective and low noise integrated module. - Continued effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors. - Continued MMW field plate GaN High Electron Mobility Transistor (HEMT) development. - Continued progressing mixed-signal GaN Monolithic Microwave Integrated Circuit (MMIC) technology development. - Continued investigations into ultra-low noise, Group III-Nitride, transistor structures for RF and mm-wave receivers and transmitters. - Continued group III-Nitride transistor development for 1 THz circuits. - Continued development of discrete, channelized, Gallium Nitride Transistors for linear and low noise transmit and receive amplifiers. - Continued development of high power density mm-wave transistor technology. - Continued effort to develop ultra-scaled AlN/GaN transistors to enable superior RF amplifier performance in G-band applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete effort to develop advanced graphene field-effect transistor (FET) technology for higher transistor cut-off frequency and lower power consumption in low-noise receivers. - Initiated heterogeneous 2D transistor development. High Efficiency, Highly Linear Amplifiers: - Continued effort to develop transmit and receive components using reduced dimensionality transistors. - Continued development of MMW AlGaN/GaN wide bandgap HEMT. - Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. - Continued high-efficiency microwave GaN HEMT amplifier development. - Continued work on GaN MMW components at >44 GHz to allow for EHF SATCOM insertion and other MMW applications spanning to 95GHz. - Continued expansion of scope of the GaN MMW device program. - Continued and demonstrate Low-Noise, High Dynamic Range Receiver Chain for Simultaneous Transmit and Receive (STAR) Applications. - Continued component development in support of multifunctional electronic warfare. - Continued transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications. - Continued development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems. - Continued development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications. - Continued Sub-MMW GaN Device technology for communications, target identification and high speed data processing. - Continued development of GaN Monolithic Microwave Integrated Circuit (MMIC) Amplifier Technology for operation greater than (>)100 GHz. - Continued development of high efficiency GaN amplifier MMICs for 50-100 GHz operation. - Continued low-noise, high dynamic range Group-III Nitride amplifier development for W-band receivers. - Continued development of group III-Nitride amplifiers for terahertz amplification. - Continued development of high power density, high output power, solid state mm-wave amplifiers. Superconducting Electronics:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued effort to develop reprogrammable superconducting digital filters capable of limiting Instantaneous Bandwidth (IBW) of output data stream from Analog-to-Digital Converter (ADC) to user defined choices and doing this with >10X lower processing latency and energy cost than possible in room temperature circuits. - Continued effort to design of Analog-to-Digital Converters (ADC) to enhance minimum detectable signal sensitivity levels by 10 dB. - Continued development of effort to improve superconducting analog to digital converter performance by more than 2 bits as well as 2x in sample rate. - Continued research on components needed to achieve improved interference immunity. - Completed development of first packaged prototype of 1 cm squared HF-UHF antenna for space limited platforms such as UAVs. - Completed development of mixed superconducting/semiconducting output circuits that allow energy efficient data transfer to room temperature at >10 Gbps per line and precision amplification of signals returned to the superconducting domain. These technologies are critical to the delivery of maximum system functionality from superconducting electronics and enable transmitter interference mitigation in wideband receivers. - Initiated heterogeneous component technology development to enable performance enhancement of analog-digital converters and ultra-wideband receivers and transmitters. Control, Reception, Transmission, and Processing of Signals: - Continued efforts to develop compact, high performance switch, filter, and high isolation device technologies for agile, broadband signal processing in cluttered environments. - Continued development of Gallium Nitride-based low-noise components for Interference Immune Navy Satcom receivers. - Continued investigations into low-noise, high dynamic range group-III Nitride receiver components for W-band and higher signal detection. - Continued development of group III-Nitride terahertz receive technologies. - Continued work on multi-THz real-time signal processing using combination of high speed electronic, photonic, and metamaterial techniques. - Continued research into affordable digital array, interfacing technologies using low power, mixed signal approaches, wafer scale antennas, and analog photonic transmission techniques. - Continued research into compact, broadband filter and channelizer components targeting multi-octave operation in the range from VHF to W-band. - Continued effort to develop micro-miniature ferroelectrically active tunable acoustic wave devices for fast reconfiguration of circuits and systems operating at microwave through sub-millimeter-wave frequencies.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated RF electronics and photonics development to implement wideband Simultaneous Transmit and Receive sensing and communications apertures on disadvantaged platforms. Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Continued developing new research in graphene synthesis and device concepts. - Continued work on graphene based devices and circuits for low power flexible electronics. - Continued research on graphene-organic hybrid materials interfaces and device structures. - Initiated large-scale hexagonal boron nitride (hBN) synthesis as substrate for graphene and other 2D materials. Anti-Tamper: - Continued efforts to develop physically unclonable functions and high density 3D packaging technologies. - Continued efforts to develop destruct mechanisms that do not cause collateral damage. - Continued efforts to develop advanced sensors and coatings.					
FY 2016 Plans: Solid State Transistors and Devices: - Continue all efforts of FY 2015 less those noted as completed above. - Complete effort to develop ultra-scaled AlN/GaN transistors to enable superior RF amplifier performance in G-band applications. - Initiate development of ultra-efficient mm-wave transistors. High Efficiency, Highly Linear Amplifiers: - Continue all efforts of FY 2015. - Initiate research into harmonic mm-wave amplifiers Superconducting Electronics: - Continue all efforts of FY 2015 less those noted as completed above. Control, Reception, Transmission, and Processing of Signals: - Continue all efforts of FY 2015. - Complete effort to develop micro-miniature ferroelectrically active tunable acoustic wave devices for fast reconfiguration of circuits and systems operating at microwave through sub-millimeter-wave frequencies.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Continue all efforts of FY 2015. Anti-Tamper: - Continue all efforts of FY 2015.					
FY 2017 Base Plans: Solid State Transistors and Devices: - Continue all efforts of FY 2016 less those noted as completed above. - Initiate development of highly linear source electric field engineered HEMT devices. - Initiate development of ultra-efficient nitrogen-polar mm-wave transistors. - Initiate Electromagnetic Applied Research initiative. High Efficiency, Highly Linear Amplifiers: - Continue all efforts of FY 2016 less those noted as completed above. - Complete and demonstrate Low-Noise, High Dynamic Range Receiver Chain for Simultaneous Transmit and Receive (STAR) Applications. - Initiate high output impedance RF amplifier development for photonically-enabled STAR architectures. Superconducting Electronics: - Continue all efforts of FY 2016 less those noted as completed above. - Initiate realization of RF mixed signal components predicted to have significantly improved performance using newly available switching devices. Control, Reception, Transmission, and Processing of Signals: - Continue all efforts of FY 2016 less those noted as completed above. - Initiate development of high RF impedance electro-optic modulators for photonically-enabled STAR architectures. Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Continue all efforts of FY 2016. Anti-Tamper:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2016 less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: SURVEILLANCE TECHNOLOGY	10.396	10.869	9.749	0.000	9.749
Description: The overarching objective of this activity is to develop advanced sensor and sensor processing systems for continuous, high volume, theater-wide air and surface surveillance, battle group surveillance, real time reconnaissance and ship defense. Major technology goals include long-range target detection and discrimination, target identification (ID) and fire control quality target tracking in adverse weather, background clutter and electronic countermeasure environments and includes modeling and simulation required to support the development of these technologies. The current specific objectives are: a) Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: Develop radar architectures, sensors, and software which address Ballistic Missile and Littoral requirement shortfalls including: sensitivity; clutter rejection; and flexible energy management. b) Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction: Develop algorithms, sensor hardware, and signal processing techniques for automated radar based contact mensuration and feature extraction in support of asymmetric threat classification and persistent surveillance and to address naval radar performance shortfalls caused by: man-made jamming and Electronic Counter Measures (ECM), unfavorable maritime conditions, and atmospheric and ionosphere propagation effects. c) Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: Develop software, and hardware for a multi-platform, multi-sensor surveillance system for extended situational awareness of the battlespace. d) Small UAV Collision Avoidance/Autonomy Technology: Develop small UAV collision avoidance/autonomy technology.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
e) Long Range Radio Frequency (RF) Identification (ID): Develop, hardware, software, algorithms, and RF techniques to extend identification capabilities in support of Intelligence Surveillance and Reconnaissance (ISR). Funding decrease from FY16 to FY17 is a result of the completion of algorithm, sensor, and signal activities. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continued Advanced Common Radar Architecture and mode development. - Initiated High Power, High Duty Factor, X-band Amplifier Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: - Continued demonstrations of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments. - Continued development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenged environments. - Continued investigation of means of optimally combining mensuration, classification, and noncooperative target recognition of surface craft. - Continued development of a technology architecture for the Persistent Autonomous Surveillance System. - Continued development of automated controls for an airborne persistent multi-node sensor network. - Continued progressing development of algorithms and signal processing for Electronic Protection in airborne radars. - Continued progressing development of software and algorithms for multi-platform radar controls. - Continued development of a technique to measure motion with a multi-aperture synthetic aperture radar. - Continued development of amplitude control of radar transmit waveforms. - Continued development of design and full-wave characterization of phased-array systems using the domain decomposition-finite element method. Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. - Completed development of technologies for a distributed, coherent surveillance network embedded in the background electromagnetic environment of a broadband wireless communication network. - Completed distributed network research on waveforms funded in prior year via 0601153N. - Initiated modeling and simulation of shipboard and airborne RF networked sensors to characterize their performance in a challenge environment. - Initiated field measurement to characterize coherent and non-coherent position, navigation, timing and communications requirements. Small UAV Collision Avoidance/Autonomy Technology: - Continued development of research technologies and analytical algorithms for an effective and highly reliable collision avoidance system. Long Range Radio Frequency (RF) Identification (ID): - Continued studies for Long Range RFID techniques and initial hardware designees.					
FY 2016 Plans: Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continue all efforts of FY 2015 less those noted as complete above. Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: - Continue all efforts of FY 2015. - Complete development of a technique to measure motion with a multi-aperture synthetic aperture radar. - Complete development of amplitude control of radar transmit waveforms. - Complete development of design and full-wave characterization of phased-array systems using the domain decomposition-finite element method. Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: - Continue all efforts of FY 2015 less those noted as complete above. Small UAV Collision Avoidance/Autonomy Technology:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015. Long Range Radio Frequency (RF) Identification (ID): - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continue all efforts of FY 2016 less those noted as complete above. Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: - Continue all efforts of FY 2016 less those noted as complete above. Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: - Continue all efforts of FY 2016 less those noted as complete above. Small UAV Collision Avoidance/Autonomy Technology: - Continue all efforts of FY 2016 less those noted as complete above. Long Range Radio Frequency (RF) Identification (ID): - Continue all efforts of FY 2016 less those noted as complete above. ***FY 2017 OCO Plans:*** N/A					
Title: VACUUM ELECTRONICS POWER AMPLIFIERS	3.197	3.464	2.747	0.000	2.747
Description: The overarching objective of this activity is to develop millimeter wave (MMW) and sub-MMW power amplifiers for use in Naval all-weather radar, surveillance, reconnaissance, electronic attack, and communications systems. The technology developed cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, bandwidth, weight, and size. Responding to strong interests from the various user communities, efforts are focused on the development of technologies for high-data-rate communications, electronic warfare and high-power radar applications at MMW and upper-MMW regime. The emphasis is placed on achieving high power at high frequency in a compact form factor. Technologies include utilization of spatially distributed electron beams					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
in amplifiers, such as sheet electron beams and multiple-beams, and creation of simulation based design methodologies based on physics-based and geometry driven design codes. The current specific objectives are: a) High Power Millimeter and Upper Millimeter Wave Amplifiers: Develop science and technology for high power millimeter and upper millimeter wave amplifiers including high current density diamond cathodes, sheet and multiple electron beam formation and mode suppression techniques in overmoded structures. b) Lithographic Fabrication Techniques: Develop lithographic fabrication techniques for upper-millimeter wave amplifiers. c) Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: Develop accurate and computationally effective device-specific multi-dimensional models for electron beam generation, large-signal and stability analysis to simulate device performance and improve the device characteristics. Funding decrease from FY16 to FY17 is a result of the completion of amplifier activities. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** High Power Millimeter and Upper Millimeter Wave Amplifiers: - Completed effort to develop a Density Modulated Electron Source. - Completed electromagnetic modeling and cold testing of beam-wave interaction structures for W-band amplifiers having octave bandwidth. - Initiated effort to develop and experimentally demonstrate a new class of miniature, broad-band-width millimeter wave (MMW) amplifiers having five times the power-to-weight ratio of existing state-of-the-art broadband MMW amplifiers. Lithographic Fabrication Techniques: - Continued effort to develop 220 GHz millimeter-wave amplifiers employing electromagnetic structures that are microfabricated using lithographic techniques.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued effort to produce a high-power (>100 W) millimeter-wave vacuum electronic amplifier at G-band using microfabrication techniques developed at NRL in conjunction with a new type of high-gain interaction circuit. - Initiated effort to develop new 3-D microfabrication techniques for upper millimeter-wave to terahertz electromagnetic (EM) circuits in complex geometries not possible by conventional methods, enabling unprecedented design freedom for high power active and passive devices. Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: - Continued effort to develop a cascaded multiple-beam traveling wave amplifier, which is expected to provide unprecedented linear output power at millimeter wave frequencies (~30-40 GHz). ***FY 2016 Plans:*** High Power Millimeter and upper Millimeter Wave Amplifiers - Continue all efforts of FY 2015, unless noted as completed above. Lithographic Fabrication Techniques: - Continue all efforts of FY 2015, unless noted as completed above. - Complete effort to produce a high-power (>100 W) millimeter-wave vacuum electronic amplifier at G-band using microfabrication techniques developed at NRL in conjunction with a new type of high-gain interaction circuit. Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: - Complete effort to develop a cascaded multiple-beam traveling wave amplifier, which is expected to provide unprecedented linear output power at millimeter wave frequencies (~30-40 GHz). ***FY 2017 Base Plans:*** High Power Millimeter and upper Millimeter Wave Amplifiers - Continue all efforts of FY 2016, unless noted as completed above. Lithographic Fabrication Techniques - Continue all efforts of FY 2016, unless noted as completed above. ***FY 2017 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602271N / *Electromagnetic Systems Applied Research*	**Project (Number/Name)** 0000 / *Electromagnetic Systems Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: NETTED EMULATION OF MULTI-ELEMENT SIGNATURES AGAINST INTEGRATED SENSORS (NEMESIS) INNOVATIVE NAVAL PROTOTYPE (INP) ***Description:*** The objective is to develop a System of Systems (SoS) able to coordinate distribute EW resources against many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing platform protection across the battlespace against many sensors, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. a) Develop reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective multi-spectral countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for platform protection across operational domains. The increase from FY16 to FY17 in the Nemesis program is due to hardware procurement and conducting field experiments of Nemesis technologies. ***FY 2015 Accomplishments:*** - Continued development of the NEMESIS EW payloads and their integration into platforms. - Continued research supporting distributed control, coordination and networking of NEMESIS payloads and platforms. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A	8.716	9.000	10.725	0.000	10.725
Accomplishments/Planned Programs Subtotals	102.750	114.644	118.941	0.000	118.941

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE supports the development of technologies that address technology needs associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of, or produce a demand for, inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.

Specific examples of metrics under this PE include:

- Provide a secure, over the horizon, on-the- move capability to communicate with higher headquarters at a data rate of 256-512 Kbps at a cost of $75,000.
- Provide an array configuration suitable for installation on aircraft that will support Tactical Common Data Link (TCDL) data rates of 10.7 and 45 Mbps at greater than 150 nautical mile range.
- Develop prototype Ku band phased array apertures in a form factor suitable for installation on the CVN-78.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602435N *I Ocean Wrfghtg Env Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	62.643	72.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing
0000: *Ocean Wrfghtg Env Applied Res*	0.000	43.303	42.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technological developments that provide new or enhanced warfare capabilities for the Battlespace Environment (BSE). The objectives of this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting naval material and operations in the BSE. This program provides for BSE technological developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.

This PE fully supports the Director of Defense Research and Engineering's Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this program is related to and fully coordinated with efforts in accordance with the on-going Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the BSE categories of Lower Atmosphere, Ocean Environments, Space & Upper Atmosphere, and Terrestrial Environments. Within the Naval Transformation Roadmap, the investment will contribute toward achieving each of the "key transformational capabilities" required by Sea Strike, Sea Shield, and Sea Basing. Moreover, environmental information, environmental models, and environmental tactical decision aids that emerge from this investment will form one of the essential components of FORCEnet (which is the architecture for a highly adaptive, human-centric, comprehensive maritime system that operates from seabed to space). The Navy program includes efforts that focus on, or have attributes that enhance, the affordability of warfighting systems.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602435N *I Ocean Wrfghtg Env Applied Res*

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	65.388	42.252	44.210	-	44.210
Current President's Budget	62.643	72.252	42.618	-	42.618
Total Adjustments	-2.745	30.000	-1.592	-	-1.592
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	30.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.466	0.000			
• SBIR/STTR Transfer	-1.279	0.000			
• Program Adjustments	0.000	0.000	-0.973	-	-0.973
• Rate/Misc Adjustments	0.000	0.000	-0.619	-	-0.619

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *AGOR Mid-life Refit*	19.340	30.000
Congressional Add Subtotals for Project: 9999	19.340	30.000
Congressional Add Totals for all Projects	19.340	30.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / *Ocean Wrfghtg Env Applied Res*	Project (Number/Name) 0000 / *Ocean Wrfghtg Env Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Ocean Wrfghtg Env Applied Res*	0.000	43.303	42.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides technologies that form the natural environment technical base on which all systems development and advanced technology depend. Furthermore, this technical base provides developments that may be utilized in the Future Naval Capabilities programs: Organic Mine Countermeasures (MCM) and Autonomous Operations. This project contains the National Oceanographic Partnership Program (NOPP) (Title II, subtitle E, of Public Law 104-201) and efforts aimed at understanding and predicting the impacts of underwater sound on marine mammals.

Major efforts of this project are devoted to: gaining real-time knowledge of the BSE, determining the natural environment needs of regional warfare, providing the on-scene commander with the capability to exploit the environment to tactical advantage and, developing atmospheric research related to detection of sea-skimming missiles and strike warfare. This project provides natural environment applied research for all fleet operations and for current or emerging systems. Major developments are routinely transitioned to the Fleet Numerical Meteorology and Oceanography Center and to the Naval Oceanographic Office where they are used to provide timely information about the natural environment for all fleet operations.

Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Efforts include ocean and atmospheric analysis and prediction for real-time description of the operational environment, shallow water acoustics, multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on MCM and Anti-Submarine Warfare (ASW) systems. Joint Strike Warfare efforts address issues in air battlespace dominance. Efforts include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance, reconnaissance, targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Coastal Geosciences/Optics	6.323	6.297	6.604	0.000	6.604
Description: The goal of this activity is to determine the sources, distribution, and natural variability (concentration and properties) of optically important matters in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments in this activity support the development and testing of expendable and autonomous bioluminescence sensors, the continued development of extended range underwater imaging technologies, and algorithm development and testing for application to ocean color remote sensing from aircraft and space in order to characterize key features of the coastal battle space such as bathymetry, shallow-water bottom types, and the distribution of ocean water optical properties.					
FY 2015 Accomplishments:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated the effort to develop new methods using sparse representation theory for global inversion of marine gravity to deep-water seafloor topography. - Continued the effort to combine optical (Vis/SWIR/TIR) and passive microwave (PM) data to (1) improve the performance of the existing NRL microwave soil moisture (SM) and vegetation water content (VWC) algorithm near inland waterways and heavily vegetated regions at 40-km resolution; and (2) develop a down-scaling algorithm to generate SM and VWC data globally at 1 km spatial resolution, which is critical but unfilled DoD requirement for determining soil strength at spatial scales required for Marine Crops/Army mobility predictions. - Continued to refine algorithms that fuse sediment information extracted from operational sonar with historical sediment databases. - Continued development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provided demonstration. - Continued experiments (and data collection) to test user performance as a function of display clutter. - Continued effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology,properties, and energetics. - Continued effort to develop and evaluate an integrated multi-sensor suite, including a small microflow cytometer, to characterize optical and biological properties of subsurface particle layers in coastal waters using unmanned underwater glider technology. - Continued effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays. - Continued development of riverine expert system for environmental characterization. - Continued an effort to create a unified framework for measuring, recording, aggregating and presenting the uncertainty of data, models, and processes to support current and future efforts to add certainty measures to environmental products. - Continued studies for rapidly relocatable prediction models for riverine, estuarine and nearshore environments. - Continued development of the BMFC (Benthic Microbial Fuel Cell) into a functionally capable technology practical for powering Navy devices. - Complete the effort to detect and recognize targets beneath foliage using new polarimetric analysis techniques applied to ultra wideband (UWB) synthetic aperture radar (SAR) imagery. - Complete the development of methods to retrieve water depth, bottom type and water constituents in complex coastal waters, inland waterways, and denied areas using multispectral imagery (MSI) by extending techniques used for coarser resolution hyperspectral imagery to account for larger (MSI) data sets.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of a new capability for the Navy to forecast the temporal and spatial evolution of bottom roughness along sandy coasts by developing a seafloor boundary layer model to predict spectral description of seafloor and sediment transport and then two-way coupling it to an ocean wave model. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of the BMFC (Benthic Microbial Fuel Cell) into a functionally capable technology practical for powering Navy devices. - Complete the effort to combine optical (Vis/SWIR/TIR) and passive microwave (PM) data to (1) improve the performance of the existing NRL microwave soil moisture (SM) and vegetation water content (VWC) algorithm near inland waterways and heavily vegetated regions at 40-km resolution; and (2) develop a down-scaling algorithm to generate SM and VWC data globally at 1 km spatial resolution, which is critical but unfilled DoD requirement for determining soil strength at spatial scales required for Marine Crops/Army mobility predictions. - Initiate studies to reduce uncertainties in data-assimilative littoral models in data-sparse environments - Initiate analysis of historic remote sensing modalities to determine whether robust climatologies can be developed which provide utility for initialization of littoral geosciences forecast models in data-poor regions. - Initiate a baseline study of littoral geosciences environmental variables and their value, singly or in combination, to reducing uncertainty of inverse and forward models, in data-poor regions ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete the effort to develop new methods using sparse representation theory for global inversion of marine gravity to deep-water seafloor topography. - Initiate development of new technologies and methodologies to delineate suspended sediment orientations in the water column and the turbulent motions which give rise to their spatial distributions, in response to the highly varied forcing of the littoral region. ***FY 2017 OCO Plans:*** N/A					
Title: Marine Mammals and Biology ***Description:*** Research on the sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. The research in this program supports Navy environmental compliance information needs and facilitates acquiring LOAs from NOAA that enable all Navy training and testing operations, and the development of appropriate state-of-the-art mitigation measure. The goal of this activity is to support: (1) marine	3.485	3.576	3.446	0.000	3.446

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
mammal research related to understanding impacts of sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; The marine mammals research conducted in this PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N. The emphasis of efforts within PE 0602435N are Marine Mammals and Biology thrusts that include Integrated Ecosystem Research/ Sensor and Tag Development, Controlled Exposure Experiments (captive, free-ranging European waters), part of the Monitoring & Detection thrust (DCL algorithm development), and effects of chronic stress (free-ranging animal studies). ***FY 2015 Accomplishments:*** - Continued at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities. - Continued multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Continued development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery. - Continued research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts). - Continued research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters. - Continued development of and evaluated models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise. - Continued development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. - Continued research on the physiology and stress of marine mammals in the wild. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: Marine Meteorology	11.563	11.078	10.807	0.000	10.807

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: The marine atmosphere affects most aspects of naval operations. This activity develops observing technologies, models, Numerical Weather Prediction (NWP) systems and Tactical Decision Aids (TDA) that describe the atmospheric environment and its impacts on naval sensors and operations. This activity focuses on uniquely marine aspects of atmospheric science such as air-sea interaction, coupled ocean-atmosphere modeling, EM and EO propagation, coastal meteorology, Tropical Cyclone (TC) prediction, and the use of remote sensing to obtain quantitative observations of atmospheric properties. Aspects of the atmospheric environment of particular interest include near-surface phenomena that affect refractivity, marine boundary layer dynamics that affect clouds, rain, visibility and fog, and processes that control TC structure, track, and intensity. Objectives of this activity are improved NWP systems and TDAs that provide NOWCAST and forecast skill at global, regional, and tactical scales for operational support, sensor and system development, and performance prediction. Funding decreases from FY 2015 - FY 2016 due to completion of the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS). ***FY 2015 Accomplishments:*** - Initiated the effort to produce the world's first numerical weather prediction model of operational accuracy covering the entire middle atmosphere. - Continue development of a quantitative prediction capability of EM propagation (EMProp) and sensor performance through improved mesoscale modeling, and characterize the uncertainty in these predictions due to the environment and propagation models. - Continue the effort to develop and evaluate a global coupled atmosphere-ocean system that can accurately simulate and predict the Madden Julian Oscillation (MJO), which is a phenomenon that serves as a bridge between current weekly forecasts and extended-range forecasts. - Complete the design, assembly, testing and delivery of a threat detection technology for Tier 1 environmental analysis of aerosols. - Complete the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS).					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of a Hybrid Ensemble 4D-VAR Data Assimilation (DA) scheme for regional models based on the global data assimilation techniques, in order to simultaneously estimate regional and global model initial conditions. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of a quantitative prediction capability of EM propagation (EMProp) and sensor performance through improved mesoscale modeling, and characterize the uncertainty in these predictions due to the environment and propagation models. - Complete the effort to develop and evaluate a global coupled atmosphere-ocean system that can accurately simulate and predict the Madden Julian Oscillation (MJO), which is a phenomenon that serves as a bridge between current weekly forecasts and extended-range forecasts. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. -Completed the effort to produce the world's first numerical weather prediction model of operational accuracy covering the entire middle atmosphere. - Initiate development of a high-altitude version of the tropical cyclone intensity prediction model (COAMPS-TC) to incorporate new upper-level physics that affect storm dynamics. - Initiate development of a probabilistic tropical cyclone forecasting system, based on the COAMPS-TC ensemble, that generates probabilistic guidance and quantifies the forecast uncertainty. - Initiate development of a high resolution global weather prediction system (based on NAVGEM) with an improved dynamical core, increased resolution (approx. 10km and 100 layers), physics upgrades, new physics-dynamics coupling, and advances in the NAVDAS-AR data assimilation system. ***FY 2017 OCO Plans:*** N/A					
Title: National Oceanographic Partnership Program (NOPP) ***Description:*** This activity focuses on US Navy investments in the NOPP. NOPP, established by the US Congress (Public Law 104-201) in Fiscal Year 1997, is a unique collaboration among 15 federal agencies involved in conducting, funding, or utilizing results of ocean research. NOPP's value to the Navy derives from the capacity of the partnership to enable and ensure multi-agency efforts where such collaboration enhances efficiency or effectiveness, and/or reduces costs. Major areas of investment by NOPP include: development of an integrated coastal ocean observation system and development of sensors, communications and data	8.415	8.260	8.626	0.000	8.626

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
acquisition, storage and processing tools required to affect it, modernization of ocean research and observation infrastructure, and marine mammal-related research. ***FY 2015 Accomplishments:*** - Continue an Arctic remote sensing program. - Continue an Advancing Air/Ocean/Land/Ice Global Coupled Prediction on Emerging Computational Architectures program - Continued development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean. - Continued marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat. - Continued real-time forecasting system of winds, waves and surge in Tropical Cyclones (TCs). - Continued effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems. - Continued development of improving wind-wave predictions: global to regional scales. - Continued study of arctic processes. - Continued development of global and climate prediction studies. - Complete a study on Improving Wind Wave Predictions: global to regional scales. - Complete a project to develop an high resolution version of HYCOM with tides. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Initiate marine mammal tagging as a component of the marine arctic ecosystem dynamics study. - Initiate development of coupled Arctic System Models to support improved forecasting and prediction of sea ice and other operational parameters - Initiate efforts to seamlessly nest high-resolution regional ocean models into tide-resolving global HYCOM ocean forecasts - Initiate project to understand the role of the ocean in providing skill in extended-range predictions of the environment through systematic model intercomparisons ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. ***FY 2017 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: Ocean Acoustics	3.347	2.586	2.288	0.000	2.288
Description: This activity is dedicated to the determination of the impact of the natural ocean environment on acoustic wave phenomena in support of naval undersea warfare and underwater force protection operations. This activity studies underwater acoustic propagation, scattering from ocean boundaries, and ambient noise issues that impact the development and employment of acoustic systems. The Littoral Zone (LZ) has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic systems, are the shallow water included in the Littoral Zone, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to rapid changes of the ocean structure. The objectives of this program are met through measuring, analyzing, modeling and simulating, and exploiting ocean acoustic factors to gain advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids. Funding decrease from FY 2015 to FY 2016 is due to the completion of efforts associated with acoustic performance predictions. ***FY 2015 Accomplishments:*** - Initiate effort to reduce acoustic propagation forecast error through a coupled ocean-acoustic assimilative model. - Continue effort to develop a new through-the-sensor environmental characterization capability for multistatic sonobuoy systems. - Continued development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. - Continued development of a Tactical Decision Aid (TDA) that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals. - Continued development of a validated, physics-based processing algorithm that diagnoses acoustic performance directly from oceanographic data. - Continued development of a set of physics-based environmental acoustic metrics to evaluate the predictions of TDAs that are used in planning asset allocation and placement of distributed Autonomous Undersea Vehicles (AUVs) in a time evolving scenario.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of improved performance predictions for sonar surveillance systems that utilize horizontal line arrays operating in shelf-break environments and relate horizontal-array signal gain and coherence length to the statistics and scale lengths of transverse environmental inhomogeneities. - Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves. - Continued development of a coupled algorithm to assimilate in-situ acoustic data into an acoustic model used for autonomous system decision support. - Complete enhancements to the accuracy of acoustic performance predictions through stochastic algorithms dealing with environmental uncertainty. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of a coupled algorithm to assimilate in-situ acoustic data into an acoustic model used for autonomous system decision support. - Complete effort to develop a new through-the-sensor environmental characterization capability for multistatic sonobuoy systems. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete effort to reduce acoustic propagation forecast error through a coupled ocean-acoustic assimilative model. ***FY 2017 OCO Plans:*** N/A					
Title: Physical Oceanography ***Description:*** The goal of this activity is to develop naval tactical uses of knowledge of the physics of the ocean within the BSE. This is achieved through the development of predictive models of the water mass structure, waves, currents, and air-sea interactions and developing measurement/observation technology. Other applications utilize knowledge of the interaction of the water column hydrodynamics and the acoustics to predict the undersea transmission characteristics and sources of uncertainty in these statistics. Utilizing knowledge of the ocean surface physics, the physical oceanography program seeks to exploit the combination of remotely sensed data, in-situ data, and adaptively sampled data to optimize predictions of ocean currents and water	10.170	10.455	10.847	0.000	10.847

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve ASW, Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs. ***FY 2015 Accomplishments:*** - Initiated the effort to develop the Navy's coupled ocean-atmosphere variational data assimilation (DA) system. - Continue the development of the calibration of ocean forcing and its uncertainty using satellite flux estimates and ocean observations propagated through the ocean physics to the surface - Continued to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems. - Continued development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. - Continued to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range dependence. - Continued the development of a data assimilative nearshore modeling capability using measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data. - Continued new ocean mixed-layer algorithms for generation of synthetic profiles which has led to the operational implementation of a new Navy Ocean Sound Speed Prediction (NOSSP) system at the Naval Oceanographic Office. - Continued the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations. - Continued the development and implementation of new techniques for parameterizing fluxes of mass and energy across the airsea interface in coupled ocean-atmosphere models, to improve operational predictions of the BSE. - Continued development and testing of acoustic communications, disposable environmental instruments, and Unmanned Undersea Vehicles (UUV) and gliders for NSW mission support. - Continued developing Delft3-D-Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) to include new options for riverine input and transport and behavior of contaminants in support of NSW mission planning. - Continued the development of synthetic aperture radar (SAR) and hyperspectral imagery exploitation for NSW and Marine Expeditionary Forces as well as the support of new riverine units. - Continued studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. - Continued development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission. - Continued the development of the coupled Delft3-D-COAMPS model within the larger naval forecast system for use in NSW mission planning. - Continued the development of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs. - Continued on-board processing of METOC data on gliders/UUV for exfiltration consistent with operational concept of operations. - Continued the custom installation of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs using Naval Oceanographic (NAVO) modeling systems. - Continued an effort to utilize data from new mooring technologies in combination with AUV data to develop practical methodologies to identify and extract the AUV-data spectral content that is not accurately represented in operational systems currently assimilating these data. - Continued an effort to quantitatively determine how the optical properties of the upper ocean's organic constituents modify physical processes, such as the depth penetration of shortwave radiation into the ocean, and integrate a representation of bio-optical variability into the coupled ocean/atmosphere modeling framework. - Complete the development of the Navy's first high-resolution fully coupled relocatable ice-ocean-atmosphere (IOA) prediction system by building coupling software to couple the Community Ice Code (CICE) ice model into the COAMPS system, evaluating the results and then demonstrating the capability. - Complete the effort to extend the predictability of currents, waves and density structure in the coastal ocean by building a coupled 4D-VAR data assimilation capability for coupled ocean-wave models and use this ability to define prediction sensitivity to targeted observations.					
FY 2016 Plans: - Continue all efforts of FY 2015 less those noted as completed above. - Complete the development of the calibration of ocean forcing and its uncertainty using satellite flux estimates and ocean observations propagated through the ocean physics to the surface. - Initiate multi-scalable visuzalization tools using GPU's, tablets and remote sensing data. - Initiate testing of Air-Deployed Ocean Profiler in research and fleet test. - Initiate development of a coupled atmosphere-ocean-cryosphere-wave prediction system capable of forecasts from the submesoscale to decadal.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate development of a high resolution Arctic ice/ocean/weather/wave prediction system that can assimilate SAR data. - Initiate Synthetic Aperture Radar Data Assimilation for Tropical Storm Forecasts - Initiate Expendable Expeditionary Data Fusion Development ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete the effort to develop the Navy's coupled ocean-atmosphere variational data assimilation (DA) system. - Initiate the development and testing of the Remote Ocean Sampling System for air-sea surface flux sampling - Initiate the development of advanced autonomy for operations of gliders and uuv's in extreme environments - Initiate the development of ocean drifters with stable salinity sensors and high resolution turbulence sensors ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	43.303	42.252	42.618	0.000	42.618

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

All Science and Technology model improvements undergo a rigorous validation verification and evaluation against quantifiable metrics before being accepted for transition into operations. In Marine Meteorology, for example, typical improvements over the past decade have amounted to a gain in skill of one forecast-day (i.e., the 4-day forecast is now as skillful as the 3-day forecast of a decade ago), and tropical cyclone forecast track error has been reduced by 50%. It is expected that future increases in skill will continue at or above this pace.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / *Ocean Wrfghtg Env Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

The AGOR Mid-Life Refit FY15 funding will support the overhaul, re-fit and upgrade of Navy research vessel THOMAS G THOMPSON (AGOR 23). In FY15 funds will be awarded to the University of Washington, the operator of THOMPSON, to support the competitive selection of a US shipyard which will implement the design plans. The THOMPSON will enter the shipyard in November 2015 to begin the refit.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: AGOR Mid-life Refit	19.340	30.000
FY 2015 Accomplishments: The AGOR Mid-life Refit FY15 funding was combined with FY13 funding, and was awarded to the University of Washington...." to manage the overhaul, re-fit and upgrade of Navy research vessel THOMAS G THOMPSON (AGOR 23). The University of Washington issued a Request for Proposals for a shipyard to conduct the overhaul, re-fit and upgrade work, scheduled to begin May 2016. Bids were evaluated, and the winning shipyard will be announced before the end of FY15. Deliverables will support environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhanced the ship safety with piping replacements in the ship's firemain and ballast water systems.		
FY 2016 Plans: The AGOR Mid-Life Refit FY16 funding represents an increase of $10M more than FY15, and provides full funding in this FY for the second vessel, AGOR 24 Roger Revelle. A contract with the University of California-San Diego's Scripps Institution of Oceanography will be developed to manage the project during FY16, with a major shipyard overhaul preliminarily planned for FY18. Deliverables will support environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhanced the ship safety with piping replacements in the ship's firemain and ballast water systems.		
Congressional Adds Subtotals	19.340	30.000

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Deliverables will support new environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhance the ship safety with piping replacements in the ship's firemain and ballast water systems.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602651M *I JT Non-Lethal Wpns Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	5.728	6.114	6.327	-	6.327	6.425	6.425	6.425	6.425	Continuing	Continuing
0000: *JT Non-Lethal Wpns Applied Res*	0.000	5.728	6.114	6.327	-	6.327	6.425	6.425	6.425	6.425	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DOD Non-Lethal Weapons Program was established by the Office of the Secretary of Defense, which designated the Commandant of the Marine Corps (CMC) as the DoD NLW Executive Agent (EA). The EA exercises centralized responsibility for joint research and development of non-lethal weapons and technology through the Joint Non-Lethal Weapons Program (JNLWP). The Office of the Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint Non-Lethal Weapons (NLW) Integrated Product Team, a multi-service flag level corporate board that provides executive oversight and management for the JNLWP for the CMC. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies, capabilities and equipment are provided to the operating forces while eliminating duplicative service S&T investment. These applied research initiatives feed non-lethal capabilities which directly support the three pillars of the 2014 Quadrennial Defense Review and comprise a fundamental part of DoD's security cooperation efforts to build partner capacity. The resulting capabilities will facilitate a fully integrated non-lethal competency as a complement to lethal firepower, providing force application options for short-of-lethal scenarios.

This program funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-materiel missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics. This program transitioned from PE 0602114N, Power Projection Applied Research, by order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, to this separate PE for Joint Non-Lethal Weapons Applied Research.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602651M *I JT Non-Lethal Wpns Applied Res*			
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	5.880	6.119	6.327	-	6.327
Current President's Budget	5.728	6.114	6.327	-	6.327
Total Adjustments	-0.152	-0.005	0.000	-	0.000
• Congressional General Reductions	-	-0.005			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.152	0.000			

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602651M / *JT Non-Lethal Wpns Applied Res*	Project (Number/Name) 0000 / *JT Non-Lethal Wpns Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *JT Non-Lethal Wpns Applied Res*	0.000	5.728	6.114	6.327	-	6.327	6.425	6.425	6.425	6.425	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-materiel missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: (U) JOINT NON-LETHAL WEAPONS	5.728	6.114	6.327	0.000	6.327
FY 2015 Accomplishments: - Continued academic research into technology areas with relevance to non-lethal weapon capabilities. - Continued investigations of alternative technologies with potential to address emerging capability gaps. - Continued to evaluate methodologies for measuring directed energy effects (millimeter - wave, high powered microwave, etc.) - Continued human effects investigation of alternative physical phenomena to non-lethally suppress humans beyond small arms range. - Continued investigations of advanced materials and emergent technologies suitable for extended range non-lethal weapon payload applications. - Continued transition of foundational effects associated with advanced electro-muscular disruption technologies to higher levels of technology development and demonstration. - Continued feasibility assessment and evaluation of candidate technologies with potential to mitigate technology challenges impeding Non-Lethal Effects (NLE) capability gap resolution. - Continued applied research to develop a framework to analyze behavioral response to non-lethal weapons - Completed incorporation of suitable sensors capable of measuring Non-Lethal (NL) stimuli into surrogate test models as part of the Human Effects Modeling Analysis Program (HEMAP) under PE 0603651M. - Completed refinement of models. Continued applied research into characterization of non-lethal phenomena and assessment of human effects and weapon effectiveness, including development of dose response and injury correlates.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602651M / *JT Non-Lethal Wpns Applied Res*	**Project (Number/Name)** 0000 / *JT Non-Lethal Wpns Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed applied research for potential emergent technologies with applicability to the clear-a-space counter-personnel mission. - Completed Laser Induced Plasma (LIP) capability to deliver novel NL effects. - Completed feasibility study of most promising LIP concepts and applications. - Initiated evaluation of the feasibility and practicality study of advanced vehicle stopping design concepts. - Initiated investigation of component High Power Microwave (HPM) technologies and transition results to higher levels of technology development and demonstration. ***FY 2016 Plans:*** - Continue all efforts from FY 2015, except those noted as completed. - Initiate evaluation of the susceptibility of targets to candidate vehicle and vessel stopping designs. ***FY 2017 Base Plans:*** - Continue all efforts from FY 2016, unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	5.728	6.114	6.327	0.000	6.327

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons. The program consists of a collection of projects that range from studies and analyses to the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602747N *I Undersea Warfare Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	88.204	150.839	126.313	-	126.313	100.501	103.666	96.462	96.726	Continuing	Continuing
0000: *Undersea Warfare Applied Res*	0.000	88.204	123.739	126.313	-	126.313	100.501	103.666	96.462	96.726	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	27.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.100

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Sep 2011). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Technologies being developed within this PE are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets. Research focused on understanding the impacts on marine mammals of manmade underwater sound is also conducted in the Program Element.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602747N *I Undersea Warfare Applied Res*

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	86.880	123.750	148.777	-	148.777
Current President's Budget	88.204	150.839	126.313	-	126.313
Total Adjustments	1.324	27.089	-22.464	-	-22.464
• Congressional General Reductions	-	-0.011			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.100			
• Congressional Directed Transfers	-	-			
• Reprogrammings	3.463	0.000			
• SBIR/STTR Transfer	-2.139	0.000			
• Program Adjustments	0.000	0.000	-20.126	-	-20.126
• Rate/Misc Adjustments	0.000	0.000	-2.338	-	-2.338

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Undersea Warfare Research*	0.000	18.600
Congressional Add: *Underwater Energetics Research*	0.000	8.500
Congressional Add Subtotals for Project: 9999	0.000	27.100
Congressional Add Totals for all Projects	0.000	27.100

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602747N / *Undersea Warfare Applied Res*	Project (Number/Name) 0000 / *Undersea Warfare Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Undersea Warfare Applied Res*	0.000	88.204	123.739	126.313	-	126.313	100.501	103.666	96.462	96.726	Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Technologies being developed within this project are aimed at enabling Sea Shield which is one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH	13.696	21.379	29.906	0.000	29.906
Description: ASW Distributed Search focuses on the development of technologies for the non-covert tactical search for undersea targets ranging from hours to weeks, using automated sensor systems deployed around operating areas, including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest, such as key US/Allied ports. "Non-covert" implies availability of airborne assets for sensor deployment (although other means may also be used), and the ability to employ active sonar along with passive and non-acoustic methods. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The submarine target must be detected beyond its weapons release range. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Distributed Search supports the ASW protected passage Maritime Shield operational constructs. Related efforts include the development of distributed systems employing optimization as well as active acoustic sensing and processing techniques, navy-unique transduction and underwater networking technology. Efforts also include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components. These efforts provide an extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. The cornerstone of Distributed Search is the development of rapidly deployable, long-endurance active sensors with automated processing suitable for use in a wide variety of operational environments.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Funding increase from FY 2015 to FY 2016 is due to 3 new programs funded in this PE: The Virtual Acoustic Sensing Array (VASA), Forward Deployed Energy & Communications Outpost (FDECO) (FY16-FY19) INP, and the Anti Submarine Warfare Mission Packages (ASW MP) (FY16-FY20). Funding increase from FY 2016 to FY 2017 is due to the increase in the number of objective experiments and the demonstration at the end of FY17 for the FDECO program and the associated integration events associated with the FDECO program. ***FY 2015 Accomplishments:*** - Continued development of non-traditional distributed search systems for deployment on air vehicles. - Continued development of novel parametric source and receiver technologies. - Continued effort to develop compressive beamforming algorithms for vector sensor towed arrays. - Continued effort to develop and demonstrate real time onboard processing for a UUV to detect, classify, and track submarines using active sonar. - Continued development of a thermophone acoustic projector technology for use in sonar applications. - Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts. - Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources. - Continued development of "intelligent" algorithms aimed at optimizing distributed multistatic sources/receivers. - Continued a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS). - Continued research into the characterization and classification of deep-ocean clutter sources to improve active sonar system performance in Convergence Zone (CZ) and other deep-ocean propagation conditions. - Continued development of Non-Traditional Transduction Methods (NTTM) which fundamentally departs from conventional ASW transduction techniques. - Continued development of Non-Acoustic Fiber Optic Sensors (NA-FOS) for ASW applications. - Continued research aimed at adaptive design and synthesis of networked distributed sensors. - Continued effort to demonstrate the effectiveness of structural acoustic-based classifier techniques to detect, localize and identify. - Completed prototype development of a low frequency (LF) underwater acoustic holographic beamforming lens for manipulating the phase fronts of narrow-band sound waves.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated effort to develop a new generation of target detection algorithms that use advanced simulations of small targets floating on a dynamic sea surface. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as complete above. - Furthering development of "intelligent" algorithms aimed at improving ASW performance of distributed multistatic sonar systems. - Complete development of a thermophone acoustic projector technology for use in sonar applications. - Complete effort to develop compressive beamforming algorithms for vector sensor towed arrays. - Complete development/improvement of multi-static signal processing techniques for systems employing coherent sound sources. - Complete research into the characterization and classification of deep-ocean clutter sources to improve active sonar system performance in Convergence Zone (CZ) and other deep-ocean propagation conditions. - Initiate development of signal and information processing algorithms for improved ASW performance of high duty cycle active sonar systems. - Initiate the Forward Deployed Energy & Communications Outpost (FDECO) INP project. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as complete above. ***FY 2017 OCO Plans:*** N/A					
Title: ANTI-SUBMARINE WARFARE (ASW) PRECISION LOCALIZATION	3.651	3.281	3.415	0.000	3.415
Description: Precision Localization focuses on the development and demonstration of technologies which use information from surveillance or search systems to determine an area of uncertainty (AOU) relative to target range, bearing, and depth adequate to handoff to an attack system. Precision Localization employs non-acoustic techniques such as magnetic and optical sensing to highly localize submerged threats. The objective is to increase magnetic sensor range and robustness, enable deployment on Unmanned Air Vehicles (UAVs), and increase optical sensing search rates. Efforts include the development of non-traditional tracking and advanced magnetic and electric field sensors and processing. These technologies will provide a decreased AOU size thus enabling the effective use of smaller, more versatile torpedoes as well as increased performance gain in detection, targeting, tracking/trailing, and homing via target acquisition and covert prosecution. ***FY 2015 Accomplishments:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated effort to develop improved electrodes and signal processing techniques to improve detection range using undersea electric field sensors. - Continued development of non-traditional tracking methods and systems for deployment on air vehicles. - Continued development of low-cost, platform based sensor networks. - Continued development of quantum sensor technologies for Magnetic Anomaly Detector (MAD). - Continued development of a non-traditional tracking system for deployment on undersea vehicles. - Continued testing of a non-traditional tracking system. - Continued development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems. - Continued an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications. - Continued an effort to extend the technology base for high performance electro-optic detectors and filters suitable for Undersea Warfare applications including underwater communications. - Continued an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems. - Continued an effort to develop optical signal processing and hybrid computing technology appropriate for Undersea Warfare and underwater communications systems. - Continued development of ASW sensor technologies capable of being deployed by a gun or missile launcher. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, unless noted as complete above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, unless noted as completed above. - Complete effort to develop improved electrodes and signal processing techniques to improve detection range using undersea electric field sensors. ***FY 2017 OCO Plans:*** N/A					
Title: ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	54.447	83.362	77.223	0.000	77.223
Description: ASW Surveillance focuses on dramatically improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of legacy ASW surveillance systems. The related technologies support the conduct of covert, wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
forward and contested operating areas, and in complex operational environments against all submarine threats, including new threats with unknown target signatures and tactics. Covertness implies use of non-observable platforms and/or deployed automated sensors employing passive sonar, or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable, off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth, acoustic communications links. FY 2015 to FY 2016 increase is due to the development of technology for the integration of large UUVs on Navy platforms. The decrease from FY 2016 to FY 2017 due to the completion of a portion of the INP-Large Displacement Unmanned Underwater Vehicle (LDUUV) effort to development an Autonomous Underwater Vehicle (AUV)-deployable bottom surveillance array networked by low complexity acoustic modems. ***FY 2015 Accomplishments:*** - Continued Modular Undersea Heavyweight Vehicle (MUHV) efforts. - Continued the development of advanced data exfiltration methods and systems. - Continued the development of advanced sensor data triage methods and systems. - Continued the development of highly sparse aperature sensing methods and systems. - Continued the development of dynamic energy distribution network methods and systems. - Continued effort to develop ultra-low power, high sensitivity, miniature, optically pumped scalar magnetometers for undersea surveillance. - Continued development an AUV-deployable bottom surveillance array networked by low complexity acoustic modems. - Continued development of Non-Acoustic, Underwater Communications. - Continued development of Advanced Imaging Methods (AIM) to provide expanded spatial, temporal and spectral imaging options. - Continued an effort to research improved seawater electrodes for Underwater Electric Potential (UEP) sensing in ASW applications. - Continued research, the goal of which is to form underwater magnetic sensors into a virtual gradiometric array via non-cabled communications. - Continued development of an acoustic/magnetic hybrid sensor.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of low cost, compact, combined acoustic sensor. - Continued electroactive polymer smart sensor development. - Continued research to improve detection of quiet, diesel-electric submarines using passive sonar arrays in deep ocean environments. - Continued research to predict performance of automated passive sonar detection and classification algorithms in shallow and deep ocean environments. - Continued biomimetic and nano sensor development. - Continued 'hockey puck' transducer/amplifier module development. - Continued broadband, directional, high power array development. - Continued development of a long endurance, air independent energy source for Large UUVs. - Continued development of Autonomy for operation of UUV in the littorals. - Continued development of core UUV technologies to extend the reliability and endurance of UUV operating in the littorals. - Continued at sea testing of prototype LDUUV technologies. - Continued Consortium for Robotics and Unmanned Systems Research (CRUSER) in support of the LD UUV program. - Completed effort to develop and test waveguide invariant-based methods of depth-classification for quiet submerged targets in littorals. - Completed development of tools which can be used to assess and exploit acoustic communications emissions. - Completed development of velocity sensitive processors for passive discrimination of quiet targets. - Initiated development of long endurance air independent energy source for "SMALL" UUV's and forward deployed sensor nodes. - Initiated development of next generation (non-Penetrating) Power and communications technologies for underwater operations. - Initiated effort to develop improved electrodes and signal processing techniques to improve detection range using undersea electric field sensors.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as complete above. - Complete development an Autonomous Underwater Vehicle (AUV)-deployable bottom surveillance array networked by low complexity acoustic modems. - Complete development of next generation (non-Penetrating) Power and communications technologies for underwater operations.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Select UUV for ASW mission and measure it's characteristics LA MGMT-NEW START PREPARATIONS - Initiate LA Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new Leap Ahead investments are able to commence execution every other year in a timely manner. LA MGMT-SUPPORT/OPS ANALYSIS - Initiate LA Management - Support/OPS Analysis - Conduct warfighter sustainment applied research and analysis, including technology management of Leap Ahead investments supporting Department of the Navy RDT&E Corporate Board priorities for new disruptive technologies. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as complete above. LA MGMT-NEW START PREPARATIONS - Continue Leap Ahead (LA) Management - Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new Leap Ahead investments are able to commence execution every other year in a timely manner. LA MGMT-SUPPORT/OPS ANALYSIS - Continue LA Management - Support/OPS Analysis - Conduct warfighter sustainment applied research and analysis, including technology management of Leap Ahead investments supporting Department of the Navy RDT&E Corporate Board priorities for new disruptive technologies. - Complete effort to develop ultra-low power, high sensitivity, miniature, optically pumped scalar magnetometers for undersea surveillance. - Complete effort to develop improved electrodes and signal processing techniques to improve detection range using undersea electric field sensors. - Initiate new passive sonar signal processing technology designed to detect, classify and track next-generation nuclear submarines. ***FY 2017 OCO Plans:*** N/A					
Title: MARINE MAMMALS ***Description:*** The goal of this activity is to support: (1) marine mammal research related to understanding impacts of underwater sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea;	2.520	2.794	2.579	0.000	2.579

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
(3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing of bioluminescence sensors). The marine mammals research conducted in this Program Element (PE) represents part of a total effort executed in coordination with complementary research performed in PE 0602435N. The emphasis of efforts within PE 0602747N Marine Mammals Activity focuses on the effects on the behavior of marine mammals of manmade sound transmitted underwater which includes Integrated Ecosystem Research, Controlled Exposure Experiments (free-ranging US waters), Marine Mammal Hearing, and part of the Monitoring & Detection thrust (Autonomous platform development; gliders, profilers, etc.), Population-level Consequences of Acoustic Disturbance, effects of chronic stress (captive/modeling studies), and risk assessment modeling. This Activity has been created specifically to address the work associated with determining and mitigating the effects on the behavior of marine mammals of manmade sound transmitted underwater. ***FY 2015 Accomplishments:*** - Continued multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Continued development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery. - Continued research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts). - Continued research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters. - Continued development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise. - Continued development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. - Continued research on effects of chronic physiological stress related to acoustic exposure of marine mammals in the wild.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued research on the population level consequences of acoustic disturbance to marine mammals. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. - Complete development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as complete above. ***FY 2017 OCO Plans:*** N/A					
Title: UNDERSEA WEAPONRY ***Description:*** Undersea Weaponry focuses on the development of enabling technologies to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Simulation Based Design, Propulsion, Power Sources, Supercavitation, and Counter Weapons/Counter Measures. The ultimate goal of this activity is to provide revolutionary capabilities needed to fill Sea Shield and Sea Strike Warfighter Capability Gaps, to accommodate unique payload limitations through the development of modular and reduced sized undersea weapons based on common technology enablers (where possible), to provide improved platform pre-engagement positioning and fire-control solutions for effective weapon-to-target engagement, and provide countermeasures and counterweapons against current and next-generation undersea weapons. ***FY 2015 Accomplishments:*** - Continued limited collection and evaluation of small supercavitating vehicle. - Continued concept designs for advanced warheads. - Continued design/formulation and early-stage testing of propulsion system components for advanced undersea platforms. - Continued development and testing of technologies for rapid reaction defense against undersea threats. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:***	13.890	12.923	13.190	0.000	13.190

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	88.204	123.739	126.313	0.000	126.313

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602747N / *Undersea Warfare Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	27.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.100

A. Mission Description and Budget Item Justification

Related efforts include novel approaches to remote detection of ocean acoustic fields, enhanced understanding of ocean acoustic structure, new transduction materials, and novel anti-submarine warfare detection methods.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Undersea Warfare Research ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** -Initiate studies using lidar for remote detection of ocean acoustic fields -Continue studies of upper ocean acoustic structure, high strain rate materials for sonar applications, and surface decluttering	0.000	18.600
Congressional Add: Underwater Energetics Research ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** -Initiate assessment of global developments in energetic materials.	0.000	8.500
Congressional Adds Subtotals	0.000	27.100

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602750N *I (U)Future Naval Capabilities Applied Research*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	171.991	179.538	165.103	-	165.103	175.233	175.258	176.250	183.188	Continuing	Continuing
0000: *(U)Future Naval Capabilities Applied Research*	0.000	166.866	179.538	165.103	-	165.103	175.233	175.258	176.250	183.188	Continuing	Continuing
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	5.125	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.125

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) address the Applied Research associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	175.924	179.686	178.954	-	178.954
Current President's Budget	171.991	179.538	165.103	-	165.103
Total Adjustments	-3.933	-0.148	-13.851	-	-13.851
• Congressional General Reductions	-	-0.148			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.932	0.000			
• Program Adjustments	0.000	0.000	-3.808	-	-3.808
• Rate/Misc Adjustments	-0.001	0.000	-10.043	-	-10.043

Change Summary Explanation

The FY 2017 funding request was reduced by -$6.8 million as required for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Technical: Not applicable.
Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602750N / *(U)Future Naval Capabilities Applied Research*	Project (Number/Name) 0000 / *(U)Future Naval Capabilities Applied Research*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *(U)Future Naval Capabilities Applied Research*	0.000	166.866	179.538	165.103	-	165.103	175.233	175.258	176.250	183.188	Continuing	Continuing

A. Mission Description and Budget Item Justification

FNC investments are typically 3-5 years in duration. They provide a continuance of basic research by maturing technologies from a Technology Readiness Level (TRL) of 3 or 4 to a TRL of 6. All FNC products require BA2 and BA3 funded technology development, which is coordinated to ensure tangible technology products are delivered upon completion of each investment. Each year the TOG refreshes the FNC Program by approving new ECs and technology products as older ones get delivered. After transition to an acquisition program, FNC products are further engineered, integrated and, ultimately, delivered to the warfighter. The development and delivery of each FNC product is guided by a Technology Transition Agreement (TTA) that is signed by the requirements and acquisition sponsors, as well as the S&T developer.

This project supports the naval pillars of Capable Manpower, Enterprise and Platform Enablers, Expeditionary Maneuver Warfare, Force Health Protection, Forcenet, Power and Energy, Sea Basing, Sea Shield and Sea Strike. Each of these pillars is listed as a separate R-2 Activity, as is FNC Management. Under each R-2 Activity, the BA 6.2 accomplishments and plans for every Enabling Capability (EC) and Technology Product in the FNC Program are listed. ECs are composed of one or more interrelated technology products, so for clarity, each product is shown under its EC.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: CAPABLE MANPOWER (CMP)	8.065	9.298	9.753	0.000	9.753
Description: This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Capable Manpower (CMP) FNC pillar. The CMP Pillar develops deliverable technologies that provide new capabilities in manpower and personnel management, training and education, and human-systems integration for more intuitive systems. The FY 2015 to FY 2016 increase was due primarily to the ramp-up of CMP-FY15-01 and CMP-FY15-02, and the initiation of CMP-FY16-01. ***FY 2015 Accomplishments:*** EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT) - Complete Augmented Immersive Team Training (AITT) - Design and demonstrate software technology to deliver augmented reality scenarios tailored to the skills of the training audience for infantry operations. - Complete Perceptual Training Systems and Tools (PercepTs) - Identify the perceptual cues in the urban and dense infrastructure environments that may improve warfighter performance.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY - Continue Cognitive Fidelity Synthetic Environment - Develop optimal characteristics for virtual simulations to elicit the appropriate perceptual-cognitive responses for Naval aviation training. - Continue Tactics & Speech Capable Semi-Automated Forces - Conduct applied research to develop learner-aware semi-autonomous forces. - Continue Virtual-Constructive Representations on Live Avionics Displays - Develop design guidelines for effective and safe representation of virtual and constructive assets on live displays. EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS) - Continue Manpower Planning and Optimization Toolset - Develop analytical techniques, data collection methodologies, and procedures to create optimized manpower requirements for the platform. - Continue Platform Design and Acquisition Toolset - Develop scenario-based models that characterize crew performance to operate ship systems during 60/90 day missions under varying physical and cognitive loads. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT) - Continue Dynamic, Adaptive & Modular Training for UAS - Expand Activity Learning capability to allow automatic matching between UAS operator training objectives, specific training contexts, and semi-automated forces behaviors. - Continue Selection for UAS Personnel (SUPer) - Develop mission scenarios to enable testing for the knowledge, skills and abilities required for operating Navy unmanned aircraft systems and integrate into an appropriate UAS simulator. - Continue UAS Control Station Human Machine Interface - Develop metrics that assess UAS Operator performance in terms of the likelihood of leading to successful unmanned aircraft system operation. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Initiate Decision Making-Learning Management System (DM-LMS) - Identify S&T solutions for Decision Making (DM) and instructional method guidelines and develop software products to plan, assess, and track decision making skill development.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Digital Integrated Representation of Tactical Environment (DIRTE) - Identify S&T solutions for classroom and sustainment training and develop rapid terrain modeling and sketchpad software products to enable small unit leaders and instructors to create effective decision making environments and scenarios. - Initiate Simulation Tailored Training and Assessment (ST2A) - Identify S&T solutions for situated tutor techniques and unobtrusive monitoring techniques and develop software and hardware prototypes to execute a decision making program of instruction and scenarios in simulation. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Initiate Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Investigate and develop an approach to an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats.					
FY 2016 Plans: EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY - Complete Cognitive Fidelity Synthetic Environment - Develop optimal characteristics for virtual simulations to elicit the appropriate perceptual-cognitive responses for Naval aviation training. - Complete Tactics & Speech Capable Semi-Automated Forces - Conduct applied research to develop learner-aware semi-autonomous forces. - Complete Virtual-Constructive Representations on Live Avionics Displays - Develop design guidelines for effective and safe representation of virtual and constructive assets on live displays. EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS) - Continue Manpower Planning and Optimization Toolset - Optimize manpower variables (task allocation, job and occupation codes, billets, and training) to better estimate the manpower components of ship total ownership cost. - Continue Platform Design and Acquisition Toolset - Develop assessment reporting tools that identify the dependencies, drivers, and risks associated with different platform designs and manning configurations. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Dynamic, Adaptive & Modular Training for UAS - Expand the activity learning capability to allow automatic matching between UAS operator training objectives, specific training contexts, and computer generated force behaviors. - Continue Selection for UAS Personnel (SUPer) - Develop mission scenarios to enable testing for the knowledge, skills and abilities required to operate Navy unmanned aircraft systems and integrate them into an appropriate UAS simulator. - Continue UAS Control Station Human Machine Interface - Develop metrics that assess UAS Operator performance in terms of the likelihood of leading to successful unmanned aircraft system operation. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Continue Decision Making-Learning Management System (DM-LMS) - Develop new technology solutions for decision making, instructional method guidelines, and software products to plan, assess, and track decision making skill development. - Continue Digital Integrated Representation of Tactical Environment (DIRTE) - Develop new technology solutions for classroom and sustainment training and develop rapid terrain modeling and sketchpad software products to enable small unit leaders and instructors the ability to create effective decision making environments and scenarios. - Continue Simulation Tailored Training and Assessment (ST2A) - Develop new technology solutions for situated tutor techniques and unobtrusive monitoring techniques, and develop software and hardware prototypes to execute a decision making program of instruction and scenarios in simulation. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Continue Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Investigate and develop an approach to an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats. EC: CMP-FY16-01 OPERATIONAL PLANNING TOOL - Initiate Operational Planning Tool - Develop decision support analytic tools that enhance collaborative planning for generating and executing safe and effective navigation & operational plans. ***FY 2017 Base Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS) - Continue Manpower Planning and Optimization Toolset - Develop measures and metrics to assess variable work packaging, improved manpower variables (task allocation, job and occupation codes, billets, and training), and estimate manpower, personnel, and training costs to better understand ship Total Ownership Cost. - Complete Platform Design and Acquisition Toolset - Deliver new manpower and system response metrics that report on the balance between system design and manpower requirements. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT) - Continue UAS Control Station Human Machine Interface - Define the priority autonomy capabilities needed by operators for the Supervisory Control of next generation unmanned systems. - Complete Selection for UAS Personnel (SUPer) - Evaluate and refine tests for the selected knowledge, skills, and abilities required to operate Navy unmanned aircraft systems. - Complete Dynamic, Adaptive & Modular Training for UAS - Analyze the generalization process of pattern-of-life for computer generated forces to novel activities, locations, and scenarios. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Continue Digital Integrated Representation of Tactical Environment (DIRTE) - Develop a Graphical User Interface (GUI) for environment generation and the capture of relevant environmental context, including maps and terrain, to train individual Marines, small unit leaders, and company level staff. - Continue Simulation Tailored Training and Assessment (ST2A) - Develop new technology solutions for situated tutor techniques and unobtrusive monitoring techniques, and develop software and hardware prototypes to execute a decision making program of instructional scenarios in simulation. - Continue Decision Making-Learning Management System (DM-LMS) - Define Kill Probability (KP) Measures (including non-performance) of decision making mastery for ground infantry squad leaders in order to reliably measure acquisition of expertise in psychomotor, cognitive/metacognitive, and affective domains. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Continue Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Assess Artificial Intelligence-enabled activities in the Electromagnetic Spectrum (EMS) reflecting presence					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
of non-combatant entities in the EMS and a representation of Opposition Forces tailored to training audience proficiency and learning objectives. EC: CMP-FY16-01 OPERATIONAL PLANNING TOOL - Continue Operational Planning Tool - Develop a systematic understanding of distributed, near-real time collaboration and decision making applicable for planning and operational staff. EC: CMP-FY17-01 MANPOWER, PERSONNEL & TRAINING STRATEGIC PLANNING APPLICATION - Initiate Manpower, Personnel & Training Planning Application - Develop a fundamental understanding of the risks and uncertainties underlying Manpower, Personnel, and Training interconnections and performance drivers, including potential impact points, time delays, and pathways of decisions across the enterprise. EC: CMP-FY17-02 FUTURE INTEGRATED TRAINING ENVIRONMENT (FITE) - Initiate Future Integrated Training Environment (FITE) - Investigate and assess technologies and methods to improve the ability to conduct Live, Virtual, and Constructive training events for the Marine Air-Ground Task Force (MAGTF). ***FY 2017 OCO Plans:*** N/A					
Title: ENTERPRISE AND PLATFORM ENABLERS (EPE) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Enterprise and Platform Enablers (EPE) FNC pillar. The EPE Pillar develops cross-cutting, deliverable technologies that provide new capabilities for naval service platforms that lower acquisition, operations and maintenance costs, improve system safety and availability, and improve platform survivability. The FY 2016 to FY 2017 decrease was due primarily to the completion of EPE-FY12-01 and EPE-FY13-01, and the planned ramp-down of EPE-FY14-02 and EPE-FY15-02. ***FY 2015 Accomplishments:*** EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION - Complete Advanced Material Propeller - Validate the finite element method (FEM) using the 1/4 scale AMP model testing data obtained by ARL/PSU for stresses, strains and deflections.	12.012	11.652	9.903	0.000	9.903

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY - Complete Advanced-Robust ICCP Anodes and Reference Cells - Complete reference cell laboratory performance research and testing. EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Continue Integrated Thermal Management System Design - Test panels for heat transfer capabilities. EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES - Continue Corrosion Resistant Surface Treatment - Complete development of single-step corrosion treatment process. - Continue Sprayable Acoustic Damping Systems - Complete research and initial corrosion testing of prototype. EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS) - Continue IHSMS Fleet Structural Health Management Decision Tool (formerly known as Distributed Structural Micro-Sensor Nodes and Rotor Hot Spot Sensors and Integration) - Conduct research in wireless energy harvesting sensors for rotorcraft structural health management, and evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots. EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT - Continue Tools for Predicting Array Operational Loading & Distribution - Develop individual predictive models for hydrodynamic effects on a towed array that include the forces imparted on a towed array by the handling system and the effects of the combined forces on array internal components. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Continue coating formulation. - Continue Aluminum Alloy Corrosion Prediction Tool - Conduct research to develop algorithm for 5000 series aluminum alloy degree of sensitization and for prediction of Mean Time to Repair. EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Conduct laboratory hot corrosion testing and analysis under simulated shipboard environmental conditions. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Develop new materials mitigation technology for submarines. ***FY 2016 Plans:*** EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Continue Integrated Thermal Management System Design - Conduct small scale testing of thermal management panels. EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES - Complete Corrosion Resistant Surface Treatment - Determine best Corrosion Resistant Surface Treatment among carbon, nitrogen, and carbonitration approaches. - Complete Sprayable Acoustic Damping Systems - Investigate and develop spray applied damping systems for improved structural vibration control. EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS) - Complete IHSMS Fleet Structural Health Management Decision Tool - Optimize physics and statistical based structural health models, rotor hot-spot sensors and integration technologies, and finalize risk reduction experiments. EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT - Complete Tools for Predicting Array Operational Loading & Distribution - Develop a predictive model of the magnitude and distribution of hydrodynamic forces on a towed array and the effect of the forces on array internal components. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Investigate and develop advanced corrosion control and thermal load reduction coatings and surface treatment/repair technologies for improved corrosion and cracking resistance on aluminum substrates.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Aluminum Alloy Corrosion Prediction Tool - Develop a sensitization detection tool hardware and refine the prediction algorithm for determining the rate of sensitization. EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT - Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Develop and evaluate a set of alloys and coatings to support higher temperature capable gas turbine operation. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Develop new hull treatment materials for submarines.					
FY 2017 Base Plans: EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Complete Integrated Thermal Management System Design - Analyze data of flight deck thermal management system during at-sea test. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Develop coating and repair tools for final testing. - Continue Aluminum Alloy Corrosion Prediction Tool - Assess the robustness of the Degree of Sensitization (DoS) prediction algorithm and refine the algorithm for integration into the DoS detection tool. EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT - Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Develop advanced marinized coatings for higher temperature service, marinized single crystal alloys, and disk coatings for oxidation and corrosion resistance. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Develop new materials mitigation technology for submarines. EC: EPE-FY16-01 ADVANCED TOPCOAT SYSTEM (ATS)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Advanced Topcoat Systems for Air Vehicle (ATS-AV) - Conduct formula optimization and modification development of advanced protective coating constituent combinations and preliminary material property validation towards TRL 6 formulas. ***FY 2017 OCO Plans:*** N/A					
Title: EXPEDITIONARY MANEUVER WARFARE (EMW) ***Description:*** This R-2 Activity contains all Navy funded Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Expeditionary Maneuver Warfare (EMW) FNC Pillar. The EMW Pillar develops deliverable technologies that provide new capabilities in expeditionary maneuver warfare, including naval ground forces, with special emphasis on regular and irregular warfare in urban environments and combating terrorism. The FY 2016 to FY 2017 decrease was due primarily to the planned ramp down of EMW-FY12-02 and the continuation of EMW-FY14-01 and EMW-FY16-01 in PE 0602131M. ***FY 2015 Accomplishments:*** EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Develop distributed resource allocation and RF situational awareness techniques to provide automated tactical-level distributed jamming on multiple ground-based EW systems. - Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Develop components and techniques to enable simultaneous transmission and reception of EW and blue-force communication waveforms. EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICA SYSTEM (MEMS) NAVIGATION SYSTEM - Continue Micro-Electro-Mechanical System (MEMS) Inertial Navigation System - Commence work to optimize sensor performance of MEMS to reduce target location error in the Navigation System of hand-held targeting systems.	6.553	6.260	2.959	0.000	2.959

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE) - Continue Automated Processing for Spectral Exploitation and Dissemination (APSED) - Conduct a feasibility effort to develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) image processing architecture that includes EO-to-HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation. - Continue Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Complete preliminary hardware design for a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution.					
FY 2016 Plans: EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Refine radio frequency situational awareness techniques and distributed resource allocation on multiple ground-based Electronic Warfare systems by providing automated tactical-level distributed jamming. - Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Enable the simultaneous transmission and reception of blue-force and Electronic Warfare communication waveforms by finalizing the components and techniques. EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICA SYSTEM (MEMS) NAVIGATION SYSTEM - Complete Micro-Electro-Mechanical System (MEMS) Inertial Navigation System - Complete optimization of MEMS sensor performance to reduce target location error in the Navigation System of hand-held targeting systems. EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE) - Complete Automated Processing for Spectral Exploitation and Dissemination (APSED) - Develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) Image Processing architecture that includes EO to HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Develop preliminary hardware design for a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution. EC: EMW-FY16-01 DENSIFIED PROPELLANT FIRE FROM ENCLOSURE - CONFINED SPACE (FFE/CS) PROPULSION TECHNOLOGIES - Initiate Densified Propellant Fire From Enclosure - Confined Space (FFE/CS) Propulsion Technologies - Refine tungsten-propellant mix, grain dimensions and configuration, and the fabrication process to reach suitable rocket nozzle exit velocities and sound pressure levels. ***FY 2017 Base Plans:*** EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Complete Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Conduct final testing of Radio Frequency (RF) situational awareness techniques and distributed resource allocation on multiple ground-based Electronic Warfare (EW) systems by providing automated tactical-level distributed jamming. - Complete Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Finalize the components and techniques to allow simultaneous transmission and reception of blue-force and Electronic Warfare (EW) communication waveforms. EC: EMW-FY16-01 DENSIFIED PROPELLANT FIRE FROM ENCLOSURE - CONFINED SPACE (FFE/CS) PROPULSION TECHNOLOGIES - Continued in PE 0602131M EC: EMW-FY17-01 HIGH RELIABILITY DPICM REPLACEMENT (HRDR) - Initiate High Reliability DPICM Replacement - Define High Reliability Dual-purpose Improved Conventional Munitions Master Safe and Arm Device hardware design and system architecture to transfer all arming, safing, and communication signals to/from the projectile's 56 sub-munition fuzes in under 6 seconds. ***FY 2017 OCO Plans:*** N/A					
Title: FNC MANAGEMENT	10.481	8.940	8.385	0.000	8.385

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: This R-2 Activity includes the Science and Technology (S&T) analyses and studies required to take new Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs) approved by the Technology Oversight Group and produce the detailed technology specifications and performance metrics needed to procure the component level technologies that must be developed and tested in order to deliver technology products to the acquisition community. This activity includes development and implementation of innovative and dynamically changing technology management business processes required to manage FNC investments supporting the naval capability pillars. The FY 2015 to FY 2016 decrease was due to the FY15 increase new start preparation funds noted above and a subsequent return in FY16 to normal funding levels. ***FY 2015 Accomplishments:*** FNC MGMT-NEW START PREPARATIONS - Continue FNC Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner. FNC MGMT-SUPPORT/OPS ANALYSIS - Continue FNC Management - Support/OPS Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars. ***FY 2016 Plans:*** FNC MANAGEMENT - Continue FNC Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner. - Continue FNC Management - Support/OPS Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars. ***FY 2017 Base Plans:*** FNC MANAGEMENT					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue FNC Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner. - Continue FNC Management - Support/OPS Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars. ***FY 2017 OCO Plans:*** N/A					
Title: FORCE HEALTH PROTECTION (FHP) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Force Health Protection (FHP) FNC pillar. The FHP Pillar develops deliverable technologies that provide new capabilities that provide Sailors and Marines with the best possible protection from operational threats by reducing morbidity and mortality when casualties occur. The FY 2016 to FY 2017 decrease was due primarily to the completion of FHP-FY11-01 and FHP-FY12-02, and the planned ramp-down of FHP-FY14-01 and FHP-FY14-03. ***FY 2015 Accomplishments:*** EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS) - Continue Multifunctional Blood Substitute (MFBS) - Conduct animal testing of optimal blood component mixture. EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM - Continue Automated Critical Care System (ACCS) - Construct mathematical models and build control algorithms for testing autonomous hardware and software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario. EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA - Complete SEMPer Fi for Air Dysoxia - Perform down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypertension.	8.962	8.670	5.730	0.000	5.730

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue SEMPer Fi for Land Blast Kit - Establish animal models and mathematical simulations to formulate window of therapeutic intervention and dosing with hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH - Continue Hypoxia Alert and Mitigation System - Formulate algorithms to detect/predict onset of hypoxia or hypoxia-like symptoms for mountain operators, casualties, and aviators. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Establish efficacy parameters for a fieldable wound cover to include novel outer cover materials and internal pharmaceutical coating that improve the clinical outcome of severe wounds. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Algorithm - Design an algorithm relating blast intensity data with traumatic brain injury indicators to predict likelihood of brain injury after a given blast event. - Neuro-Functional Assessment Tool - Establish testing paradigm and sensory modality for a non-psychometric device that detects and estimates severity of traumatic brain injury. - Continue Sensor - Investigate designs for a self powered blast sensor that detects and quantifies acceleration, pressure, and impulse from a given blast event and outputs the data electronically.					
FY 2016 Plans: EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS) - Complete Multifunctional Blood Substitute (MFBS) - Finalize animal testing of optimal blood component mixture. EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM - Continue Automated Critical Care System (ACCS) - Formulate autonomous hardware and software system to monitor and maintain combat casualties with minimal human intervention during a 2-6 hour Casualty Evacuation scenario.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA - Complete SEMPer Fi for Land Blast Kit - Determine window of therapeutic intervention and dosing with hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain or internal organs. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH - Continue Hypoxia Alert and Mitigation System - Conduct assembly of the sensor suite to detect and predict the onset of hypoxia and integrate mitigation strategies for individuals operating in high altitudes or Casualty Evacuation missions in unpressurized aircraft. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Develop a fieldable wound cover comprising outer cover materials and an internal pharmaceutical coating that improves the clinical outcome of severe wounds. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Algorithm - Collect experimental data for use in algorithm development that relates integrated blast intensity with cognitive impairment to predict the likelihood of brain injury after single or multiple blast exposures. - Continue Neuro-Functional Assessment Tool - Conduct experimental development of a non-psychometric device that detects and estimates the severity of traumatic brain injury. - Continue Sensor - Demonstrate a self-powered blast sensor in bench and laboratory testing for sensitivity to acceleration, pressure and impulse.					
FY 2017 Base Plans: EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM - Complete Automated Critical Care System (ACCS) - Complete technology development of hardware/software to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Hypoxia Alert and Mitigation System - Finalize methods of detecting individual-specific challenges associated with combating casualties in warfighters operating at altitude. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Conduct efficacy testing of innovative pharmaceutical solutions and novel materials for use in an enhanced bandage system for management of complex limb trauma. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Blast Load Assessment: Sense and Test (BLAST) (formerly sensor, algorithm, and neurofunctional assessment tool) - Model the relationship between the injurious forces from blast incidents and the medical outcomes experienced by exposed warfighters, conduct validation of a Neuro-Functional Assessment Tool that provides a simple evaluation for Traumatic Brain Injury, and refine the self-powered, head-mounted, micro sensor being developed to detect the blast over-pressure and acceleration forces that cause traumatic brain injury. EC: FHP-FY16-01 INCAPACITATION PREDICTION FOR READINESS IN EXPEDITIONARY DOMAINS - AN INTEGRATED COMPUTATIONAL TOOL (I-PREDICT) - Initiate I-PREDICT - Begin development of an integrated, in-silico, morphomentrically-scalable model of the human being that estimates the injury response from external forces. ***FY 2017 OCO Plans:*** N/A					
Title: FORCENET (FNT) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Forcenet (FNT) FNC Pillar. The FNT pillar develops deliverable technologies that provide new capabilities in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), networking, navigation, sensors, decision support, cyber-space, intelligence, and space technologies that will provide the architectural framework for naval warfare in the information age.	27.348	32.351	42.489	0.000	42.489

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The FY 2015 to FY 2016 increase was due primarily to the planned ramp-up of FNT-FY15-01, FNT-FY15-02 and FNT-FY15-04, and the initiation of FHT-FY16-01 and FNT-FY16-02. The FY 2016 to FY 2017 increase was due primarily to the planned ramp-up of FNT-FY15-02 and FNT-FY16-02, and the initiation of FNT-FY17-01, FNT-FY17-02, and FNT-FY17-04. ***FY 2015 Accomplishments:*** EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE - Complete Pro-Active Computer Network Defense and Information Assurance (formerly known as Common Operational Security Decision System, Next Generation Security and Security Management Protocol, and Next Generation Sensors and Gateways) - Developed interactive controls for map-based visualization of Computer Network Defense policy deployments, a path-aware trusted routing algorithm for maximizing Information Assurance of security management communications, and adaptive learning and decision algorithms for pro-active defense mechanisms and for creating Computer Network Defense policy. EC: FNT-FY11-02 FAST MAGIC - Complete Fast Magic Product 1 - Conduct applied research. - Complete Fast Magic Product 2 - Conduct applied research. EC: FNT-FY11-05 NRL SPACE - Complete Multi-INT Tracking - Develop vessel tracking algorithms and characterization techniques. - Complete Tagging - Perform data tagging research based on key parametric values used in the Maritime environment. EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL) - Continue Mission-Based Waveform Controls & Networking - Develop baseline waveforms and validate performance against operational scenarios. EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE - Continue Autonomous Information-Based Surveillance Control - Develop algorithms for information based UAV routing and patching. - Continue Contextual Enterprise Information - Develop the analytical services framework, including enterprise exploitation services for situation context between relevant theater sensor collections and exploitation products.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Mobile Autonomous ISR to C2 Synchronization - Develop enterprise distributed software solution that will model mission tracks, translate these tracks to information tracks, and produce relevant information fulfillment and deficit objects. EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Develop data exchange message techniques and new algorithms for control and coordination of distributed EW assets. EC: FNT-FY13-03 SILK THREAD - Continue Silk Thread Product 1 - Conduct applied research. - Continue Silk Thread Product 2 - Conduct applied research. EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Research and analyze algorithms to enable cross-domain information fusion and optimize use of remote sensing assets. - Continue Detection & Classification Algorithms (DCA) - Research and analyze algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Develop and evaluate the performance of methods that are context aware and determine the value of information for a mission. - Continue Data Exfiltration and Networked Platform Interaction - Develop components and design methods leading to a low cost radio that meets size, weight, and power constraints. EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Initiate Advanced AEW Electronic Protection - Develop techniques to improve E2-D electronic protection. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Initiate Naval Tactical Cloud Analytics (formerly known as ASW Naval Tactical Cloud, EXW Naval Tactical Cloud, and IAMD Naval Tactical Cloud) - Perform the data science activities to ingest all relevant data (acoustic, IR, EO, magnetic, radar, SIGINT, METOC) into the Naval Tactical Cloud to enable efficient decision support analytics in support of effective ASW, EXW and IAMD mission execution based on Commander's Intent.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Initiate Compact, Scalable Integrated RF (Compact-SIRF) - Develop techniques for high speed data conversion and processing between Radio Frequency (RF) collection and digital processing systems using low size, weight and power RF analog and digital designs. - Initiate Electronic Warfare Tactical Decision Aid (EW-TACAID) - Develop performance measures and expert models that provide meaningful feedback to the EW operator and develop an intuitive EW display. - Initiate Scalable Integrated RF for Submarines (SIRF-Sub) - Develop techniques for high speed data conversion and processing between RF collection and digital processing systems.					
FY 2016 Plans: EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL) - Complete Mission-Based Waveform Controls & Networking - Develop Anti-Access/Area Denial enhancements to waveforms, along with advanced networking techniques, and validate performance through emulation. EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE - Complete Autonomous Information-Based Surveillance Control - Complete algorithm development for information based Unmanned Aerial Vehicle (UAV) routing and pathing. - Complete Contextual Enterprise Information - Develop and demonstrate the analytical services framework, including enterprise exploitation services, for situation context between relevant theater sensor collections and exploitation products. - Complete Mobile Autonomous ISR to C2 Synchronization - Transition to MARCORSYSCOM a set of services that can automate the mapping of mission relevant information requirements to information fulfillments or deficits, and provide a sensor tasking recommendation to resolve deficits. EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Develop automation techniques for multiple Electronic Warfare systems across multiple ships, including network layer monitoring. EC: FNT-FY13-03 SILK THREAD - Continue Silk Thread Product 1 - Conduct applied research. - Continue Silk Thread Product 2 - Conduct applied research.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Research and analyze algorithms to enable cross-domain information fusion and optimize use of remote sensing assets. - Continue Detection & Classification Algorithms (DCA) - Research and analyze algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Develop and evaluate the performance of methods that are context aware and determine the value of the information for an ASW mission. - Continue Data Exfiltration and Networked Platform Interaction - Develop digital radio components and waveforms directed toward host platforms with limited size, weight, and power and with the desired communication range and performance. EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Continue Advanced AEW Electronic Protection - Develop techniques to improve E-2D Advanced Hawkeye electronic protection. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Continue Data Focused Naval Tactical Cloud (formerly called Naval Tactical Cloud Analytics) - Conduct the data science activities to ingest all relevant data into the Naval Tactical Cloud to enable efficient decision support analytics for enhanced ASW, IAMD and EXW situational awareness and improved mission execution effectiveness. EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Continue Compact, Scalable Integrated RF (Compact-SIRF) - Develop scalable and modular, low Size, Weight and Power (SWaP) components and techniques for multi-function Radio Frequency processing on SWaP restricted platforms. - Continue Electronic Warfare Tactical Decision Aid (EW-TACAID) - Create an intuitive display with good user-centered design practices that has adaptive instructional content to suit an individual's aptitudes, learning preferences, and learning styles. - Continue Scalable Integrated RF for Submarines (SIRF-Sub) - Investigate techniques that facilitate the processing and high speed data conversion between digital processing and Radio Frequency collection systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY16-01 BUGLE - Initiate Bugle - Develop algorithms that enable Battle Group communications. EC: FNT-FY16-02 COMBINED EO/IR SURVEILLANCE AND RESPONSE SYSTEM (CESARS) - Initiate Multispectral EO/IR Countermeasures against Advanced Threats (MEIRCAT) - Investigate multiband laser, window, and sensing technologies as well as advanced countermeasure techniques for shipboard defense. - Initiate Shipboard Panoramic EO/IR Cueing and Surveillance System (SPECSS) - Investigate small pixel Mid-Wave Infrared (MWIR) Focal Plane Array (FPA) technologies and innovative approaches for seamless stitching of multiple FPAs to create large format, high pixel-count imagers.					
FY 2017 Base Plans: EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Develop automated queuing/attack techniques and tactical use of cross domain data for multiple Electronic Warfare (EW) systems across multiple ships. EC: FNT-FY13-03 SILK THREAD - Continue Silk Thread Product 1 - Conduct applied research. - Continue Silk Thread Product 2 - Conduct applied research. EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Complete Adaptive Multi-Int Correlation & Identification (AMICA) - Research and analyze algorithms to enable cross-domain information fusion and optimization of theater and tactical battlespace assets to conduct anti-surface warfare. - Complete Detection & Classification Algorithms (DCA) - Research and analyze algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Develop advanced techniques for automated, high accuracy, low error rate, adaptive processing.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Data Exfiltration and Networked Platform Interaction - Integrate and conduct initial demonstration of the radio components and waveforms in a host platform in a simulated environment. EC: FNT-FY14-03 EXCHANGE OF ACTIONABLE INFORMATION AT THE TACTICAL EDGE (EAITE) - Continue from PE 0602131M Actionable Information Tactical Applications from PE 0602131M - Develop natural language processing lexicon algorithms to enable machine understanding of a user defined information requirement. EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Continue Advanced AEW Electronic Protection - Develop techniques to improve Advanced Hawkeye (E2-D) electronic protection capability. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Continue Data Focused Naval Tactical Cloud - Mature Naval Tactical Cloud platform services for streaming, serial ingest and data management within an all source/adaptive data ecosystem, with additional focus on development of federated query and analytic services, to include Expeditionary Warfare readiness and course-of-action recommendations. EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Continue Scalable Integrated RF for Submarines (SIRF-Sub) - Investigate new techniques/functionality focusing on Electronic Warfare/Intelligence, Surveillance, Reconnaissance/Electronic INTelligence (EW/ISR/ELINT) collection and processing techniques for the modular functionality payload. - Continue Compact, Scalable Integrated RF (Compact-SIRF) - Develop a modular payload bay and modular Radio Frequency (RF) front end bay for small/medium sized unmanned undersea vehicles. - Continue Electronic Warfare Tactical Decision Aid (EW-TACAID) - Develop new user interface concepts to mitigate shortcomings and issues associated with the Electronic Warfare environment and develop a deeper understanding of the nature of the Electronic Warfare domain content that is most suited for instruction via adaptive training. EC: FNT-FY16-01 BUGLE - Continue Bugle - Develop algorithms that enable battle group communications in communication-challenged, forward-deployed environments.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY16-02 Combined EO/IR Surveillance and Response System (CESARS) - Continue Shipboard Panoramic EO/IR Cueing and Surveillance System (SPECSS) - Begin high fidelity tracking algorithm development. - Continue Multispectral EO/IR Countermeasures against Advanced Threats (MEIRCAT) - Begin high resolution sensor algorithm development. EC: FNT-FY17-01 COMMUNICATIONS AND INTEROPERABILITY FOR INTEGRATED FIRES (CIIF) - Initiate Communications as a Service (CaaS) - Develop distributed optimization algorithms and Quality of Service (QoS) protocols for heterogeneous data link networks. - Initiate Mission-Based Networking for DDS (MiND) - Develop forward error correction and directional networking algorithms. EC: FNT-FY17-02 SUBMARINE SIMULTANEOUS TRANSMIT AND RECEIVE (SUBSTAR) - Initiate Submarine Simultaneous Transmit and Receive (SubSTAR) - Develop a submarine broadband antenna enabling simultaneous transmit and receive capability. EC: FNT-FY17-04 RESILIENT HULL/INFRASTRUCTURE MECHANICAL & ELECTRICAL SECURITY (RHIMES) - Initiate SCAMM - Develop software algorithms that protect naval Hull, Mechanical and Electrical (HM&E) systems against cyber threats. - Initiate SCRAM - Develop information shaping cyber capabilities for tactical platforms. ***FY 2017 OCO Plans:*** N/A					
Title: POWER AND ENERGY (P&E) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Power and Energy (P&E) FNC pillar. The P&E Pillar develops deliverable technologies that provide new capabilities in energy security, efficient power and energy systems, high energy and pulse power. The FY 2015 to FY 2016 decrease was due primarily to the planned ramp-down of P&E-FY12-01 and P&E-FY12-03.	8.200	6.758	11.795	0.000	11.795

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The FY 2016 to FY 2017 increase was due to the initiation of P&E-FY17-02. ***FY 2015 Accomplishments:*** EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER - Continue Renewable Thermal Engine - Conduct test planning for integration of component technologies including test methods, procedures, facilities, and schedule. EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Continue Air Independent Propulsion System - Develop Standard Operating Procedures, maintenance schedules, system piping and instrumentation diagrams, and system components for an Unmanned Undersea Vehicle energy section. EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS - Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Assess circuit protection analytic model results, pursue circuit protection component and system design for Phase 1, and initiate Phase 2 model development for components and system circuit protection. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY - Initiate Compact High Density Tactical Energy Storage - Conduct evaluation of conceptual multifunction energy storage module technologies and overall operational modeling analysis. - Initiate Multi-Function High Density Shipboard Energy Storage - Conduct full-scale ship multifunctional energy storage module analysis and evaluation of conceptual multifunction energy storage module technologies. ***FY 2016 Plans:*** EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER - Complete Renewable Thermal Engine - Finish final design and fabrication of full-scale tactical power system prototype, incorporating all features to be exercised in a TRL 6 demonstration. EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Continue Air Independent Propulsion System - Conduct final design of Phase II fuel cell energy system and coordinate test planning.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS - Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Conduct modelling, simulation and cost analyses of Phase II circuit protection designs and prepare test and safety plans for Phase II circuit protection devices. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY - Continue Compact High Density Tactical Energy Storage - Develop tactical multifunction Energy Storage Module subcomponent technology and designs. - Continue Multi-Function High Density Shipboard Energy Storage - Develop final designs, which integrate ship energy storage module component technologies into a subscale system, and develop subscale system test plans.					
FY 2017 Base Plans: EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Complete Air Independent Propulsion System - Conduct final design of Phase II fuel cell energy system and coordinate test planning. EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS - Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Transition the modeling and simulation and technology development effort from an initial 1kV voltage level to the final 20kV voltage level. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY - Continue Multi-Function High Density Shipboard Energy Storage - Demonstrate the capability of subscale energy storage component technologies and perform an analysis of the ship impact of multifunction energy storage with high pulse loads. - Continue Compact High Density Tactical Energy Storage - Complete development of tactical multifunction Energy Storage Module subcomponent technology and continue analysis of tactical multifunction Energy Storage Module technology designs.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: P&E-FY17-02 TORPEDO ADVANCED PROPULSION SYSTEM (TAPS) - Initiate Torpedo Advanced Propulsion System (TAPS) - Initiate safety analyses and system modeling concepts for each technology identified in the Analysis of Alternatives (AoA). ***FY 2017 OCO Plans:*** N/A					
Title: SEA BASING (BAS) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Basing (BAS) FNC pillar. The BAS Pillar develops deliverable logistics, shipping and at-sea transfer technologies that provide new capabilities for projecting expeditionary force from the sea base and providing sea based joint operational independence through improved connector, at-sea transfer and shipboard logistical capabilities. The FY 2015 to FY 2016 decrease was due to the planned ramp-down of BAS-FY11-01. ***FY 2015 Accomplishments:*** EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE - Continue Environmental Ship Motion Forecasting - Develop environmental and ship motion sensor and forecasting components. ***FY 2016 Plans:*** EC: EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE - Complete Environmental Ship Motion Forecasting - Develop environmental and ship motion sensor and forecasting components. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A	5.590	0.066	0.000	0.000	0.000
Title: SEA SHIELD (SHD) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Shield (SHD) FNC pillar. The SHD Pillar develops deliverable technologies that provide new capabilities in theater air and missile defense, anti-submarine warfare,	45.190	52.681	42.097	0.000	42.097

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total

mine countermeasures, defensive surface warfare, global defensive assurance, anti-terrorism, and fleet/force protection.

The FY 2015 to FY 2016 increase was due primarily to the initiation of SHD-FY16-04, SHD-FY16-05, SHD-FY16-06, SHD-FY16-07 and SHD-FY16-OSD.

The FY 2016 to FY 2017 decrease was due primarily to the completion of SHD-FY10-01, SHD-FY10-03, SHD-FY11-01, SHD-FY12-01 and SHD-FY12-03, the planned ramp-down of SHD-FY13-07, SHD-FY14-02, SHD-FY14-04, SHD-FY14-08 and SHD-FY15-07, and the movement of SHD-FY16-OSD out of the FNC Program into PE 0602782N.

FY 2015 Accomplishments:
EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES
- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Develop STANDARD missile guidance algorithm to support the dual-pulse rocket motor.
- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Develop a dual-pulse rocket motor for STANDARD missile.

EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM
- Continue Long Range LFBB Sonar (AUV Platform Option) - Demonstrate and refine detection & classification algorithms for stealthy mines.

EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING
- Complete Vector Sensor Towed Array - Evaluate and deliver component technology for thin-line Vector Sensor Towed Array (VSTA), common array acoustic modules, and a validated physics-based VSTA performance model.
- Complete Vector Sensor Towed Array Signal Processing - Evaluate and report sonar signal processing detection performance from at-sea and laboratory test events and assess hardware implications for the processing strategy.

EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM
- Continue Torpedo Common Hybrid Fuzing System - Conduct developmental simulation and testing.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD) - Continue Radar Resource Manager for IAMD - Develop algorithms to provide dynamic force-level management and coordination of radar tracks. EC: SHD-FY12-03 SONAR AUTOMATION - Continue Active Sonar Automation - Identify and evaluate in lab performance of algorithms to improve active sonar operator performance in detecting submarines while reducing false contact rates. - Continue Passive Sonar Automation - Identify and evaluate the in-laboratory performance of algorithms that improve passive sonar operator against quiet submarines in the presence of clutter. EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Continue Compact Modular Sensor-Processing Suite (CMSS) - Develop processing & data fusion for onboard classification. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Continue Cooperative Networked Radar - Develop techniques for cross platform radar operation. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8 - Continue Next Generation Multistatic Active Capability (NGMAC) - Develop algorithms for use in the Multistatic Active Capability system that improve performance, reduce operator workload, and allow for use in all ocean environments. - Continue Unmanned Targeting Air System (UTAS) - Update vehicle noise models and coordinate with Magnetic Anomaly Detection algorithms. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Continue USV-based Mine Neutralization (formerly called Drifting Mine Neutralization Technology) - Develop low-cost sensing, navigation, and battle damage assessment solutions, algorithm development, and associated autonomy. - Continue MCM Payload Automation for Data Analysis (Formerly a technology component of MCM Payload Automation) - Develop automatic target recognition algorithms for risk-based MCM.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue MCM Payload Automation for Planning (Formerly a technology component of MCM Payload Automation) - Develop planning algorithms for risk-based MCM. - Continue Single Sortie MCM Detect-to-Engage Payload - Develop architecture, command and control, planning algorithms and design options for hardware. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE - Continue ATT Timeline Compression (ATTTC) - Perform technology requirements definition, algorithm development, and performance prediction for acoustic illumination and engagement controller. - Continue Concept C Countermeasure - Perform technology requirements definition. - Continue HVU Mounted Sonar - Conduct requirements studies and ship scope checks. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS) - Continue Autonomous Threat Detection and Localization - Model the AUWS sensor architecture, target detection and tracking algorithms and fusion methodology, and conduct simulation testing. - Continue Remote Command & Control - Model the AUWS sensor, weapon and gateway communications protocols and algorithms, and conduct simulation testing. - Continue Tactical Positioning & Fire Control - Model the AUWS node positioning and management algorithms for effective fire control, and conduct simulation testing. EC: SHD-FY14-08 TERMINATOR (T3) - Continue Terminator S - Develop a hypothesis-based algorithm to provide a fire control solution against a missile defense threat. - Continue Terminator E - Develop guidance modifications to the Evolved Sea Sparrow Missile. - Continue Terminator R - Develop guidance modifications to the Rotating Airframe Missile. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Continue Hyper Velocity Projectile - Demonstrate the component technology required to support hypervelocity launch and common interfaces for powder gun and railgun launch conditions.					
FY 2016 Plans: EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES - Complete Enhanced Lethality Guidance Algorithms (ELGA) - Optimize the guidance algorithm to increase the probability of kill against an expanded threat set.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Enhanced Maneuverability Missile Airframe (EMMA) - Mature the technologies associated with the dual pulse rocket motor and integrated thrust vector control, incorporating risk reduction schemes. EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM - Complete Long Range LFBB Sonar (AUV Platform Option) - Finalize software configuration and perform final data collection. EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM - Complete Torpedo Common Hybrid Fuzing System - Conduct final at-sea data collection, testing and demonstration of Technology Readiness Level #6. EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD) - Complete Radar Resource Manager for IAMD - Refine, mature, and test advanced algorithms for ballistic missile defense track coordination. EC: SHD-FY12-03 SONAR AUTOMATION - Complete Active Sonar Automation - Evaluate and deliver algorithms to improve active sonar operator performance in detecting submarines while reducing false contact rates. - Complete Passive Sonar Automation - Evaluate and deliver algorithms that improve Passive Sonar operator performance against quiet submarines in the presence of clutter. EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Continue Compact Modular Sensor-Processing Suite (CMSS) - Achieve low False Alarm Rate with advanced data fusion techniques. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Continue Cooperative Networked Radar - Develop techniques for cross platform radar operation. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Next Generation Multistatic Active Capability (NGMAC) - Develop algorithms for use in the Multistatic Active Capability system that improve performance, reduce operator workload, and allow for use in all ocean environments. - Complete Unmanned Targeting Air System (UTAS) - Update vehicle noise models and coordinate with Magnetic Anomaly Detection algorithms. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Continue MCM Payload Automation for Data Analysis - Develop probabilistic Enemy Course of Action models and update algorithms supporting Net-centric Sensor Analysis for MIW (NSAM). - Continue MCM Payload Automation for Planning - Develop probabilistic Enemy Course of Action models and update algorithms supporting Mine-warfare Environmental Decision-Aid Library (MEDAL). - Continue Single Sortie MCM Detect-to-Engage Payload - Develop the architecture, command and control algorithms, planning algorithms, and hardware design options. - Continue USV-based Mine Neutralization - Develop low-cost sensing, navigation, and battle damage assessment solutions, algorithms, and associated autonomy technology. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE - Continue Concept C Countermeasure - Commence array re-design to correct technical issues discovered during testing. - Continue ATT Timeline Compression (ATTTC) - Develop algorithms and real time code for guidance enhancements. - Complete HVU Mounted Sonar - Develop an array hull-mount and baffling mechanism, and model the resultant acoustic performance. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS) - Continue Autonomous Threat Detection and Localization - Model system node positioning algorithms and mission planning improvements, and conduct simulation testing. - Continue Remote Command & Control - Model and assess improved integrated system communications configuration protocols and algorithms. - Continue Tactical Positioning & Fire Control - Develop an improved sensor node architecture and conduct evaluation modeling of detection, classification, localization and targeting capabilities. EC: SHD-FY14-08 TERMINATOR (T3)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Terminator S (formerly Terminator E, S and R) - Develop fire control algorithms for implementation in the Ship Self-Defense System (SSDS). EC: SHD-FY15-03 AUTOMATION FOR UXV-BASED MCM - Initiate MCM Task Force Planning - Develop algorithmic approaches for optimal tailoring of heterogeneous MCM assets. - Initiate Expeditionary MCM Automated Data Analysis - Investigate the applicability of physics-based approaches to performance estimation. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Continue Hyper Velocity Projectile - Demonstrate the component technology required to support a hypervelocity launch and common interfaces for powder gun and railgun launch conditions. EC: SHD-FY16-04 SHIP-LAUNCHED EW EXTENDED ENDURANCE DECOY (SEWEED) - Initiate Ship-launched EW Extended Endurance Decoy (SEWEED) - Develop preliminary vehicle, payload, rocket, and launcher conceptual designs and sizing. EC: SHD-FY16-05 SURFACE SHIP PERISCOPE DETECTION AND DISCRIMINATION (SSPDD) - Initiate Surface Ship Periscope Detection and Discrimination (SSPDD) - Develop specialized interface hardware for technology components. EC: SHD-FY16-06 NEXT GENERATION AIRBORNE PASSIVE SYSTEM (NGAPS) - Initiate Next Generation Airborne Passive System (NGAPS) - Develop an 'A-size' deep, long-duration, passive sonobuoy for area surveillance that takes advantage of Reliable Acoustic Path detection against modern quiet submarines and is tethered to a surface float containing a radio. EC: SHD-FY16-07 SOFTKILL PERFORMANCE AND REAL-TIME ASSESSMENT (SPARTA) - Initiate Softkill Performance and Real-Time Assessment (SPARTA) - Develop and establish design criteria, system requirements and software requirements. EC: SHD-FY16-OSD MODULAR UNDERSEA EFFECTORS (MUSE)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initate Modular UnderSea Effectors (MUSE) - Develop acoustic propagation modeling, algorithms for tracking and tracking, and algorithms to exploit the acoustic communications environment.					
FY 2017 Base Plans: EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Complete Compact Modular Sensor-Processing Suite (CMSS) - Use additional environmental data to validate advanced data fusion techniques and low False Alarm Rates. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Complete Cooperative Networked Radar - Develop software algorithms and techniques for cross-platform radar operation that deliver enhanced sensitivity. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8 - Complete Next Generation Multistatic Active Capability (NGMAC) - Finish applied research efforts in support of a demonstration of the Next Generation Multistatic Active Capability sonobuoys in a relevant at sea Navy environment. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Complete USV-Based Mine Neutralization - Finalize low-cost sensing and navigation solutions, algorithm development, and associated autonomy. - Complete Single Sortie MCM Detect-to-Engage Payload - Finalize command and control technology and planning algorithms, and implement them on the MCM hardware. - Complete MCM Payload Automation for Data Analysis - Finish algorithm development and description. - Complete MCM Payload Automation for Planning - Finalize risk calculation software integration and documentation. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE - Continue ATT Timeline Compression (ATTTC) - Modify the algorithms based on test results. - Continue Concept C Countermeasure - Continue with array re-design to correct technical issues discovered during testing. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Tactical Positioning & Fire Control - Develop enhanced fire control solution algorithms and technology for advanced minefield planning. - Continue Autonomous Threat Detection and Localization - Model improved sensor node algorithms and updated software. - Continue Remote Command & Control - Develop final gateway buoy design and adaptive acoustic communications protocols. EC: SHD-FY14-08 TERMINATOR (T3) - Continue Terminator S (formerly Terminator E, S and R) - Develop fire control algorithms for implementation in the Ship Self-Defense System (SSDS). EC: SHD-FY15-03 AUTOMATION FOR UXV-BASED MCM - Continue MCM Task Force Planning - Formulate core algorithms that provide mathematical foundation for effects based application of risk, re-planning, and incorporation of legacy and emerging MCM systems. - Continue Expeditionary MCM Automated Data Analysis - Develop performance estimation and environmentally-adaptive Automatic Target Recognition (ATR) algorithms. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Continue Hyper Velocity Projectile - Demonstrate the component technology required to support a hypervelocity launch with common interfaces for powder gun and railgun launch conditions. EC: SHD-FY16-04 SHIP-LAUNCHED EW EXTENDED ENDURANCE DECOY (SEWEED) - Continue Ship-launched EW Extended Endurance Decoy (SEWEED) - Develop preliminary vehicle, payload, rocket, and launcher conceptual designs and sizing. EC: SHD-FY16-05 SURFACE SHIP PERISCOPE DETECTION AND DISCRIMINATION (SSPDD) - Continue Surface Ship Periscope Detection and Discrimination (SSPDD) - Develop specialized interface hardware for technology components. EC: SHD-FY16-06 NEXT GENERATION AIRBORNE PASSIVE SYSTEM (NGAPS) - Continue Next Generation Airborne Passive System (NGAPS) - Develop Algorithms and hardware for field communications, control, health monitoring, mission planning and contact separation and correlation.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: SHD-FY16-07 SOFTKILL PERFORMANCE AND REAL-TIME ASSESSMENT (SPARTA) - Continue Softkill Performance and Real-Time Assessment (SPARTA) - Develop and establish design criteria, system requirements, and software requirements. EC: SHD-FY16-OSD MODULAR UNDERSEA EFFECTORS (MUSE) - Continued in PE 0602782N EC: SHD-FY17-02 AUTONOMOUS UNMANNED SURFACE VEHICLES FOR MINE WARFARE (MIW) - Initiate Autonomous Situational Awareness and Hazard Avoidance System for USVs - Develop perception and route-planning autonomous control for Unmanned Surface Vehicles (USVs). - Initiate High Temperature Superconducting (HTS) Magnetic Influence Sweep Payload for USVs - Develop superconducting technology for the mine influence sweep payload on Unmanned Surface Vehicles (USVs). - Initiate Underway Refueling and Data Transfer for USVs and RMMVs - Develop technology for underway refueling of Unmanned Surface Vehicles (USVs) and Remote Multi-Mission Vehicles (RMMVs) and conduct data transfer from an RMMV. EC: SHD-FY17-05 DEEP RELIABLE ACOUSTIC PATH EXPLOITATION SYSTEM (DRAPES) - Initiate Deep Reliable Acoustic Path Exploitation System (DRAPES) - Develop algorithms for undersea communications, health monitoring, and contact separation and correlation. ***FY 2017 OCO Plans:*** N/A					
Title: SEA STRIKE (STK) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE. The Sea Strike (STK) FNC pillar develops deliverable technologies that provide new capabilities in power projection and deterrence, precise and persistent offensive power, weapons, aircraft, and expeditionary warfare. The FY 2015 to FY 2016 increase was due primarily to the planned ramp-up of STK-FY15-01, STK-FY15-02 and STK-FY15-03, and the initiation of STK-FY16-01 and STK-FY16-02.	34.465	42.862	31.992	0.000	31.992

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The FY 2016 to FY 2017 decrease was due primarily to the completion of STK-FY12-01 and STK-FY13-02, and the planned ramp-down of STK-FY13-04, STK-FY14-01, STK-FY14-03, STK-FY15-03 and STK-FY17-04. ***FY 2015 Accomplishments:*** EC: STK-FY11-01 STRIKE ACCELERATOR - Complete Strike Accelerator - Develop and understand advanced airborne capability to accurately identify targets using Advanced Target Recognition. EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP) - Complete Identification and Defeat of EA Systems (IDEAS) - Develop innovative EW countermeasures that employ flexible and robust techniques against advanced Electronic Attack systems. - Complete Network "Sentric" Electronic Protection (EP) - Develop techniques for APG-79 electronic protection. EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE. - Continue Coherent Electronic Attack for Submarines (CEAS) - Develop advanced Electronic Support and Electronic Attack techniques for detecting and countering advanced coastal surveillance RF threats. EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Develop algorithms for moving maritime RF identification. EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION - Continue Hostile Fire Suppression System - Develop a robust muzzle flash tracking algorithm and begin the laser source design process. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Evaluate hardware and software. EC: STK-FY13-04 AIM-9X ENABLERS (AXE) - Continue SMOKE - Design and model an advanced rocket motor and subsystems device for the AIM-9X Sidewinder missile. EC: STK-FY14-01 BANK SHOT - Continue Bank Shot - Study and understand passive sensor phenomenology to enable its use for surveillance.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Design, develop, and improve weapon-to-weapon communications, coupled with algorithms for limited weapon autonomy, to address the surface warfare mission area. - Continue Collaborative Electronic Attack (CEA) - Develop concepts and techniques that improve U.S. Naval forces ability to conduct Anti Surface Warfare. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Continue Synthetic Aperture Radar Electronic Protection - Develop algorithms and techniques to improve synthetic aperture radar electronic protection. EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Initiate Helicopter Active RPG Protection (HARP) - Design and develop prototype concepts and new processes for a Rocket Propelled Grenade (RPG) hard kill defense for rotorcraft. - Initiate Multi-Spectral EO/IR Seeker Defeat - Develop and enhance existing test capability to include EO/IR hybrid hardware-in-the-loop for obscurant and jammer evaluation. EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Initiate MUHV Autonomy Suite - Define the autonomy framework. - Initiate MUHV Sensors, Navigation and Guidance - Evaluate and downselect hardware. EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT) - Continue Extended-Range Targeting (E-RAT) - Design and develop prototypes and processes that address extended range targeting and fire control. EC: STK-FY17-04 ALPO - Initiate ALPO - Begin the concept and technology development phase to establish the initial feasibility of the proposed solution for an advance signal processing system. ***FY 2016 Plans:*** EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Coherent Electronic Attack for Submarines (CEAS) - Conduct experiments of the waveform interactions and spectrum processing that occurs between advanced Electronic Warfare and radar systems in order to assess the effectiveness of new electronic support detection and electronic attack countermeasure techniques. EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Develop algorithms for moving maritime Radio Frequency identification. EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION - Complete Hostile Fire Suppression System - Demonstrate real-time muzzle flash detection and tracking. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Develop relevant algorithms. EC: STK-FY13-04 AIM-9X ENABLERS (AXE) - Continue SMOKE - Evaluate and model advanced kinematic technology improvements for a future Air-to-Air missile. EC: STK-FY14-01 BANK SHOT - Bank Shot - Study and understand passive sensor phenomenology. EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Design, develop, and improve weapon-to-weapon communications, coupled with algorithms for limited weapon autonomy, that address the surface warfare mission area. - Continue Collaborative Electronic Attack (CEA) - Develop adaptable Electronic Warfare mission prioritization and collaborative classification algorithms to enable U.S. Naval forces the ability to conduct Anti-Surface Warfare. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Continue Synthetic Aperture Radar Electronic Protection - Develop algorithms and techniques to improve synthetic aperture radar electronic protection.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Continue Helicopter Active RPG Protection (HARP) - Design and develop prototype concepts and new processes for a Rocket Propelled Grenade (RPG) hard-kill defense for rotorcraft. - Continue Multi-Spectral EO/IR Seeker Defeat - Conduct modeling and simulation to define countermeasure sources and expendables requirements for rotary wing aircraft defense against advanced multi-spectral Electro-Optical/Infrared (EO/IR) Man Portable Air Defense Systems (MANPADS). EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Continue MUHV Autonomy Suite - Downselect an autonomy suite prototype. - Continue MUHV Sensors, Navigation and Guidance - Conduct fiber optic development. EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT) - Continue Extended-Range Targeting (E-RAT) - Design, develop, and improve prototypes and processes that address extended range targeting and fire control. EC: STK-FY16-02 REACTIVE ELECTRONIC ATTACK MEASURES (REAM) - Initiate Reactive Electronic Attack Measures (REAM) - Develop signal detection and classification techniques that can recognize new and agile radar threats. EC: STK-FY17-04 ALPO - Continue ALPO - Commence development of advanced signal processing system algorithms.					
FY 2017 Base Plans: EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Develop algorithms for achieving Radio Frequency (RF) identification of moving maritime contacts. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Refine the subsystem design and development plan. EC: STK-FY13-04 AIM-9X ENABLERS (AXE)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue SMOKE - Evaluate and model advanced kinematic technology improvements for a future Air-to-Air missile. EC: STK-FY14-01 BANK SHOT - Complete Bank Shot - Evaluate and model sensor phenomenology. EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Design, develop, and improve weapon-to-weapon communications, coupled with algorithms for limited weapon autonomy that address the surface warfare mission area. - Continue Collaborative Electronic Attack (CEA) - Develop and prototype highly synchronized collaborative multiple platform Electronic Attack (EA) techniques. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Continue Synthetic Aperture Radar Electronic Protection - Develop of algorithms and techniques to improve synthetic aperture radar electronic protection. EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Continue Helicopter Active RPG Protection (HARP) - Design and develop prototype concepts and new processes for a Rocket Propelled Grenade (RPG) hard-kill defense for rotorcraft. - Continue Multi-Spectral EO/IR Seeker Defeat - Develop Infra-Red CounterMeasures (IRCM) Electro-Optic/ Infra-Red (EO/IR) techniques for both flare and jammer, used alone and in combination, while utilizing Navy developed Hardware-In-The-Loop (HITL). EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Continue MUHV Autonomy Suite - Develop autonomy algorithms for mission planning, waypoint navigation, and vehicle health assessment. - Continue MUHV Sensors, Navigation and Guidance - Develop multiband and hybrid sonar, inertial navigation, and fiber optic systems. EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT) - Continue Extended-Range Targeting (E-RAT) - Design, develop, and improve prototypes and processes that address extended range targeting and fire control.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 0000 / *(U)Future Naval Capabilities Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY16-02 REACTIVE ELECTRONIC ATTACK MEASURES (REAM) - Continue Reactive Electronic Attack Measures (REAM) - Adapt machine learning algorithms from the Adaptive Radar Countermeasures (ARC) program to support offensive Electronic Warfare Support (ES) and Electronic Attack (EA) capabilities, including integrated unknown emitter characterization and response. EC: STK-FY17-04 ALPO - Continue ALPO - Continue developing advanced signal processing system algorithms for the advanced signal processing system. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	166.866	179.538	165.103	0.000	165.103

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

As discussed in Section A, there are a significant number of FNC technology products within this PE. In all cases, these technology products support the Department of the Navy FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs) that control the naval pillars of Sea Shield, Sea Strike, Sea Basing, Forcenet, Naval Expeditionary Maneuver Warfare, Enterprise and Platform Enablers, Power and Energy, Capable Manpower, and Force Health Protection. Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602750N / *(U)Future Naval Capabilities Applied Research*	Project (Number/Name) 3346 / *Future Naval Capabilities Adv Tech Dev*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	5.125	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.125

A. Mission Description and Budget Item Justification

The efforts described in this Project address the Applied Research associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy's Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: New Accomplishment/Planned Program Entry	5.125	0.000	0.000	0.000	0.000
FY 2015 Accomplishments: Accelerated the develop of the Automated Critical Care System (ACCS) for care of injured personnel during transport to a medical facility. Initiated the development of autonomous control of cyber secure long distance medical data transfer and patient sedation. Completed the development of autonomous control of patient ventilation.					
FY 2016 Plans: N/A					
FY 2017 Base Plans: N/A					
FY 2017 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	5.125	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602750N / *(U)Future Naval Capabilities Applied Research*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

D. Acquisition Strategy

N/A

E. Performance Metrics

In all cases, FNC technology products support the Department of the Navy's FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs). Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning and adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602782N *I Mine & Exp Warfare Applied Res*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	34.339	37.418	33.916	-	33.916	34.482	38.636	37.708	31.876	Continuing	Continuing
0000: *Mine & Exp Warfare Applied Res*	0.000	34.339	37.418	33.916	-	33.916	34.482	38.636	37.708	31.876	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE provides technologies for Naval Mine Countermeasures (MCM), Expeditionary Warfare, U.S. Naval sea mining, Naval Special Warfare (NSW), and Joint Tri-Service Explosive Ordnance Disposal (EOD). This program is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capability Objectives through the development of technologies to achieve military objectives with minimal casualties and collateral damage. Within the Naval Transformation Roadmap, this investment will achieve one of three "key transformational capabilities" required by "Sea Shield" as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within "Sea Strike" by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. These efforts concentrate on the development and transition of technologies for the MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). The Mine and Obstacle Detection/Neutralization efforts include technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting and neutralization/breaching. The Urban Asymmetric Operation effort includes critical warfighting functions such as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The Naval Special Warfare and Explosive Ordnance Disposal technology efforts concentrate on the development of technologies for safe near-shore mine detection, diver mobility and survivability, and ordnance disposal operations.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602782N *I Mine & Exp Warfare Applied Res*			
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	32.526	37.418	33.203	-	33.203
Current President's Budget	34.339	37.418	33.916	-	33.916
Total Adjustments	1.813	0.000	0.713	-	0.713
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.567	0.000			
• SBIR/STTR Transfer	-0.754	0.000			
• Program Adjustments	0.000	0.000	1.368	-	1.368
• Rate/Misc Adjustments	0.000	0.000	-0.655	-	-0.655

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602782N / *Mine & Exp Warfare Applied Res*	Project (Number/Name) 0000 / *Mine & Exp Warfare Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Mine & Exp Warfare Applied Res*	0.000	34.339	37.418	33.916	-	33.916	34.482	38.636	37.708	31.876	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on reducing the time involved in conducting MCM operations and increasing safe standoff from minefields. It develops and transitions technologies for MCM-related and UAEO-related FNC ECs. The MCM effort includes technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as C4ISR, fires, maneuver, sustainment, etc. The sea mining effort emphasizes technologies for future sea mines. The Naval Special Warfare and Explosive Ordnance technology efforts concentrate on the development of technologies to enhance diver capabilities including: safe near-shore mine sensing, mobility and survivability, and ordnance disposal operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: MINE TECHNOLOGY	2.955	0.878	3.835	0.000	3.835
Description: This activity assesses advanced sea mine technologies to maintain expertise in this Naval Warfare area. An acoustic sensing capability for the naval mine Target Detection Device (TDD) is being addressed. Future mine and minefield concepts are being addressed. The funding increase from FY 2016 to 2017 reflects the realignment of the Advanced Sea Mines FNC effort SHD-FY16-OSD Modular UnderSea Effectors (MUSE) program from PE 0602750N Future Naval Capabilities Applied Research. ***FY 2015 Accomplishments:*** - Continue analysis of intermediate and deep water minefield concepts. - Continued assessment of sea mine technologies in order to maintain a level of expertise in naval mines. - Continued development of concepts for semi-autonomous and remote controlled mines and minefields. - Continued development of target discrimination technology for Target Detection Device (TDD). ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue the Modular UnderSea Effectors (MUSE) that transferred from PE 0602750N- Develop of acoustic propagation modeling, algorithms for tracking, and algorithms to exploit the acoustic communications environment. - Initiate investigation into advanced mine sensing concepts. ***FY 2017 OCO Plans:*** N/A					
Title: MINE/OBSTACLE DETECTION ***Description:*** This activity focuses on applied research to enable longer detection ranges and precise mine location with fewer false alarms in a variety of challenging environments. It supports Discovery and Invention (D&I) and MCM-related FNC ECs. Efforts in Synthetic Aperture Sonar (SAS) technologies for longer range detection and classification of mine-like targets and magnetic gradiometer sensing and electro-optic (EO) technology for buried mine identification, and sensor integration onto Autonomous Underwater Vehicles (AUVs) are being addressed. EO sensor research develops algorithms to enable image processing for rapid overt reconnaissance from an Unmanned Aerial Vehicle (UAV). Other processing, classification and data fusion techniques to reduce operator workload, and a mine burial prediction "expert system" are also being developed. Efforts also support development of MCM Mission Modules for Littoral Combat Ships (LCS). Funding increase from FY 2015 to FY 2016 will support improvements for the Airborne Laser Mine Detection System (ALMDS). Funding decrease from FY 2016 to FY 2017 is due to the completion of the Airborne Laser Mine Detection Systems Improvement effort that was part of the Speed to Fleet Initiatives that was a 2 year effort that started in FY 2015. ***FY 2015 Accomplishments:*** - Initiated effort to double underwater optical imaging range via the use of time-reversed LIDAR pulse propagation. - Continue applied research in environmentally adaptive Automatic Target Recognition (ATR). - Continue development of in situ sensors to groundtruth overhead tactical sensors. - Continue effort to develop a three-dimensional underwater metamaterial cloaking technology.	19.252	25.050	18.858	0.000	18.858

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue effort to provide Navy magnetic silencing ranges with an advanced diagnostic capability to optimize signature reduction techniques. - Continued development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and sidelooking sonars. - Continued development of UUV-based, extended range, electro-optic identification sensors and supporting meteorology and oceanography and planning systems. - Continued integration of iPUMA and SAS systems in a single vehicle to obtain 100% area coverage. - Continued to investigate and develop signal processing algorithms in areas of research such as environmentally adaptive channel estimation/equalization, multi-carrier modulation techniques, and spatial diversity exploitation to enable reliable, high-rate communication between fixed and/or mobile nodes in an ad hoc underwater acoustic communication network. - Continued development of a Mine/Obstacle Detection and Avoidance capability for Autonomous Underwater Vehicles (AUVs) equipped with the iPUMA sonar system. - Continued development of a small ultrasound acoustic underwater camera for UUV-based classification and identification of underwater mines. - Continued development of drifting mine detection concepts. - Continued development of heat engine for unmanned underwater vehicles powered by thermal gradients in the water column. - Continued modeling of data fusion and mine contact handling. - Continued research to demonstrate new structural-acoustic-based mine identification algorithms that do not require extensive training data to work in new underwater environments. - Continued research to extend electro-optical imaging resolution in underwater environments by using short exposure techniques. -Continued development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas. - Continued development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats. - Continued development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate. - Continued development of a high source level, single crystal based projector that can extend the maximum detection range of the Low Frequency Broadband (LFBB) Mine Identification System. - Continued Phase 2 of Advanced Mission Module Technology Development.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued performance evaluation of physical layer signal processing algorithms and signaling schemes developed for underwater acoustic communication networks. - Continued development of technologies for detection of mines and obstacles in riverine environments. - Continued development of mine burial prediction models which include migrating sandwaves. - Continued development of prediction models for surf zone optical properties. - Continued effort to quantify and validate improvements in probability of detection and the reduction of false alarms that can be achieved through multi-static acoustic sensing and processing for cooperating, unmanned vehicles. - Continued development of system concepts for wide area detection of surface and submerged drifting mines. - Continued investigation into associated phenomenology and development of sensing technologies for mine and obstacle detection, classification and localization. - Continued development of new artificial intelligence technology/techniques required for long duration AUV's. - Complete effort to design and build advanced navigational capabilities for a fin propelled UUV in near-shore, turbid, obstacle cluttered environment. - Initiate applied research in interactive sensing for MCM. - Initiate speed-to-fleet (S2F) technology development and demonstration for ALMDS P3I.					
FY 2016 Plans: - Continue all efforts of FY 2015 less those noted as completed above. - Continue effort to double underwater optical imaging range via the use of time-reversed LIDAR pulse propagation. - Complete development of new artificial intelligence technology/techniques required for long duration AUV's. - Complete effort to develop a three-dimensional underwater metamaterial cloaking technology. - Complete effort to provide Navy magnetic silencing ranges with an advanced diagnostic capability to optimize signature reduction techniques. - Initiate applied research into sensor-generic architectures for multi-session minefield mapping with multiple UUVs - Initiate investigation into acoustic radiation forces, or vibro-acoustography to generate new target discrimination feature sets - Initiate applied research in continuous sensing modalities to differentiate between targets and background - Initiate investigation into audition based object formation and attention models for MCM - Initiate applied research in model-based MCM sonar performance estimation					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate studies of coastal and riverine environmental characterization to enhance signature reduction for NSW platforms. - Initiate applied research in underwater communications for multiple cooperating minehunting unmanned vehicles. - Complete S2F technology development and demonstration for ALMDS P3I					
FY 2017 Base Plans: - Continue all efforts of FY 2016 less those noted as completed above. - Continue effort to double underwater optical imaging range via the use of time-reversed LIDAR pulse propagation. - Complete development of UUV-based, extended range, electro-optic identification sensors and supporting meteorology and oceanography and planning systems. - Complete integration of iPUMA and SAS systems in a single vehicle to obtain 100% area coverage. - Complete development of a small ultrasound acoustic underwater camera for UUV-based classification and identification of underwater mines. - Complete development of heat engine for unmanned underwater vehicles powered by thermal gradients in the water column. - Complete development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas. - Complete development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats. - Initiate applied research that links observable impacts on acoustic scattering and/or propagation with the underlying phenomenology and/or processes that affect the environment. - Initiate applied research to investigate use of topological spaces for target/clutter features in sonar data.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: MINE/OBSTACLE NEUTRALIZATION	0.435	0.412	0.430	0.000	0.430
Description: Activity includes applied research to support selected MCM related FNC ECs for rapid mine and obstacle neutralization and sea mine jamming techniques to increase surface ship safe standoff from threat mines. It includes various lethality, vulnerability and dispensing computational tools, models and assessments to support the various far-term Surf Zone (SZ) and Beach Zone (BZ) mine and obstacle breaching concepts. ***FY 2015 Accomplishments:*** - Continue development of system concepts for autonomous neutralization of surface and submerged drifting mines - Initiate investigation of techniques for neutralization of buried mines. - Initiate investigation of techniques for emulation sweep. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Initiate investigation of technigues for neutralization of moored and drifting ocean mines. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Continue investigation of techniques for emulation sweep. - Initiate investigation into coupling of reacquire & identify capabilities with precision neutralization for buried mines. ***FY 2017 OCO Plans:*** N/A					
Title: SPECIAL WARFARE/EOD	11.697	11.078	10.793	0.000	10.793
Description: The goal of this effort is to develop technologies to extend stand-off of special operations and EOD forces in clandestine hydrography, mine clearance and port security missions while increasing the range and effectiveness of divers. Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. Developed technologies will transition to the Joint Service EOD Program, the Naval EOD Program, or the DOD Technical Response Group. This activity includes applied research in sensor technology for NSW and EOD autonomous and handheld sonar systems to increase detection range and					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
accuracy in harsh environments. Other efforts include mission support technology improvements for AUVs and human divers - such as communications, navigation and life support. ***FY 2015 Accomplishments:*** - Continue development of technologies to neatralize energetic materials from a safe standoff using small EOD robots. - Continue development of technologies to excavate buried IEDs from a small EOD robot. - Continue development of technologies to demonstrate an autonomous dual manipulator robot for complex underwater EOD missions. - Continue development of technologies to enhance diver situational awareness. - Continue development of technologies to reduce platform vulnerability. - Continue investigation of multi-modal signature reduction technologies for wet/dry-submersibles and semi-submersibles. - Continue development of AUV technologies for autonomous inspection of ship hulls. - Continue development of technologies for contaminated water diving. - Continue development of technologies for enhanced navigation and Intelligence, Surveillance and Reconnaissance (ISR) in riverine environments. - Continue development of technologies to detect and locate IEDs. - Continue development of technologies to access IEDs. - Continue development of technologies to diagnose and identify underwater munitions. - Continue development of technologies to identify and diagnose components and characteristics of Improvised Explosive Devices. - Continued development of technologies to detect and locate buried munitions. - Continued effort to support Joint Service Explosive Ordnance Disposal (JSEOD) applied research. - Complete development of an air-delivery method of small/tactical UUVs to extend sensor operational range and expedite ingress. - Complete development of technologies to detect trace and bulk explosive materials from a safe position manually. - Complete development of technologies for prospective tele-autonomy features in EOD robotic platforms command and control. - Initiate development of technologies to dispose of ordnance with insensitive munitions from a safe standoff position manually or using smal lEOD robots.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate development of technologies to diagnose buried ordnance in situ from a safe standoff position manually or using small EOD robots. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of technologies to dispose of ordnance with insensitive munitions from a safe standoff position manually or using small EOD robots. - Initiate development of technologies for ultra light weight, low cost, highly capable autonomous robotic systems for complex dismounted operations. - Initiate applied research into for autonomous ISR and mapping in canopied coastal and riverine environments - Initiate 'through the sensor' in-stride mapping of coastal and riverine land and seascapes using operational EO/IR, radar and acoustic sensors - Initiate investigation of techniques to detect deeply buried explosive threats and ordnance from a safe standoff distance - Initiate investigation of techniques to neutralize or render safe explosive threats that result in low collateral damage to surrounding infrastructure. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Initiate development of technologies to diagnose buried explosive threats using an EOD robotic platform or a hand-held device. - Initiate development of technologies to detect/locate biological WMD using an EOD robotic platform or a hand-held device. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	34.339	37.418	33.916	0.000	33.916

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602782N / *Mine & Exp Warfare Applied Res*	**Project (Number/Name)** 0000 / *Mine & Exp Warfare Applied Res*

E. Performance Metrics

The overall metrics of this applied research program are the development of technologies which focus on the Expeditionary Warfare challenge of speeding the tactical timeline and increasing safe standoff from minefields. Individual project metrics include the transition of 6.2 technology solutions into 6.3 advanced technology programs.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602898N *I (U)Science & Tech Management - ONR Headquarters*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	0.000	0.000	29.575	-	29.575	28.363	27.637	26.306	26.937	Continuing	Continuing
0000: *(U)Science & Tech Management - ONR Headquarters*	0.000	0.000	0.000	29.575	-	29.575	28.363	27.637	26.306	26.937	Continuing	Continuing

A. Mission Description and Budget Item Justification

This is a newly established Program Element (PE) for the Office of Naval Research to centrally fund Non-Labor Management Headquarters Activity corporate support for the Navy Science and Technology program. Funding includes logistics, acquisition, and communications support for the Command.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	29.575	-	29.575
Total Adjustments	0.000	0.000	29.575	-	29.575
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Rate/Misc Adjustments	0.000	0.000	29.575	-	29.575

Change Summary Explanation

Funding was realigned from the Science Programs into this newly established PE.

Technical: Not applicable.
Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602898N / *(U)Science & Tech Management - ONR Headquarters*	Project (Number/Name) 0000 / *(U)Science & Tech Management - ONR Headquarters*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *(U)Science & Tech Management - ONR Headquarters*	0.000	0.000	0.000	29.575	-	29.575	28.363	27.637	26.306	26.937	Continuing	Continuing

A. Mission Description and Budget Item Justification

This is a newly established Program Element (PE) for the Office of Naval Research to centrally fund Non-Labor Management Headquarters Activity corporate support for the Navy Science and Technology program. Funding provides for logistics, acquisition, and communications support for the Command.

Funding was realigned from the Science Programs into this newly established PE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: New Accomplishment/Planned Program Entry	0.000	0.000	29.575	0.000	29.575
FY 2015 Accomplishments: N/A					
FY 2016 Plans: N/A					
FY 2017 Base Plans: This project provides for ONR Non-Labor Headquarters' support for the Navy S&T programs. Specifically, funding facilitates the execution of the Navy's basic research, applied research, and advanced technology development programs at the nation's universities/colleges, Navy laboratories, Warfare Centers, and private industry. - Continue providing corporate support in facilitating the purchase of the S&T programs for the Navy - Continue ensuring audit readiness and compliance					
FY 2017 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	0.000	0.000	29.575	0.000	29.575

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602898N / *(U)Science & Tech Management - ONR Headquarters*	**Project (Number/Name)** 0000 / *(U)Science & Tech Management - ONR Headquarters*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE funds the support needed to accomplish ONR's mission. Program performance is measured by attaining financial benchmarks for planned obligations vs. actual obligations and planned expenditures vs. actual expenditures.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603114N *I Power Projection Advanced Technology*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	36.651	36.971	96.406	-	96.406	12.392	12.445	12.445	12.445	Continuing	Continuing
2911: *Power Proj Adv Tech*	0.000	36.651	36.971	96.406	-	96.406	12.392	12.445	12.445	12.445	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board of 20 January 2015. This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare. This program develops and demonstrates advanced technologies, including Electromagnetic (EM) Rail Gun for naval weapon systems. Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

This program develops and demonstrates advanced technologies, including Electromagnetic (EM) Rail Gun for naval weapon systems.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	37.734	37.093	27.648	-	27.648
Current President's Budget	36.651	36.971	96.406	-	96.406
Total Adjustments	-1.083	-0.122	68.758	-	68.758
• Congressional General Reductions	-	-0.122			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.083	0.000			
• Program Adjustments	0.000	0.000	68.800	-	68.800
• Rate/Misc Adjustments	0.000	0.000	-0.042	-	-0.042

Change Summary Explanation

Technical: Not applicable.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603114N *I Power Projection Advanced Technology*

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603114N / *Power Projection Advanced Technology*	Project (Number/Name) 2911 / *Power Proj Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2911: *Power Proj Adv Tech*	0.000	36.651	36.971	96.406	-	96.406	12.392	12.445	12.445	12.445	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Time Critical Strike (TCS) and ForceNet FNC components which address technological issues associated with the development of strike weapons that significantly decrease the launch to engagement timeline; provide the Navy of the future the ability to quickly locate, target, and strike critical targets; and enhance mission capabilities and operational utility of Naval forces by dramatically increasing the autonomy, performance, and affordability of Naval organic, Unmanned Vehicle systems. The Navy is furthering the development of solid state, high energy laser technology for use as a weapon system on future surface ships.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: PRECISION STRIKE TECHNOLOGY	36.651	36.971	96.406	0.000	96.406
Description: The focus of this activity is on those technologies that will support the Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets. This activity includes support to the following FNC Enabling Capabilities (ECs): Advanced Naval Fires Technology, Hostile Fire Detection and Response, Dynamic Target Engagement & Enhanced Sensor Capabilities, and Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets. Solid State Laser program funding continues in PE 0602114N for FY 2015. FY 2016 to FY 2017 increase in funding is due to Solid State Laser Technology Maturation Program (SSL-TM) program entering its fabrication and testing phase. ***FY 2015 Accomplishments:*** Electromagnetic (EM) Railgun -Continued development and testing of projectile component concepts at 32 MJ muzzle energy tests. -Continued ship integration study efforts. -Continued next generation industry repetitive rate launcher development and test planning. -Continued next generation repetitive rate pulsed power fabrication in support of future repetitive rate launcher testing. -Continued fabrication of rep rate lab launcher for testing of barrel life components. -Continued next generation industry rep rate launcher preliminary design. -Continued component fabrication and testing of repetitive firing rate barrel life with EM lab launcher at tactically relevant muzzle energy.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603114N / *Power Projection Advanced Technology*	**Project (Number/Name)** 2911 / *Power Proj Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Weapons System Improvement -Continued kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives. These studies will assess engineering feasibility of various kill-chain options and assess the capability provided. Solid State Laser Technology Quick Reaction Capability (SSL-QRC) - Completed development of the Solid State Laser Quick Response Capability (SSL-QRC) to upgrade the NAVSEA developed Laser Weapons System (LaWS). - Completed integration and installation of LaWS on a Naval Surface combatant to support the extended demonstration in the Persian Gulf. Solid State Laser Technology Maturation Program (SSL-TM) - Continued development of a maritime laser weapons system through competitive procurement. - Initiated Laser System engineering integration trade studies and design with contractor developed designs. This system will be capable of supporting missions such as small boat, UAV, and ISR disruption and defeat. This work included scientific and engineering trade studies to support integration and test of an advanced development system. This system will include a maritime beam director and high power, solid state laser (SSL) that is capable of tracking and engaging a surface or airborne target at a suitable stand-off distance in the maritime environment and includes efforts to measure atmospheric absorption and turbulence. -Continued development of the Hybrid Predictive Avoidance Safety System (HPASS) to de-conflict laser system operations with friendly sensors and platforms.					
FY 2016 Plans: Electromagnetic (EM) Railgun - Continue all efforts of FY 2015, unless noted as completed above. Weapons System Improvement - Continue all efforts of FY 2015, unless noted as completed above. Solid State Laser Technology Quick Reaction Capability (SSL-QRC) - Continue all efforts of FY 2015, unless noted as completed above.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603114N / *Power Projection Advanced Technology*	**Project (Number/Name)** 2911 / *Power Proj Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Solid State Laser Technology Maturations Program (SSL-TM) - Continue all efforts of FY 2015, unless noted as completed above. - Continue development of the Hybrid Predictive Avoidance Safety System (HPASS) to deconflict laser system operations with friendly sensors and platforms. - Initiate land based testing of system and system components. ***FY 2017 Base Plans:*** Electromagnetic (EM) Railgun - Continue all efforts of FY 2016, unless noted as completed. - Complete repetitive rate pulsed power fabrication in support of the future repetitive rate launcher testing. Weapons System Improvement - Continued all efforts of FY 2016, unless noted as completed above. Solid State Laser Technology Maturation Program (SSL-TM) - Continue all efforts of FY 2016, unless noted as completed above. - Initiate land based testing of system and system components. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	36.651	36.971	96.406	0.000	96.406

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The metrics used are programmatic milestones and technical milestones, such as completion of technical trade studies examining suitable technologies for subsequent prototype development; incremental laboratory and field testing of components and sub-systems; and delivery of industry-developed prototypes for demonstration.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603123N *I Force Protection Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	25.149	38.044	48.438	-	48.438	49.554	30.803	16.769	16.769	Continuing	Continuing
2912: *Force Protection Advanced Technology*	0.000	22.613	35.371	45.713	-	45.713	46.780	28.029	13.995	13.995	Continuing	Continuing
3049: *Force Protection*	0.000	2.536	2.673	2.725	-	2.725	2.774	2.774	2.774	2.774	Continuing	Continuing

Note

There are two new Leap Ahead initiatives starting in FY 2016 - Forward Deployed Energy & Communications Outpost (FDECO) INP and Medium Displacement Unmanned Surface Vehicle (MDUSV) effort.

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This program supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603123N *I Force Protection Advanced Technology*		
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	25.831	38.044	49.256	-	49.256
Current President's Budget	25.149	38.044	48.438	-	48.438
Total Adjustments	-0.682	0.000	-0.818	-	-0.818
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.683	0.000			
• Rate/Misc Adjustments	0.001	0.000	-0.818	-	-0.818

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / *Force Protection Advanced Technology*	Project (Number/Name) 2912 / *Force Protection Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2912: *Force Protection Advanced Technology*	0.000	22.613	35.371	45.713	-	45.713	46.780	28.029	13.995	13.995	Continuing	Continuing

Note

There are two new Leap Ahead initiatives starting in FY 2016 - Forward Deployed Energy & Communications Outpost (FDECO) INP and Medium Displacement Unmanned Surface Vehicle (MDUSV) effort.

A. Mission Description and Budget Item Justification

This project addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. For the new FY 2016 effort, Forward Deployed Energy and Communications Outpost (FDECO) INP, the project addresses advanced technology development associated with providing the undersea energy and communications infrastructure necessary to assure undersea dominance; extend the reach of undersea assets; enhance SA and standoff advantage without reducing forward presence and; provide endurance for unmanned systems necessary for force multiplication in an A2/AD environment. For the new FY 2016 effort, Medium Displacement Unmanned Surface Vehicle (MDUSV), the project will radically change the way the Navy does mine influence sweep, ASW and EW missions; it will introduce larger USVs to the Navy; and it will introduce advanced autonomy to the surface Navy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)	8.434	13.743	13.487	0.000	13.487
Description: Activity includes: advanced technology demonstrations to evaluate emerging energy technologies and advanced technology development for Unmanned Sea Surface Vehicles. The funding increase from FY 2015 to FY 2016 is due to the initiation of the Medium Displacement Unmanned Surface Vehicle (MDUSV) Leap Ahead effort and the FDECO program that initiates fully from a study of distributed, open, adaptable, and scalable architectures suitable to future Naval demands. To full scale INP Project to transition the key advanced technology elements, Forward Deployed Energy (FDE), Forward Deployed Communications (FDC) and Forward Deployed Docking (FDD) into acquisition programs. ***FY 2015 Accomplishments:*** - Continued development of autonomous navigation for Unmanned Sea Surface Vehicles from a host ship - Continued efforts to conduct advanced technology demonstrations to evaluate emerging energy technologies using Navy and Marine Corps facilities as test beds.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 2912 / *Force Protection Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated Forward Deployed Energy & Communications Outpost (FDECO) Architecture Planning Study to analyze distributed, open, adaptable, and scalable architectures suitable to future Naval demands. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. - Initiate the FDECO INP project. - Initiate Medium Displacement Unmanned Surface Vessel (MDUSV) effort to demonstrate the operational benefit of a highly autonomous, large USV with a modular payload capability and demonstrate at-sea three modular payloads. The activity will consist of advancements to autonomous control, payload integration, and at-sea demonstration of vessel autonomous control and payloads supporting mine warfare, anti-submarine warfare and electronic warfare. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Title: AIRCRAFT TECHNOLOGY ***Description:*** The Aircraft Technology activity develops technologies for enhanced capability of Naval aviation aircraft platforms in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. It also develops new Naval air vehicle concepts and high impact, scalable Naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tiltrotor rotor drive systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. This activity directly supports the Naval Aviation Enterprise Science and Technology Objectives and the Naval Science and Technology Strategic Plan, principally in the Autonomy and Unmanned Systems, Platform Design and Survivability, Power and Energy and Total Ownership Cost Focus Areas. The funding increase from FY 2015 to FY 2016 is due to the initiation of the joint TERN program. The funding increase from FY 2016 to FY 2017 is due to the increase investment in the joint TERN effort and to maturation of Autonomous Aerial Cargo/Utility System (AACUS) technology from advanced research to advanced development. ***FY 2015 Accomplishments:***	14.179	21.628	32.226	0.000	32.226

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 2912 / *Force Protection Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued demonstration of initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS). - Continued the advanced technology demonstration portion of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts will begin with major engine manufactures and system contractors to develop/mature the highest priority, long-lead propulsion system technologies, including variable/adaptive cycle engine components, for next generation carrier-based Tactical Air (TACAIR)/Intelligence, Surveillance and Reconnaissance(ISR) systems. - Continued VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts through completion. - Demonstrated sensor improvements, capability expansion and technology maturation of the Autonomous Aerial Cargo/Utility System (AACUS). ***FY 2016 Plans:*** - Continue all efforts of FY 2015. - Initiate the joint TERN program to conduct an at sea demonstration of Vertical Take-Off and Landing (VTOL) enabling technologies in support of DDG-51 and LCS-2 based future long endurance Unmanned Air Vehicle (UAV) capabilities. - Demonstrate portability to another rotary wing aircraft capability expansion and technology maturation of the Autonomous Aerial Cargo/Utility System. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. - Continue the AACUS program by demonstrating the capability to perform the assault support mission from mission request to final landing on a multiple delivery flight. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	22.613	35.371	45.713	0.000	45.713

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 2912 / *Force Protection Advanced Technology*

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which focus on the warfighter and providing the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage, while preserving operational capability. Overall metric goals are to transition the advanced technology projects into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements. Specific examples of metrics under this PE include: - Advanced technology demonstrations to evaluate emerging energy technologies.

For the new FY 2016 effort, Forward Deployed Energy and Communications Outpost (FDECO) INP, the overall goals of this advanced technology program are the development of technologies which focus on energy management and transfer technologies that enable persistent undersea operations by UxV Fleet; provide system architectures that are persistent, scalable and mission agile; provide communication and energy infrastructure available in degraded and contested environments and; provide a platform-agnostic solution that reduces development and maintenance costs. Overall metric goals are to transition the key advanced technology elements, Forward Deployed Energy (FDE), Forward Deployed Communications (FDC) and Forward Deployed Docking (FDD) into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements. Specific examples of metrics include: - Advanced technology demonstrations to evaluate energy & data transmission and persistent connectivity.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / *Force Protection Advanced Technology*	Project (Number/Name) 3049 / *Force Protection*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3049: *Force Protection*	0.000	2.536	2.673	2.725	-	2.725	2.774	2.774	2.774	2.774	Continuing	Continuing

A. Mission Description and Budget Item Justification

Develop advanced technologies, critical to protecting naval installations, to provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: EMERGING THREATS	2.536	2.673	2.725	0.000	2.725
Description: This activity includes development of advanced technologies critical to protecting naval installations, and will provide seamless, full spectrum protection against asymmetric terrorist attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.					
FY 2015 Accomplishments: - Continued development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools. - Continued research to reduce force protection manpower and equipment costs through automation and predictive learning algorithms. - Continued threat characterization research and perception experiments for sensor performance optimization and model development and validation. - Continued development of all weather sensors optimized for installation of force protection. - Continued research into sensors for use in counter-surveillance around protected facilities. - Continued research to advance sensor fusion capabilities in high density networks with diverse sensor grids. - Continued development of assessment algorithms and information analysis technologies to augment skills or replace persons in operations centers. - Continued interim demonstration of acoustic sensors for perimeter and area surveillance in realistic environments.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 3049 / *Force Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of protection technology for naval installation power and energy infrastructure. - Continued expansion of research into sensors and countermeasures for use against unmanned underwater to include surface swimmers, underwater divers, and underwater diver propulsion aids. - Continued demonstration of multi-band electro-optical sensors and fusion algorithms in adverse weather conditions. - Initiated demonstration of sensors and countermeasures for use against underwater to include surface swimmers, underwater divers, diver propulsion aids, and underwater unmanned vehicles. - Initiated research in non-acoustic detection, tracking, classification, and engagement of underwater threats to naval installations. - Initiated development of autonomous unmanned harbor defense systems for perimeter patrol and threat interdiction. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. - Initiate research into automated vehicle entry control point monitoring, automatic vehicle classification, risk assessment and logic system decision making. - Initiate development of non-contact biometric verification technologies to support unmanned automated access control systems. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	2.536	2.673	2.725	0.000	2.725

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 3049 / *Force Protection*

E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to protect naval installations. Overall metric goals are to reduce the required manpower and skill levels devoted to the force protection mission. Specific metric under the Project includes: 50% reduction of manpower associated with FP surveillance, situational awareness, and decision making, 2x improvement in electro-optical sensor performance in adverse weather conditions, 50% reduction in sensor cost per square or cubic meter of detection at a given resolution, and a 50% reduction in false alarm rates for automated detection and tracking algorithms both above and below water.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603271N *I Electromagnetic Systems Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	62.860	34.856	26.421	-	26.421	26.199	24.897	20.789	8.056	Continuing	Continuing
2913: *Electromagnetic Systems Advanced Technology*	0.000	62.860	34.856	26.421	-	26.421	26.199	24.897	20.789	8.056	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 January 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this Program Element (PE) address technologies critical to enabling the transformation of discrete functions to network centric warfare capabilities, which simultaneously perform Radar, Electronic Warfare (EW), and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities. Within the Naval Transformational Roadmap, this investment offers affordable options for the transformational capabilities required by the Sea Shield (Theater Air and Missile Defense), Sea Strike (Persistent Intelligence, Surveillance, and Reconnaissance), and ForceNet (Communications and Networking) SeaPower 21 Naval Warfighting Pillars.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603271N *I Electromagnetic Systems Advanced Technology*		
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	64.574	34.899	26.488	-	26.488
Current President's Budget	62.860	34.856	26.421	-	26.421
Total Adjustments	-1.714	-0.043	-0.067	-	-0.067
• Congressional General Reductions	-	-0.043			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.450	0.000			
• SBIR/STTR Transfer	-2.164	0.000			
• Rate/Misc Adjustments	0.000	0.000	-0.067	-	-0.067

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603271N / *Electromagnetic Systems Advanced Technology*	Project (Number/Name) 2913 / *Electromagnetic Systems Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2913: *Electromagnetic Systems Advanced Technology*	0.000	62.860	34.856	26.421	-	26.421	26.199	24.897	20.789	8.056	Continuing	Continuing

A. Mission Description and Budget Item Justification

Work in this project addresses cost-effective RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: ELECTRONIC AND ELECTROMAGNETIC SYSTEMS	3.598	13.518	17.260	0.000	17.260
Description: The overarching objective of this activity is to develop, test, and demonstrate communications, electronic attack (EA), electronic surveillance (ES), electronic warfare (EW), and radar functions. This activity also includes development of affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures. A portion of this PE is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition program of record. a) Advanced EW Enabling Technologies (Formerly Titled: Electronic Warfare (EW) Roadmap) - Develop classified advanced electronic warfare technology in support of current and predicted capability requirements. b) Electromagnetic Maneuver Warfare Command & Control (EMC2) (FY16-FY20)- Enable a battle group to work cooperatively in the EM Spectrum (EMS) to optimize Electronic Warfare (EW), Information Operations (IO), Communications (Comms) and Radar performance. EMC2 will build upon the Resource Allocation Manager (RAM) that was previously developed for single multifunction systems under the InTop program to optimize spectrum and functional use across a platform and an entire battle group. The increase from FY 2015 to FY 2016 is due to the initiation of a new INP Electromagnetic Maneuver Warfare Command & Control (EMC2) Project. The increase from FY16 to FY17 reflects an increase in the level of effort for the new Electromagnetic Maneuver Warfare Command & Control (EMC2) INP Program.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Advanced EW Enabling Technologies (formerly titled: Electrontic Warfare (EW) Roadmap): - Continued development of classified advanced electronic warfare technology in support of current and predicted capability requirement. ***FY 2016 Plans:*** Advanced EW Enabling Technologies (formerly titled: Electronic Warfare (EW) Roadmap): - Continue all efforts of FY 2015 unless noted as completed above. Electromagnetic Maneuver Warfare Command & Control (EMC2): - Initiate Wideband Airborne Multifunction System design. - Initiate Low-Band RF Intelligent Distribution Resource (LowRIDR) SubSystem build. - Initiate Electromagnetic Warfare Command and Control system design. ***FY 2017 Base Plans:*** Advanced EW Enabling Technologies: - Continue all efforts of FY 2016 unless noted as complete above. Electromagnetic Maneuver Warfare Command & Control (EMC2): - Continue all efforts of FY 2016 unless noted as complete above. ***FY 2017 OCO Plans:*** N/A					
Title: GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	2.228	2.338	2.800	0.000	2.800
Description: The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using either GPS systems, non-GPS navigation devices, or atomic clocks. This activity will increase the operational effectiveness of U.S. Naval units. The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). The major objectives of this activity are:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
a) GPS Anti-Jam Antennas and Receivers - Integrate and demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; to integrate and demonstrate anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats. b) Precision Time and Time Transfer - Integrate and demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; to integrate and demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time. c) Non-GPS Navigation Technology - To integrate and demonstrate inertial navigation systems for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; to integrate and demonstrate a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. The following are non-inclusive examples for projects funded in this activity. The increase from FY 2016 to FY 2017 is due to increased funding for the Navigation and Precision Timekeeping initiative. ***FY 2015 Accomplishments:*** GPS Anti-Jam Antennas and Receivers: - Continued GPS Antenna System for Enhanced EP, ES and Precise Navigation. - Continued development of Small Antenna Based Anti-spoofing project. - Continued Modernized Integrated Spoofer Tracking. - Continued development of Advanced Spoofer Tracking. - Continued development of Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment. - Continued Modernized Receiver for RF Challenged Environments. - Continued development of the Simulation of GPS Signals in a Stressed Environment. - Continued development of Self Calibrating GPS Anti-Jam Antennas for Electronic Support.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued Cognitive Modernized GPS User Equipment (MGUE) for GPS-Denied Environments project. Precision Time and Time Transfer: - Continued DoD master clock time transfer via optical fibers. - Continued development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO). - Continued development and Distributing Time-frequency Device. - Continued development of Rb 3-cc Tactical Grade Atomic Clock (TGAC). - Initiate Tactical Grade Atomic Clock. Non-GPS Navigation Technology: - Continued Two-Axis Fiber Optic Inertial Navigation System Phase II project. - Continued Mechanical System (MEMS) Inertial Navigation System (INS) Phase II project. - Continued Angle-Only Infra Red Celestial Navigation System. - Continued Optically Transduced MEMS Inertial Navigation System project. - Continued Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Continued Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project. - Continued development of Wavewinds project. - Continued development of Small Unmanned Underwater Vehicle - Sonar Aided Inertial Navigation Technology (UUV-SAINT) project. - Continued development of Portable PCNS project. - Continued development of Superconducting Magnetometer On-Board Navigation (SIMON) System. - Continued development of Alternative Navigation Over Unstructured or Featureless Terrain. - Complete Precise At-Sea Ship's Indoor Outdoor Navigation (PASSION). - Initiate Miniature Ultra-Cold Atom Chip Inertial Sensors.					
FY 2016 Plans: GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2015 unless noted as complete above. - Complete Modernized Integrated Spoofer Tracking. Precision Time and Time Transfer:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015. - Complete Tactical Grade Atomic Clock Non-GPS Navigation Technology: - Continue all efforts of FY 2015 less those noted as completed. - Complete Two-Axis Gyro-compass Fiber Optic Inertial Navigation System. - Complete development of Superconducting Magnetometer On-Board Navigation (SIMON) System. - Initiate Broadband Navigation Sonar (BBNS) Technology					
FY 2017 Base Plans: GPS Anti-Jam Antennas and Receivers: - Complete development of Small Antenna Based Anti-spoofing project. - Complete development of Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment. - Complete Modernized Receiver for RF Challenged Environments. - Complete development of the Simulation of GPS Signals in a Stressed Environment. - Complete development of Self Calibrating GPS AJ Antennas for Electronic Support. - Complete Cognitive Modernized GPS User Equipment (MGUE) for GPS-Denied Environments project. - Complete GPS Antenna System for Enhanced EP, ES and Precise Navigation. - Initiate advanced receiver design implementing advanced and collective acquisition and tracking techniques. Precision Time and Time Transfer: - Continue all efforts of FY 2016 less those noted as complete. - Complete development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO). - Initiate the development of generalized time transfer modem for terrestrial and shipboard systems. - Initiate cold atom development efforts for compact, deployable next generation clock technology to surpass current Rubidium and Cesium standards, providing longer accurate time holdover in GPS denied environments. - Initiate RF and Optical time transfer effort for terrestrial, surface, and airborne platforms. Non-GPS Navigation Technology: - Continue all efforts of FY 2016 less those noted as complete.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Optically Transduced MEMS Inertial Navigation System project. - Complete Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Complete development of Wavewinds project. - Complete development of Small Unmanned Underwater Vehicle Sonar Aided Inertial Navigation Technology (UUV-SAINT) project. - Complete development of Portable PCNS project. - Complete development of Alternative Navigation Over Unstructured or Featureless Terrain. - Complete Two-Axis Fiber Optic Inertial Navigation System Phase II project. - Complete Mechanical System (MEMS) Inertial Navigation System (INS) Phase II project. - Initiate advanced development of geophysical, RF, and celestial navigation aids for manned and unmanned surface and subsurface platforms. - Initiate cold atom gravimetric measurement system for aids to inertial sensors. ***FY 2017 OCO Plans:*** N/A					
Title: INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP) ***Description:*** The overarching objective of the INTOP INP is to develop and demonstrate a set of prototypes that integrate RF functionality (EW, Radar, Communications, Navigation) into a common set of multi-function apertures electronics and software through an architecture that is modular, scalable across all platforms, and open at the RF as well as computer and software level. The apertures are capable of providing multiple simultaneous, independent beams which can together perform any of the above functions. The major objectives of this activity are: a) Submarine SATCOM Array - Develop wide-band SATCOM array capable of supporting EW for submarines. b) Electronic Warfare (EW)/Information Operations (IO)/Line of Sight (LOS) Communications (Comms) for Surface Combatants - Develop wide-band array to support EW capability and other functions, including but not limited to IO and LOS Comms, for surface combatants with potential application to other platforms.	48.198	10.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
c) Architecture, Standards and Devices - Develop architecture and standards for wide-band multi-beam, multi-band arrays and below deck systems and the technology and electronic devices needed to make integrated array systems affordable. d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions. e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager. f) Digital Radar - Develop an all digital radar to demonstrate advanced concepts for coherent radar networking and control, which will increase radar coverage and provide new levels of electronic protection (EP), while maximizing radar resources and reducing cost. g) Low Band Communications, IO and EW - Develop low band technology development and concept studies leading to development of an Advanced Development Model (ADM). The decrease between FY 2015 and FY 2016 is representative of the InTop program coming to an end. The funding provided in FY 2016 is to complete all efforts under the InTop program originally scheduled to be completed in FY 2015. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2015 Accomplishments:*** Submarine SATCOM Array: - Complete integration and test. EW/IO/Comms for Surface Combatants: - Complete integration and test of ADM. Architecture, Standards and Devices: - Complete development of deckhouse and platform integration strategies and concepts. Surface Combatants Satellite Communications Array:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete design effort. Resource Allocation Manager: - Continued integration and test of RAM. Digital Radar: - Continued system build for back-end. - Continued and completed design effort for front-end. - Initiate system build for front-end. Low Band Communications, IO and EW: - Continue and complete development of the initial architecture and requirements. - Initiate subsystem designs. ***FY 2016 Plans:*** Resource Allocation Manager: - Complete integration and test of RAM. Digital Radar: - Complete system build for front-end. - Complete system build for back-end. Low Band Communications, IO and EW: - Complete subsystem designs. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A					
Title: NETTED EMULATION OF MULTI-ELEMENT SIGNATURES AGAINST INTEGRATED SENSORS (NEMESIS) ***Description:*** The objective is to develop a System of Systems (SoS) able to coordinate distribute EW resources against many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by	8.836	9.000	6.361	0.000	6.361

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
providing platform protection across the battlespace against many sensors, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. a) Develop reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective multi-spectral countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for platform protection across operational domains. This R2 activity was initiated in PE 0602271N and expanded in FY 2015 to PE 0603271N. The decrease from FY16 to FY17 reflects the transition toward the integration and demonstration of the new technologies. The first 3 years FY14-FY16 are dedicated toward the design, development and procurement of new technologies. Years FY17 and FY18 are dedicated toward the integration and demonstration of these new technologies. ***FY 2015 Accomplishments:*** - Continued development and demonstration of the NEMESIS EW payloads and their integration into platforms. - Continued application of the research supporting distributed control, coordination and networking of NEMESIS payloads and platforms. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	62.860	34.856	26.421	0.000	26.421

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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D. Acquisition Strategy

N/A

E. Performance Metrics

Advanced Electronic Sensor Systems for Missile Defense and Long Range Detection and Tracking ECs are aligned to the Navy's Advanced Cruiser (CG(X)) plans and closely coordinated with Naval Sea Systems Command Integrated Warfare Systems (PEO IWS 2.0). Other performance metrics are discussed within the R-2a.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603640M *I MC Advanced Technology Demo*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	125.696	131.490	140.416	-	140.416	142.407	142.368	142.368	142.368	Continuing	Continuing
2223: *Marine Corps ATD*	0.000	84.107	88.818	93.355	-	93.355	94.664	94.925	93.976	93.976	Continuing	Continuing
2297: *Futures Directorate*	0.000	41.589	42.672	47.061	-	47.061	47.743	47.443	48.392	48.392	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (20 January 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps)to include specific Marine Corps objectives defined by the USMC S&T Strategic Plan. It provides the vision and key objectives for the essential S&T efforts that will enable the continued supremacy of United States Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare. It also directly supports Expeditionary Force 21 (EF 21), which is now the Marine Corps' capstone concept that establishes the vision and goals for USMC S&T over the next 10 years and provides a plan for guiding the design and development of the future force. One third of the Marine Corps operating forces will be forward deployed. These forces will be task-organized into a greater variety of formations, capable of operating from a more diverse array of ships dispersed over wider areas, in order to meet the Combatant Commanders' security cooperation and partner engagement requirements. In the event of crises, those forces will be able to composite these distributed formations into larger, cohesive naval formations. This presents both challenges and opportunities for USMC S&T. Expeditionary Force 21 will inform future decisions regarding how the Marine Corps will adjust organizational structure to exploit the value of regionally focused forces. A fixed geographic orientation will facilitate Marine Commanders and their staffs with more frequent interactions with theater- and component-level organizations, establishing professional bonds and a shared sense of the area's challenges and opportunities. Expeditionary Force 21 provides the basis for future Navy and Marine Corps capability development to meet the challenges of the 21st Century. The vision for Expeditionary Force 21 is to provide guidance for how the Marine Corps will be postured, organized, trained, and equipped to fulfill the responsibilities and missions required around the world. Through Expeditionary Force 21, the Marine Corps intends to operate from the sea and provide the right sized force in the right place, at the right time.

As a key component of naval expeditionary forces, the Marine Corps has unique and technologically stressing requirements because of its expeditionary mission and intensive operational tempo, Marine Air-Ground Task Force (MAGTF) structure, and conduct of maneuver warfare. Critical requirements in this PE are: Command, Control, Communications, Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); maneuver techniques and means; force protection; logistic sustainment; human performance, training and education; and firepower. There are ongoing actions to develop and demonstrate advanced technologies and concepts in operational environments. Joint service efforts are aligned with Defense Technology Objectives and Joint Warfighting Capability Objectives. In addition, there is funding for experimentation in warfighting concepts as well as operational assessment of emerging technologies, to include technical support of operating forces to assess military utility of selected technologies. This PE specifically supports: continued development of enhanced warfighting capabilities through field experiments with Marine operating forces; rapid response to low-, mid-, and high-intensity conflicts as well as methods for countering irregular threats; and expansion of seabasing and naval force packaging capabilities. The investment directly assists in fulfilling the forward presence requirements of Sea Shield and the transformational capabilities prescribed

by Sea Strike. The Future Naval Capability (FNC) process is supported and funds are programmed accordingly. This PE is largely focused on demonstration of products and capabilities from the knowledge base and Discovery and Invention (D&I) phases of Naval S&T. As Naval partners, the Navy and Marine Corps S&T Team strive to transition technologies that will implement objectives outlined in the Naval Operations Concept. This PE also funds technical solutions designed to increase Naval force capability, such as the Naval Expeditionary Combat Command. Investments in S&T provide the opportunities for future capabilities and will prevent technological surprise. The PE as a whole will advance the amphibious and expeditionary capabilities for the Combatant Commanders. The Marine Corps Service Campaign Plan (MCSCP, guided by the Commandant's Planning Guidance, is the lens through which USMC S&T priorities are acted upon in order to support the future development of the Total Force.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	128.320	137.562	140.416	-	140.416
Current President's Budget	125.696	131.490	140.416	-	140.416
Total Adjustments	-2.624	-6.072	0.000	-	0.000
• Congressional General Reductions	-	-0.103			
• Congressional Directed Reductions	-	-5.969			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.624	0.000			

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / *MC Advanced Technology Demo*	Project (Number/Name) 2223 / *Marine Corps ATD*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2223: *Marine Corps ATD*	0.000	84.107	88.818	93.355	-	93.355	94.664	94.925	93.976	93.976	Continuing	Continuing

A. Mission Description and Budget Item Justification

Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Force Protection; Human Performance, Training and Education; Logistics; Command, Control, Communications and Computers (C4); Intelligence, Surveillance and Reconnaissance (ISR) and Firepower. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development Phase are planned, as well as fieldable prototyped to reduce risk in System Concept Development and Demonstration. A tactically effective Mine Countermeasures (MCM) capability is vital to Force Protection and necessary if Maneuver on land is to become a functional component of Naval Expeditionary Maneuver Warfare. Maneuver, supported by MCM provides synchronization and speed of detection, breaching, clearance, proofing, and marking operations. This project supports: 1) engaging regional forces in decisive combat on a global basis; 2) responding to all other contingencies and missions in the full spectrum of combat operations (high, middle, and low intensity), in Military Operations in Urban Terrain (MOUT), and in Operations other than War (OOTW); and 3) warfighting experimentation. By providing the technologies to enable these capabilities, this project supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment.

In addition, this project supports the goals and objectives of the Littoral Combat/Power Projection related Enabling Capability (EC) within the Future Naval Capabilities (FNC) portfolio. The focus of the EC within this PE is technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan and is one of the highest ranked Capability Gaps prioritized by the Chief of Naval Operations and the Marine Corps Combat Development Command (MCCDC). The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4)	6.124	6.374	6.950	0.000	6.950
Description: This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term USMC operations. The focus is on development and leveraging advanced C4 technologies to enable enhanced Distributed Operations, Irregular Warfare, and Marine Corps Expeditionary Warfare. Specifically, the C4 Thrust intends to demonstrate markedly improved capabilities in over-the-horizon (OTH), beyond line-of-sight, and restricted environment communications; mobile networking; tactical decision making; tactical situational awareness; and small unit position location and navigation. Advanced technology resources will be applied to complement commercial, other service, and defense agency investments to produce a technology base to address identified Marine Corps technology gaps.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2223 / *Marine Corps ATD*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
FY 2015 Accomplishments: - Continued urban navigation with limited Global Positioning System availability demonstrations. - Continued demonstrations of improved urban communications capabilities. - Continued developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace. - Continued creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone. - Continued Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two. - Continued Application Network Architecture and Automated Small Unit Decision Tools. - Continued Advanced Communications Systems and Small Unit C3. - Continued smart radio efforts. - Completed creating a service oriented sensor network for expeditionary forces' current and future tactical sensors. - Initiated Tactical Cyber Warfare. - Initiated mobile security. - Initiated Networking On-The-Move Technology insertion. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete mobile security. - Initiate MAGTF C2 Technology insertion. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete demonstrations of improved urban communications capabilities. - Complete Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two. - Complete Application Network Architecture and Automated Small Unit Decision Tools. - Complete urban navigation with limited Global Positioning System availability demonstrations - Complete Advanced Communications Systems and Small Unit C3. - Initiate an Advanced HF Antenna effort. ***FY 2017 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: FIREPOWER	8.997	9.365	8.521	0.000	8.521
Description: This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/ propulsion, lethality, and accuracy. ***FY 2015 Accomplishments:*** - Continued development of targeting and engagement technologies for distributed operations collaborative fires integration and demonstrations. - Continued design, development, prototyping and testing of lightweight technologies that provide individual Marines enhanced capabilities to detect and identify man-size targets out to at least the maximum effective range of their personal weapons during all conditions (daylight, limited visibility, & darkness) by integrating multiple capabilities into a single system. - Continued E&D portion of Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view. - Continued E&D portion of Semi-Autonomous Fires Technology (SAFT) to develop semi-autonomous fire control systems for use in next generation remote weapons systems, to enhance performance and minimize gunner/operator burden. - Completed scalable effects conventional warhead concept development. - Completed improved mortar munition integration and demonstrations. - Completed Flight Control Kinematic Unit effort (effort renamed Flight Control Mortar). Design & develop technology that provides guidance, navigation, and controls (GNC) to 81mm mortar rounds to enable trajectory shaping in urban environment to precisely & accurately strike specific targets. - Completed Non-Magnetic Azimuth Sensing technology. - Completed development of Miniature Urban Missile, leveraging technology from MEMS, designation, guidance and control, and warhead design, to develop a shoulder launched missile capable of defeating a variety of targets. - Completed development of precision 60mm mortar system, to demonstrate increased precision, range, and lethality in a light mortar, providing indirect fire support through projectile flight trajectory shaping. - Completed Weapons Spectral Signature Characterization and Mitigation (WSSCM) to develop pigments, dyes, and polymers to mitigate Short Wave Infrared (SWIR) signature for weapons systems applications.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated investigation of the scalability of variable effects conventional munitions, gun, and propulsion technologies for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare. - Initiated development of precision fires engagement technologies, to include trajectory shaped 81mm mortars, 83mm missiles, and smaller precision munitions. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Initiate High Reliability Dual Purpose Improved Conventional Munitions (DPICM) Replacement (HRDR) to include projectile integration, lethality enhancement, fuze setting integration and aerodynamic and aerospace technologies. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: FORCE PROTECTION ***Description:*** This activity supports the Force Protection Thrust's Advanced Technology Demonstration efforts in the areas of individual Marine platforms, equipment and autonomous systems. This includes technologies to enable detection, neutralization, breaching, and clearing of explosive hazards from the beach exit to inland objectives. Efforts supported under Force Protection also include the demonstration of technologies such as Air Defense/Counter Rocket, Artillery, and Mortar (CRAM) and counter tactical surveillance and targeting, including pre-shot sniper detection, technologies in support of maneuver warfare, small unit distributed operations, and technologies for improved Personnel Protective Equipment for individual protection against blast, ballistic, and blunt impact threats. ***FY 2015 Accomplishments:*** - Continued development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication. - Continued development of technologies to locate and defeat IEDs. - Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared). - Continued Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment.	9.378	9.838	10.720	0.000	10.720

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters. - Continued demonstration of laser technology readiness for battlefield employment. - Continued physics-based characterization of signatures of proud/buried targets/explosive hazard indicators across the spectrum of applicable detection modalities using knowledge/investigation of target physics. - Continued a program to demonstrate the fusion of multiple modes of detection of explosive hazards into a single system. - Continued development of advance modular and scalable personal protective equipment utilizing advances in mobility/survivability modeling and simulation, materials, and bio-fidelic surrogates. - Continued development of materials and helmet systems that absorb/dissipate blast shock waves - Continued an advanced technology demonstration for modular mission packages for the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Continued an advanced technology demonstration for autonomous vehicles in the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Continued an advanced technology demonstration that detect and classify tactical surveillance and targeting threats before engagement from a moving platform. - Completed the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame for action. - Completed the development of detecting and locating sniper weapons using the return of their unique radar signatures. - Completed fusion of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform. - Completed the development of automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/dawn/moonlit/starlit night). - Initiated an integrated technology demonstration to develop a system of systems that addresses route reconnaissance and clearance for a MEU. - Initiated a project to develop organic technology solutions for the detection and clearance of explosive hazards and obstacles encountered by Marine Corps forces during amphibious operations. - Initiated a project to investigate the detection and neutralization of explosive hazards in multiple, diverse, environments.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated a program to fuse multiple technologies that will detect and classify tactical surveillance and targeting threats before engagement from a moving platform. - Initiated projects to develop Personnel Protection Equipment (PPE) through novel Modular, Tailorable and scalable design concepts which increase survivability and operational suitability to the warfighter. - Initiated broad based material (ceramics, fiber and Fiber Re-Enforced Plastics) to demonstrate the possibility of significant weight reductions (greater than 50%) can be achieved. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete a program to fuse multiple technologies that will detect and classify tactical surveillance and targeting threats before engagement from a moving platform. - Complete development of materials and helmet systems that absorb/dissipate blast shock waves. - Initiate an advanced technology demonstration that uses Warfighter modeling and simulation efforts and advanced materials to create, test, and evaluate modular and scalable personal protective equipment. ***FY 2017 OCO Plans:*** N/A					
Title: HUMAN PERFORMANCE, TRAINING & EDUCATION	12.255	12.767	13.207	0.000	13.207
Description: This activity addresses the applied research effort of the Human Performance Training and Education thrust (HPT&E). The HPT&E thrust investment profile is directed at two technology investment areas, Warrior Resilience, and Decision Making and Expertise Development. The funding aligned to Warrior Resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Those funds aligned to Decision Making and Expertise Development refers to training and education technologies and methodologies that accelerate the development and improve the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. ***FY 2015 Accomplishments:*** - Continued the development of small-unit training for adaptability and resiliency in decision making (SUDM), to enhance the Marine Air Ground Task Force's capabilities by training and equipping small-unit leaders to handle					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
the demanding complexities and possess the adaptive mindset necessary to operate across the spectrum of conflict; empowering our strategic corporals as well as all of our junior leaders to fight, operate, and win in this challenging security environment. - Completed team immersive language and cultural learning in simulation environments. - Completed development of physical conditioning assessment and training optimization methods to improve warfighter performance - Completed mobile field technologies for predicting readiness and performance into more advanced development and demonstration of utility. - Completed development of technologies and methodologies for integrated mental skills resilience training (previous efforts neural mechanisms of mental skills resilience). - Completed the development of rapid auto cognitive task analysis(AutoCTA), to address the problems associated with accurately determining training system requirements, to develop a standardized, theory driven and JCIDS aligned, rapid CTA technique for extracting knowledge from experts and efficiently modeling tasks. - Completed development of technology to improve the transfer and maintenance of resilience training in the Marine Corps, to include measures of climate for Warfighter resilience, and small unit leader and team member training to enhance climate resilience, social support, and relapse prevention modules for deployment. - Initiated design and development of a Marine augmented classroom environment (ACE) that will enhance instructors' teaching performance and student learning outcomes. - Initiated design and development of a test-bed and conduct The Basic School evaluation to test the efficacy of simulation based training in that curriculum. - Initiated development and demonstrate an agent-based surrogate instructor development environment (ASIDE) to allow USMC to field small-team focused intelligent training solutions. - Initiated development of training to optimize the use of resilience skills (TOURS), specifically develop and iterate training modules for relapse prevention, deployable refresher training, supports for transfer climate and social support for small unit leaders. - Initiated development of an individualized fatigue countermeasure training tool for Marines that will provide increased fatigue resilience training effectiveness, improved fatigue management and reduced fatigue-related operational errors. - Initiated development of a master instructor development system (MIND) which will provide measurement framework to support the development of master instructors by creating a developmental model of instructor mastery.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated design and development of methods for establishing optimal training intervals for the Marine Corps Martial Arts Program (MCMAP) for improvement in physical performance and warrior mindset. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete the development of training to optimize the use of resilience skills (TOURS), specifically develop and iterate training modules for relapse prevention, deployable refresher training, supports for transfer climate and social support for small unit leaders. - Complete design and development of methods for establishing optimal training intervals for the Marine Corps Martial Arts Program (MCMAP) for improvement in physical performance and warrior mindset. - Initiate the development of measures of training effectiveness that connect training tasks with measures of performance under various stressors. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete design and development of a test-bed and conduct The Basic School evaluation to test the efficacy of simulation based training in that curriculum. - Complete development and demonstrate an agent-based surrogate instructor development environment (ASIDE) to allow USMC to field small-team focused intelligent training solutions. This effort initiated in FY 2013 due to operational requirements. - Complete design and development of a Marine augmented classroom environment (ACE) that will enhance instructors' teaching performance and student learning outcomes. - Initiate a unified theory of warrior resilience and fitness to enhance performance and mitigate injuries at the infantry small unit level. ***FY 2017 OCO Plans:*** N/A					
Title: INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) ***Description:*** This activity supports the demonstration of technologies to enhance situational awareness and tactical decision making through automated analysis, fusion of data, rapid integration of information, and acquired knowledge resulting in actionable intelligence at the lower command levels. The activity includes the demonstration of ISR efforts involving enhanced reconnaissance and persistent surveillance, and sensors for unmanned ground and aerial vehicles. Advanced Technology demonstrations also include the collection of information [monitoring, sensing, and locating] in the 3D urban battlespace as well as exploiting information	4.545	4.730	5.170	0.000	5.170

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2223 / *Marine Corps ATD*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
[identifying and classifying data] as part of the intelligence preparation of the battlespace in order to facilitate operational maneuver and distributed operations. ***FY 2015 Accomplishments:*** - Continued new Actionable Intelligence for Expeditionary and Irregular Warfare efforts which include Human Network Decision Modeling and the fusion across modeling approaches to increase prediction accuracy. - Continued the development of a workflow manager capable of cloud service discovery and configuration. - Continued research on the development of automated data tagging algorithms that enable connected graphs of structured and unstructured data. - Continued technology development required to enable tactical UAS on-board processing of terabytes of data in real time. - Continued development of a user composable search and display capability enabled by map reduce technology. - Continued Tagging, Tracking, and Locating efforts to demonstrate a system that will automatically translate large amounts of wide area surveillance data into tracks, useful to expose entity to entity associations; build urban context, as well as detect events and anomalies; and associate objects, tasks, locations and events for creating actionable intelligence. - Continued project to improve the enterprise recognition of critical tactical information relevant to real-time mission execution. - Continued project to demonstrate the feasibility of analytic populated big data architectures to populate and maintain a global knowledge environment relevant to rapid turn amphibious mission planning. - Continued project to develop a set of video analytic classifiers (entity, behavior, and scene) that can run in a power efficient manner in embedded hardware. - Continued project to improve expeditionary force capabilities to discover and process data across integrated cross domain systems. - Continued project to enable the synchronized planning and management and ISR assets given a set of disparate mission information requirements. - Continued project to enhance the extraction of target quality information from unregistered unstructured images and imagery. - Continued effort to automate the design and conduct of use cases relevant to tactical information requirements. - Completed development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed development and demonstration of measurement and signature intelligence data management and integration capability. - Completed efforts to refine enemy course of action prediction software to adapt to stimuli. - Completed development of tactical sensor nets with organic unattended multi-level security processing and information dissemination. - Completed new Relevant and Situational Information on Demand such as Identity Dominance Enabled by an Integrated Biometric/Tag Track and Locate (TTL) Capability, providing human tracking algorithms based on models of biometric (face, voice and soft) and TTL (optical taggant) capabilities and modeling a biometric/optical taggant system relevant to human tracking across an urban 5 km x 2 km area. - Completed efforts to develop methods and techniques for investigating open source information on the Internet to form a human terrain map indicating space and time features to aid network identification and prediction of enemy activity. - Completed efforts to incorporate social models for human decision making with statistical models. - Completed efforts to extend the utility of track classification algorithms to sparse data. - Completed efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures. - Completed efforts to show entity tracking using disparate ground and air sensors and tools that automatically compute latent area atmospheric measures. - Completed development of model based own force decision tools based on adversarial decision making models. - Completed development of an active layered sensing capability. - Completed research to develop more audio exploitation algorithms that can be used on audio files with a low signal to noise. - Initiated research to develop concept based information retrieval from unstructured data sources based on structured grammars or intensity vectors. - Initiated research to develop a capacity to run tracklett fusion, track analysis and data to track or track to track correlation as a distributed service run as a map-reduce job, both forensically and in real time. - Initiated research to develop a prototype system capable of maintaining the entity models needed for entity co referencing during real time natural language processing workflows. - Initiated research on the development of a capability to automate the extraction of video events relevant to mission information needs in real time on power efficient hardware.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated research on implementing orchestrated advanced analytics running across cloud and non-cloud based architectures. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. - Complete new Actionable Intelligence for Expeditionary and Irregular Warfare efforts which include Human Network Decision Modeling and the fusion across modeling approaches to increase prediction accuracy. - Complete the development of a workflow manager capable of cloud service discovery and configuration. - Complete Tagging, Tracking, and Locating efforts to demonstrate a system that will automatically translate large amounts of wide area surveillance data into tracks, useful to expose entity to entity associations; build urban context, as well as detect events and anomalies; and associate objects, tasks, locations and events for creating actionable intelligence. - Complete research to develop concept based information retrieval from unstructured data sources based on structured grammars or intensity vectors. - Initiate project to optimize the collection planning process through automation by automatically generating sensor plans, automating the production of information products, and delivering the most relevant information to the warfighters to enable rapid response in an evolving intelligence environment. - Initiate project to develop a capability to automatically deliver mission relevant information to an agile tactical unit based on mission ontologies, user preferences and high level descriptions of information needs. - Initiate project to develop a capability that will track and enhance mission readiness enabled by a dynamic machine understanding of mission information needs, a matured sensor optimization ability and operations research applied to course of action analysis. - Initiate the development of level 1 and level 2 fusion capabilities applied to complex graphs. - Initiate the development of cost functions for predictions made from data embedding spaces. - Initiate the development of complex event detection that is informed by entity pedigree. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete research on the development of automated data tagging algorithms that enable connected graphs of structured and unstructured data. - Complete technology development required to enable tactical UAS on-board processing of terabytes of data in real time. - Complete research to develop a capacity to run tracklett fusion, track analysis and data to track or track to track correlation as a distributed service run as a map-reduce job, both forensically and in real time.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete research to develop a prototype system capable of maintaining the entity models needed for entity co referencing during real time natural language processing workflows. - Complete research on technologies needed to tailor information delivery to warfighters based on mission context and user preferences. - Complete project to enhance the extraction of target quality information from unregistered unstructured images and imagery. - Initiate the development of a knowledge informed workflow manager capable of generating workflows automatically in response to alert conditions. - Initiate the development of power efficient neuro inspired algorithms for machine understanding. ***FY 2017 OCO Plans:*** N/A					
Title: LITTORAL COMBAT/POWER PROJECTION (LC/PP)	19.368	18.255	20.150	0.000	20.150
Description: This activity addresses the advanced technology development associated with associated with the Marine Corps participation in the Department of the Navy's (DoN) Science and Technology Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the DoN Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are generated by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The funding is aligned with the Naval challenges associated with projecting power despite anti-access and area denial, specifically the Sea Shield, Power and Energy, FORCEnet, and the Naval Expeditionary Maneuver Warfare warfighting capability gaps. The funding profile reflects the alignment of the FNC program investments into Enabling Capabilities (ECs); ECs respond to priority Naval warfighting capability gaps. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The FY2016 to FY2017 increase in the Littoral Combat/Power Projection activity is due to a FY2016 Congressional reduction and will realign the activity to its original programming levels in FY2017. Accordingly, the Future Naval Capabilities within the activity will be re-phased and amended appropriately to accommodate the delta. ***FY 2015 Accomplishments:*** - Continued development of wide area surgical and persistent surveillance technologies. - Continued development of the Ground Based Air Defense On-the-move high energy laser demonstrator. - Continued development of modular scalable effects prototype weapon.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of tactical urban breaching technologies. - Continued development of counter improvised explosive devices technologies. - Continued development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. - Continued development of technologies to lighten the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. - Continued the development of a wide area hyperspectral sensor for small UAS platforms. - Completed development of fuel efficient Medium Tactical Vehicle Replacement (MTVR) technologies. - Initiated development of an azimuth and inertial navigation system (AIMS). - Initiated development of spectral and reconnaissance imagery for tactical exploitation (SPRITE)-(EMW-FY14-01), previously funded in 0603673N) - Initiated development of Target Processing Center (TPC) sensor correlation and fusion technology; specifically, context fusion, and radar fusion and false track mitigation. - Initiated development of technologies to enable the exchange of actionable information at the tactical edge; specifically, actionable information tactical applications, data conditioning and network adaptive communication services. - Initiated the development of advanced models that translate changes in METOC conditions to changes in mission task measures of effectiveness. - Initiated the development of algorithms capable of improving the accuracy of the threat picture in a targeting processing center.					
FY 2016 Plans: - Continue all efforts of FY 2015, less those noted as completed above. - Complete development of an azimuth and inertial navigation system (AIMS). - Complete development of modular scalable effects prototype weapon. - Complete development of tactical urban breaching technologies. - Complete development of counter improvised explosive devices technologies. - Complete development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete development of technologies to lighten the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Continue development of Densified Propellant Fire From Enclosure/Enclosed Space(DP FFE/CS)enabling capability; specifically the analysis to incorporate tungsten into the SMAW Block 2 rocket motor propellant to decrease the detrimental effects of launch back-blast and over-pressure in confined spaces. (Effort was previously funded by PE 0603673N FY16.) - Initiate development of Advanced Topcoat System - Ground Vehicle Enabling Capability (EPE-FY16-01); specifically the formulation development of a high performance, zero-isocyanate Chemical Agent Resistant Coating (CARC) system that provides enhanced corrosion resistance and improved operational functionality on ground vehicle platforms. - Initiate the development of a high reliability distributed fuzing system for the 155mm DPICM projectile. ***FY 2017 OCO Plans:*** N/A					
Title: LOGISTICS	11.042	13.603	14.061	0.000	14.061
Description: This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into four pillars: efficient and responsive force sustainment, planning and directing logistics operations, logistics demand reduction, and fleet maintenance. These pillars are thoroughly integrated and perpetually related in execution. The FY 2015 to FY 2016 increase in the Logistics Thrust Activity is due to the initiation of the intelligent microgrid systems effort in support of Expeditionary Force-21. ***FY 2015 Accomplishments:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued exploring the development of portable fuel cell technologies capable of providing Power in the 100 Watt to 500 Watt power range. - Continued analysis of material alternatives for automated vehicle health monitoring and reporting. - Continued demonstration of advanced concepts for mobile infrastructure. - Continued integration and demonstration of electrochemical ultracapacitors into hybrid electric power systems. - Continued efforts to improve advanced electrical power generation from fuel cells and renewable sources as well as to improve the efficiency of conventional generation via hybridization and smart-grid technologies. - Continued integration and demonstration of advanced materials to reduce maintenance into selected vehicle and machinery components. - Continued the development of robotic systems to facilitate the packaging and handling of logistic supplies. - Continued a field demonstration of renewable energy devices and deployable equipment showing fewer liabilities when delivering expensive fuel, thereby lowering Marine Corps operational costs. - Completed efforts to develop a micro turbine generator capable of 100W average power. - Completed research into developing a replaceable electrode battery power source that consists of a metallic structure that is consumed during power generation and then easily replaced with a new metallic component that restores a full charge. - Completed development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads. - Completed development of advanced lightweight fuel to energy conversion concepts. This includes development of power management electronics for reducing power requirements for military radios. - Initiated operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies. - Initiated development of alternative (non-electrochemical) energy storage technologies for hybrid power system load management. - Initiated development of low energy desalination technologies to allow for efficient salt-water purification at the small/individual scale. - Initiated the development of anti-fouling and non-fouling water purification components to enable enduring performance of small water purification systems. - Initiated the development of real-time water quality monitoring systems for use with small scale water purification systems. - Initiated the development of efficient water packaging and distribution technologies.					
FY 2016 Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015, less those noted as completed above. - Complete exploring the development of portable fuel cell technologies capable of providing Power in the 100 Watt to 500 Watt power range. - Complete integration and demonstration of electrochemical ultracapacitors into hybrid electric power systems. - Initiate development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain. - Initiate the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices. - Initiate the development of alpha-particle semiconductors to harness energy from alpha-emitting materials and create ultra-high energy density nuclear batteries. - Initiate the development of ultra-high efficiency piezoelectric devices. - Initiate the development of intelligent microgrid systems for the expeditionary unit.					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete integration and demonstration of advanced materials to reduce maintenance into selected vehicle and machinery components. - Complete analysis of material alternatives for automated vehicle health monitoring and reporting. - Complete demonstration of advanced concepts for mobile infrastructure. - Complete the development of robotic systems to facilitate the packaging and handling of logistic supplies. - Complete efforts to improve advanced electrical power generation from fuel cells and renewable sources as well as to improve the efficiency of conventional generation via hybridization and smart-grid technologies. - Complete operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies. - Complete development of alternative (non-electrochemical) energy storage technologies for hybrid power system load management. - Complete a field demonstration of renewable energy devices and deployable equipment showing fewer liabilities when delivering expensive fuel, thereby lowering Marine Corps operational costs. - Complete development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain. - Complete the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of alpha-particle semiconductors to harness energy from alpha-emitting materials and create ultra-high energy density nuclear batteries. - Complete the development of ultra-high efficiency piezoelectric devices. - Complete the development of intelligent microgrid systems for the expeditionary unit. ***FY 2017 OCO Plans:*** N/A					
Title: MANEUVER ***Description:*** The Maneuver Thrust Technology Area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of current and future Marine Corps maneuver systems. This Thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. The emphasis is on enhancing capabilities for manned and unmanned ground platforms in support of Marine Corps expeditionary warfare objectives including: Expeditionary Force-21, Operational Maneuver from the Sea, Ship to Objective Maneuver, SeaBasing, and sustained operations ashore. The FY 2015 to FY 2016 increase in the Maneuver Thrust Activity is due to increased cost associated with development of a vehicle demonstrator that focuses on enhanced crew survivability. ***FY 2015 Accomplishments:*** - Continued advanced electromagnetic armor technology development efforts. - Continued development of fuel efficiency and battlefield power systems for improved performance. - Continued survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability. - Continued advanced suspension systems development with ride height adjustment, ride quality adjustment, rollover prevention, and load equalizing systems for USMC tactical wheeled platforms to enhance tactical mobility in support of Distributed Operations. - Continued a survivability/active protection systems improvement effort to increase effectiveness of defeat (Pdefeat) of shoulder launched RPG type threats and ATGM threats on light platforms utilizing non-kinetic kill technologies.	12.398	13.886	14.576	0.000	14.576

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued efforts evaluating the current ground fleet platforms for their mobility and control capabilities as they relate to inclusion of an autonomous vehicle capability that will provide support to the dismounted Marine during Enhanced Company Operations (ECO). - Continued efforts to demonstrate integrated armor solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants thereby enhancing tactical mobility and survivability. - Continued programs to address and enhance maneuver capability gaps in mobility such as efforts, transitioned from 6.2, aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO). - Continued the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles. - Continued the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies. - Continued mobility technologies that enable improved vehicle/warfighter agility and stability. - Continued lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms. - Continued survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles. - Continued the development of technologies that enable vehicle component modularity and reduce life cycle costs. - Continued development of a Combat S&T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency. - Continued new mobility efforts for On-Board Vehicle Power to increase mobile exportable power for Diesel Electric Propulsion Concepts and a Fuels effort to investigate future fuel alternatives for internal combustion engines to include Fischer-Tropsch and coal gasification processes for use in military tactical wheeled vehicles. - Continued Maneuver Enabling Technologies such as Vehicle Stabilization to improve vehicle suspension and control technologies to stabilize the platforms themselves to improve ride quality, shoot on the move capability and human systems integration. - Continued studies to identify technology development plans to close identified force protection capability gaps. - Continued a Vehicle Demonstrator program to design and fabricate an Integrated Power Demonstrator platform capable of producing the power needs for mobility and survivability concept demonstrations. - Initiated development of a vehicle demonstrator that focuses on enhanced crew survivability.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated the development of autonomous perception technologies to enable operations under adverse atmospheric conditions. ***FY 2016 Plans:*** - Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	84.107	88.818	93.355	0.000	93.355

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

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COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2297: *Futures Directorate*	0.000	41.589	42.672	47.061	-	47.061	47.743	47.443	48.392	48.392	Continuing	Continuing

A. Mission Description and Budget Item Justification

As a subordinate organization under the Deputy Commandant, Combat Development and Integration (DC, CD&I), the mission of the Futures Directorate (FD) is to identify plausible future security environments and develop and explore warfighting concepts and Concepts of Operations (CONOPS). It does this in order to identify potential future capability gaps and opportunities in order to inform future force development. DC, CD&I is designated as the United States Marine Corps (USMC) Advocate for Science and Technology (S&T). As Director FD, the Commanding General (CG) of the Marine Corps Warfighting Laboratory (MCWL) is the DC, CD&I designated Proponent of USMC S&T and serves as the USMC Executive Agent for Marine Corps S&T. The FD also serves as the Marine Corps' liaison to the Joint Staff for Joint Concept Development and Experimentation; thereby facilitating service-specific experiments as well as participation in joint service experimentation.

The current Futures Directorate Campaign Plan (FDCP) addresses how the Naval Services must reshape their capabilities in order to meet the concepts and CONOPS called for in the Secretary of the Navy's "Cooperative Strategy 21" and the Marine Corps' capstone "Expeditionary Force 21 (EF21)" concept. Execution of the FDCP results in recommendations to Marine Corps advocates and proponents so that they may more cohesively and logically structure the future Navy and Marine Corps team. In support of the Marine Corps' role to provide an ever-ready quick strike force to protect US interests, FDCP pursues concepts and new capabilities focused on the Marine Air-Ground Task Force (MAGTF). The MAGTF is the Marine Corps' doctrinal, task organized, force deployment package. It consists of four elements: the Command Element that provides overarching command and control (C2) of the entire force; the Ground Combat Element normally built around a core infantry unit with supporting armor, artillery, and other ground units; the Aviation Combat Element which provides aircraft, air defense, and other aviation functions; and the Logistics Combat Element which consists of combat service support (CSS) elements including medical, supply, and transportation. FDCP also examines future enhancements in training, organization, and equipment. FD accomplishes its mission through five subordinate Divisions:

Futures Assessment Division's (FAD's) mission is to: research, examine, and describe plausible future security environments 15 to 30 years into the future. Knowledge of these future security environments will provide an estimate of possible future threats, challenges, and opportunities, to include: the rise of possible partners and adversaries, emerging disruptive technologies, and likely sources of conflict. This work is largely accomplished through research, seminar participation, and coordination with various experts in academia, the intelligence community, and think tanks.

Emergent Force Development's (EFD's) mission is to: explore select future security environments, emerging warfighting opportunities and challenges in order to guide development of Marine Corps Service concepts and CONOPS. EFD is responsible for the production of formally published concepts, CONOPS, and options for future force organization and posture that describe how the Marine Corps will operate and fight.

Three Divisions fall under CG, MCWL to conduct concept-based experimentation. MCWL's mission is to: explore and analyze Marine Corps service concepts using an integrated combination of research; modeling and simulation (M&S); wargaming; live force experimentation; S&T discovery, assessment, and integration; and analysis in order to better understand how these concepts expose gaps and create opportunities for future force development.

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Wargaming Division conducts formal wargames to frame emerging warfighting concepts, establish the Joint context for the Marine Corps Force Development System, and establish priorities for development of experimental and non-experimental capabilities.

Experiment Division conducts live force concept-based experimentation to facilitate exploration of prototype and surrogate technologies, as well as Tactics, Techniques, and Procedures (TTPs), in order to better refine equipment requirements and to identify Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) initiatives needed to produce future capabilities.

Science and Technology Division conducts investigations and assessments to identify, modify where appropriate, and evaluate technological capabilities that support advanced warfighting concepts, and to explore the military utility of promising new commercial or government technologies in support of urgent and compelling needs. MCWL investigates the relevance to EF21 capabilities and gaps of advanced technologies according to the following EF21 derived Thrust Areas: Command, Control, Communications, and Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); Autonomy and Robotics; MAGTF Fires; Maneuver; Expeditionary Logistics (to include Expeditionary Energy); Expeditionary Medicine; Cyber and Electronic Warfare (EW); and Force Protection.

FD/MCWL investments encompass inquiries into multiple warfighting areas, including: CSS and Force Protection; MAGTF C4; MAGTF ISR; Fires, Targeting, and Maneuver; and Warfighting Excellence.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: COMBAT SERVICE SUPPORT (CSS) AND FORCE PROTECTION	7.262	7.788	10.785	0.000	10.785
Description: This activity includes FD/MCWL CSS and force protection experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity may be conducted under the Thrust Areas of Expeditionary Logistics, Expeditionary Medicine, Force Protection, or Autonomy and Robotics. The FY 2016 to FY 2017 increase in category funding is attributable to a shift in radar technology use (due to lack of technological advances as well as availability), while investigating systems that can identify, neutralize, or destroy unmanned systems. This realization led to increased costs due to exploring additional/alternative radar capabilities. In addition, efforts related to automating ship to shore surface connectors as well as placing an increased emphasis on providing enhanced medical care over a distributed battlefield (afloat as well as ashore) caused funding to increase. These efforts are being pursued to provide additional MAGTF support. ***FY 2015 Accomplishments:*** - Continued to develop and experiment with bio-sciences (medical) technologies.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued assessment of unmanned ground logistics delivery technologies that support infantry small unit operations. - Continued a MCWL-Defense Advanced Research Projects Agency (DARPA) partnership for the development and demonstration of a MCWL centric legged robot in an effort to "Lighten the Load" of individual Marines. - Continued research and assessment of technologies that reduce the demand required to support the MAGTF. - Continued testing and assessment of logistics enablers in support of EF21 experimentation. - Initiated assessment and experimentation with technologies that provide enhanced medical care over a distributed battlefield, to include "virtual" care and the use of autonomous systems in support of medical evacuation over ground, surface (water), or air. - Initiated evaluation and assessment of emerging technologies that support energy demand reduction. - Initiated investigation and assessment of logistics related emerging autonomous air delivery technologies and capabilities that further enhance current Programs of Record (PORs) and influence future planning and decision making. - Initiated evaluation and experimentation with technologies that can identify, neutralize, or destroy unmanned systems (aerial, ground, or surface).					
FY 2016 Plans: - Continue all efforts of FY 2015 less those noted as completed above. - Complete a MCWL-DARPA partnership for the development and demonstration of a MCWL centric legged robot in an effort to "Lighten the Load" of individual Marines. - Initiate research and assessment of advanced manufacturing techniques to determine military utility in expeditionary environments. - Initiate assessment and experimentation to understand the relevance of autonomy to ship to shore surface connectors. - Initiate assessments and experimentation with advanced technologies to enable standoff detection of improvised explosive devices (IEDs).					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as complete above. - Complete development and experimentation with bio-sciences (medical) technologies. - Complete research and assessment of technologies that reduce the demand required to support the MAGTF. - Initiate development and assessment of enhanced seabased medical capabilities in support of the MAGTF.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: FIRES, TARGETING, AND MANEUVER	2.403	1.016	3.071	0.000	3.071

Description: This activity includes FD/MCWL experimentation efforts in the areas of fires, targeting, and maneuver including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity will be conducted under the Thrust Areas of MAGTF Fires, Maneuver, and Autonomy and Robotics.

The FY 2015 to FY 2016 decrease in category funding is attributable to reducing investments in the weaponization portion of exploring both airborne and ground weaponized autonomous systems.

The FY 2016 to FY 2017 increase in category funding is mainly due to increased levels of investment into autonomous swarming technologies to capitalize on identified academia opportunities.

FY 2015 Accomplishments:
- Continued development and assessment of weaponized unmanned ground robotic systems.
- Continued development of technologies that enhance the utility of autonomous systems.
- Continued test and assessment of future ship to shore connectors that support EF21.
- Continued research, development, and experimentation with weapons and other ground combat systems that enhance the combat effectiveness of small units operating in the urban littorals.
- Initiated investigation of innovative technologies to enhance squad-level capabilities.
- Initiated evaluation and assessment of both airborne and ground weaponized autonomous/semi-autonomous "man-in-the-loop" systems.

FY 2016 Plans:
- Continue all efforts of FY 2015 less those noted as completed above.
- Complete test and assessment of future ship to shore connectors that support EF21.
- Initiate assessment and experimentation into the utility of robotic systems as platforms to support target acquisition and designation.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate assessment of the expeditionary utility of autonomous swarming technologies for unmanned air and ground systems. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2015, less those noted as complete above. - Complete evaluation and assessment of both airborne and ground weaponized autonomous/semi-autonomous "man-in-the-loop" systems. ***FY 2017 OCO Plans:*** N/A					
Title: MARINE AIR-GROUND TASK FORCE (MAGTF) COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4) ***Description:*** With this submission, the name of the category changed to now include MAGTF in the title. This change is made to provide clarification between separate C4 efforts discussed in another project within this PE. This activity encompasses all FD/MCWL C4 related experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced C4 capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity will be conducted under the Thrust Areas of C4ISR and Cyber/EW. The FY 2015 to FY 2016 increase in category funding is attributable to focusing on EF21, with development and testing of a configurable C2 suite that enhances operations from aviation platforms and evaluation and experimentation with emerging technologies that support future maritime C2 capabilities. The FY 2016 to FY 2017 decrease in category funding is mainly due to a culmination of experimentation with modified commercial-off-the-shelf (COTS) waveforms; thereby allowing a shift into using existing POR-based waveforms to conduct further experimentation. ***FY 2015 Accomplishments:*** - Continued development and assessment of a MAGTF network management system. - Continued development and assessment of a configurable C2 suite that enables operations from alternate seabased platforms in support of EF21 experimentation.	9.190	10.592	9.770	0.000	9.770

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development and assessment of a configurable C2 suite that enhances operations from L-Class shipping in support of EF21 experimentation. - Continued a follow-on effort to test and evaluation of an integrated C2 application in support of EF21 experimentation. - Initiated development and assessment of systems that permit unmanned aerial system (UAS) operations in a global positioning system (GPS) denied environment. - Initiated development and assessment of a configurable C2 suite that enhances operations from aviation platforms in support of EF21 experimentation. - Initiated investigations and assessment of technologies that support C2 enablers for shore deployed MAGTF elements that is platform agnostic and capable of deployment from the sea, air, or ground. - Initiated evaluation and experimentation with emerging technologies that support future maritime C2 capabilities/EF21. - Initiated development and assessment of technologies that support a maritime Fly-In Command Element (FICE) capable of operating from the sea-base during the conduct of immediate crisis response operations.					
FY 2016 Plans: - Continue all efforts of FY 2015 less those noted as completed above. - Complete development and assessment of a configurable C2 suite that enables operations from alternate seabased platforms in support of EF21 experimentation. - Complete development and assessment of a configurable C2 suite that enhances operations from L-Class shipping in support of EF21 experimentation. - Complete development and assessment of technologies that support a maritime FICE capable of operating from the sea-base during the conduct of immediate crisis response operations. - Initiate assessment and experimentation with integration and interoperability of software applications to increase the situational awareness, lethality, and survivability of distributed tactical ground formations.					
FY 2017 Base Plans: - Continue all efforts of FY 2016, less those noted as complete above. - Complete development and assessment of a MAGTF network management system. - Initiate exploration, development, and experimentation of cyber/EW capabilities at the tactical level, to enable tactical operators to sense, visualize, and exploit the cyber/EW environment.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate development and experimentation that enable seamless operations in a technology denied environment. ***FY 2017 OCO Plans:*** N/A					
Title: MARINE AIR-GROUND TASK FORCE (MAGTF) INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) ***Description:*** With this submission, the name of the category changed to now include MAGTF in the title. This change is made to provide clarification between separate ISR efforts discussed in another project within this PE. This activity includes FD/MCWL ISR related experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced ISR capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity will be conducted under the Thrust Areas of C4ISR and Autonomy and Robotics. The FY 2015 to FY 2016 decrease in category funding is attributable to reassessment of seabased and landing force ISR capability investments as well as adjusting investments in enhancing UAS sensor packages. The FY 2016 to FY 2017 increase in category funding is mainly due to reassessing, refocusing, and enhancing seabased and landing force ISR capabilities. ***FY 2015 Accomplishments:*** - Continued development and assessment of seabased and landing force ISR capabilities that enable EF21 experimentation. - Continued development, integration, and assessment of technologies to fuse multiple sensor payloads into a single user interface to enable utility for tactical operators. - Initiated development and assessment of enhanced UAS sensor packages. - Initiated examination and assessment of technologies that support future employment of UAS operations from seabased platforms. ***FY 2016 Plans:***	3.297	2.575	4.048	0.000	4.048

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue all efforts of FY 2015, less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as complete above. - Complete development and assessment of enhanced UAS sensor packages. ***FY 2017 OCO Plans:*** N/A					
Title: FUTURES DIRECTORATE (FD) / MARINE CORPS WARFIGHTING LABORATORY (MCWL) OPERATIONS (SUPPORT) ***Description:*** FD/MCWL Operations (Support) efforts include overall FD/MCWL experimentation doctrine, planning, analysis, data collection, as well as technology transition tracking efforts. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. ***FY 2015 Accomplishments:*** - Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. - Continued to provide technical, strategic, and managerial support to Marine Corps experimentation. - Continued to provide overall analysis and reporting of experimentation efforts, analytical assistance during experiment design, and maintenance of an ad-hoc analysis capability. - Initiated deliberate broad-based commercial technology forecasting in support of experimentation long-range planning and combat development. - Initiated technical, strategic, and managerial support for operations with advanced technology utilizing autonomy, robotics, and cyber capabilities. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A	11.748	11.811	11.682	0.000	11.682
Title: WARFIGHTING EXCELLENCE	7.689	8.890	7.705	0.000	7.705

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: This activity includes FD/MCWL efforts in the development and assessment of joint and service warfighting concepts, joint and service missions, analysis of emerging threats and opportunities, and joint capability experimentation. It also includes FD/MCWL service experimentation in areas that impact multiple warfighting functions. Although this category covers several small (less than $500K per FY) efforts being pursued by FD/MCWL, most programs listed below are considered major (valued at $500K or more) or have near-real-time operational impact. The FY 2015 to FY 2016 increase in category funding is mainly due to increased focus on M&S-based hardware, software, and training capabilities that support planning/experimentation processes, as well as investments to improve Wargaming abilities. The FY 2016 to FY 2017 decrease in category funding is attributable to reduced levels of investment in broad-based technical and analytical support at the component, Service, and Joint levels. ***FY 2015 Accomplishments:*** - Continued executive agent responsibilities for the Marine Corps Title Ten (X) Wargame, Expeditionary Warrior, as well as the Joint and other service Title X programs, such as the United States Army's Unified Quest, the Air Force's Unified Engagement and Futures wargame, and the Navy Global wargame. Title X war games address future capabilities in the context of Title X readiness responsibilities. - Continued management and oversight of non-Title X Wargaming, including the highly visible Office of the Secretary of Defense Net Assessment Transformation War Game series and the Special Operations Command wargaming series. - Continued to support the core Center for Emerging Threats and Opportunities (CETO) mission to: provide broad-based technical and analytical support for Marine Corps combat development and experimentation programs at the component, Service, and Joint levels. This support includes the full spectrum of combat development-related missions and tasks to include the assessment of plausible future security environments and the identification of future threats, adversaries, opportunities, technologies, strategic settings, and associated geographic, environmental, economic, and demographic conditions in order to inform the development of innovative warfighting concepts, CONOPS, and capabilities across the DOTMLPF spectrum. Serve as a catalyst to stimulate thought and debate on issues of importance to the Marine Corps. - Continued funding contributions to Joint Concept Technology Demonstrations (JCTDs) and Emerging Capability Technology Demonstrations (ECTDs) (formerly known as Advanced Concept Technology					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Demonstrations (ACTDs)). Both JCTDs and ECTDs are intended to rapidly field needed capabilities by using emergent mature technologies matched with innovative operational concepts. - Initiated development and assessment of modeling and simulation hardware, software, and training capabilities that support planning/experimentation processes. ***FY 2016 Plans:*** - Continue all efforts of FY 2015. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	41.589	42.672	47.061	0.000	47.061

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this PE is the development, demonstration, and assessment of technologies that represent capabilities to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare in the future. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603651M *I JT Non-Lethal Wpns Tech Dev*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	11.163	12.745	13.117	-	13.117	13.448	13.387	13.387	13.387	Continuing	Continuing
3022: *Joint Non Lethal Weapons*	0.000	11.163	12.745	13.117	-	13.117	13.448	13.387	13.387	13.387	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DOD Non-Lethal Weapons Program was established by the Office of the Secretary of Defense, which designated the Commandant of the Marine Corps (CMC) as the DoD NLW Executive Agent (EA). The EA exercises centralized responsibility for joint research and development of non-lethal weapons and technology through the Joint Non-Lethal Weapons Program (JNLWP). The Office of the Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint Non-Lethal Weapons (NLW) Integrated Product Team, a multi-service flag level corporate board that provides executive oversight and management for the JNLWP for the CMC. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies, capabilities and equipment are provided to the operating forces while eliminating duplicative service S&T investment. These advanced technology development initiatives feed non-lethal capabilities which directly support the three pillars of the 2014 Quadrennial Defense Review and comprise a fundamental part of DoD's security cooperation efforts to build partner capacity. The resulting capabilities will facilitate a fully integrated non-lethal competency as a complement to lethal firepower, providing force application options for short-of-lethal scenarios.

This program funds Advanced Technology Development of next-generation non-lethal capabilities and includes performing analysis, technology development efforts, and modeling and simulation necessary to ensure optimum weaponization and use of these capabilities. Investment areas include research and development of next-generation NLWs such as: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-materiel missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications). Next-generation non-lethal systems focus on long-range localized non-lethal effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, vessels, and also in close proximity to high-value civilian facilities.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603651M *I JT Non-Lethal Wpns Tech Dev*		
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	11.498	12.745	13.117	-	13.117
Current President's Budget	11.163	12.745	13.117	-	13.117
Total Adjustments	-0.335	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.335	0.000			

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603651M / *JT Non-Lethal Wpns Tech Dev*	Project (Number/Name) 3022 / *Joint Non Lethal Weapons*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3022: *Joint Non Lethal Weapons*	0.000	11.163	12.745	13.117	-	13.117	13.448	13.387	13.387	13.387	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the research and development of next-generation NLWs and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponization and use of these NLWs. Investment areas include research and development of next-generation NLWs such as: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-materiel missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materiels (including materiels for vehicle/vessel stopping and counter-facility applications). Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, vessels, and also in close proximity to high-value civilian facilities.

The FY2015 to FY2016 increase in funding in the Joint Non-Lethal Weapons Technology Development PE is due the initiation of prototype development, demonstration, and transition to higher levels of technology development of the most promising candidate technologies addressing the extended range/duration incapacitation capability gap.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: JOINT NON-LETHAL WEAPONS	11.163	12.745	13.117	0.000	13.117
FY 2015 Accomplishments: - Continued effort to assess the general utility, effect, and effectiveness of technologies for incapacitating personnel, clearing facilities, stopping vehicles and vessels, and denying enemy access to protected areas. - Continued prototype development and transition to higher levels of technology development of advanced payloads for candidate technological capabilities with applications relevant to emerging capability gaps. - Continued transition to higher levels of development and demonstration for the most promising candidate technologies employing multisensory stimuli. - Continued transition to higher levels of technology development and demonstrate the most promising directed energy technologies under consideration for counter-personnel and counter-materiel applications. - Continued non-lethal effects characterization through modeling and effects testing for joint advanced technology development using Human Effects Modeling Analysis Program (HEMAP). - Continued evaluation of alternative non-lethal prototype technologies offering operational utility and transition best candidates to higher levels of technology development and acquisition. - Continued advanced prototype development and demonstration of a smaller, lighter active denial technology demonstrator based on the most promising and mature 95 GHz source technology.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603651M / *JT Non-Lethal Wpns Tech Dev*	**Project (Number/Name)** 3022 / *Joint Non Lethal Weapons*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued incorporation of suitable sensors capable of measuring NL stimuli into surrogate test models as part of the HEMAP. - Continued prototype development, demonstration and transition to higher levels of technology development of the most promising candidate technologies addressing the extended range/duration incapacitation capability gap. - Completed research to define and transition to higher levels of technology development the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry. - Completed addressing non-lethal counter-personnel capability gaps with alternative directed energy technologies. - Completed technology development employing optimized electro-muscular disruption waveforms and mechanisms for an extended duration counter-personnel suppression capability. - Completed advanced system component research and development for integration into NLE systems (vehicle stopping, vessel stopping, and counter personnel systems). - Initiated modular prototyping of High Power Microwave (HPM) component hardware meeting development objectives for subsequent integration into an HPM-capable system configuration. ***FY 2016 Plans:*** - Continue all efforts from 2015, except those noted as completed. ***FY 2017 Base Plans:*** - Continue all efforts from 2016, except those noted as completed. - Complete advanced prototype development and demonstration of a smaller, lighter active denial technology demonstrator based on the most promising and mature 95 GHz source technology. - Initiate development of technologies to deliver emerging novel counter-materiel and counter-personnel payloads to target while minimizing risk to the operator. - Initiate development of a laboratory/benchtop High-Power Radio-Frequency (HPRF) directed energy system to validate short pulse counter-materiel effects. Refine, integrate and demonstrate breadboard system. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	11.163	12.745	13.117	0.000	13.117

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603651M / *JT Non-Lethal Wpns Tech Dev*	**Project (Number/Name)** 3022 / *Joint Non Lethal Weapons*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons which address identified and prioritized joint NLW capability gaps. The program consists of a collection of projects for the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, mitigation of high priority joint NLW capability gaps, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603673N *I (U)Future Naval Capabilities Advanced Tech Dev*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	257.806	265.562	249.092	-	249.092	259.009	259.119	260.541	270.950	Continuing	Continuing
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	252.971	258.562	249.092	-	249.092	259.009	259.119	260.541	270.950	Continuing	Continuing
9999: *Congressional Adds*	0.000	4.835	7.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.835

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) address the Advanced Technology Development associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy's Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	260.847	258.860	271.498	-	271.498
Current President's Budget	257.806	265.562	249.092	-	249.092
Total Adjustments	-3.041	6.702	-22.406	-	-22.406
• Congressional General Reductions	-	-0.298			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	7.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.500	0.000			
• SBIR/STTR Transfer	-5.541	0.000			
• Program Adjustments	0.000	0.000	-12.692	-	-12.692
• Rate/Misc Adjustments	0.000	0.000	-9.714	-	-9.714

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *ASW Research Prog - Cong*	4.835	7.000
Congressional Add Subtotals for Project: 9999	4.835	7.000
Congressional Add Totals for all Projects	4.835	7.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603673N *I (U)Future Naval Capabilities Advanced Tech Dev*

Change Summary Explanation

The FY 2017 funding request was reduced by -$5.0 million as required for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Technical: Not applicable.
Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	Project (Number/Name) 3346 / *Future Naval Capabilities Adv Tech Dev*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	252.971	258.562	249.092	-	249.092	259.009	259.119	260.541	270.950	Continuing	Continuing

A. Mission Description and Budget Item Justification

FNC investments are typically 3-5 years in duration. They provide a continuance of basic research by maturing technologies from a Technology Readiness Level (TRL) of 3 or 4 to a TRL of 6. All FNC products require BA2 and BA3 funded technology development, which is coordinated to ensure tangible technology products are delivered upon completion of each investment. Each year the TOG refreshes the FNC Program by approving new ECs and technology products as older ones get delivered. After transition to an acquisition program, FNC products are further engineered, integrated and ultimately, delivered to the warfighter. The development and delivery of each FNC product is guided by a Technology Transition Agreement (TTA) that is signed by the requirements and acquisition sponsors, as well as the S&T developer.

This project supports the naval pillars of Capable Manpower, Enterprise and Platform Enablers, Expeditionary Maneuver Warfare, Force Health Protection, Forcenet, Power and Energy, Sea Basing, Sea Shield and Sea Strike. Each of these pillars is listed as a separate R-2 Activity. Under each R-2 Activity, the BA 6.3 accomplishments and plans for every Enabling Capability (EC) and Technology Product in the FNC Program are listed. ECs are composed of one or more interrelated technology products, so for clarity, each product is shown under its EC.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: CAPABLE MANPOWER (CMP)	17.518	18.451	19.195	0.000	19.195
Description: This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Capable Manpower (CMP) FNC pillar. The CMP Pillar develops deliverable technologies that provide new capabilities in manpower and personnel management, training and education, and human-systems integration for more intuitive systems.					
FY 2015 Accomplishments: EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT) - Complete Augmented Immersive Team Training (AITT) - Develop, integrate, and demonstrate hardware and software for Augmented Reality training for infantry operations. - Complete Perceptual Training Systems and Tools (PercepTs) - Design, demonstrate, and evaluate the efficacy of new technologies for perceptual training.					
EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Cognitive Fidelity Synthetic Environment - Design and develop virtual simulations that elicit the appropriate perceptual-cognitive responses for Naval aviation training. - Continue Tactics & Speech Capable Semi-Automated Forces - Demonstrate software that automatically generates doctrinally accurate semi-autonomous forces that are adaptive to training scenario events. - Continue Virtual-Constructive Representations on Live Avionics Displays - Test, evaluate, and refine the Live, Virtual, & Constructive (LVC) zymology used during experimentation and validation efforts. EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS) - Continue Manpower Planning and Optimization Toolset - Develop total ownership cost measures and analytical techniques to evaluate proposed shipboard manpower and personnel requirements. - Continue Platform Design and Acquisition Toolset - Develop a software toolset for evaluation of ship design and manpower configurations. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT) - Continue Dynamic, Adaptive & Modular Training for UAS - Design knowledge structures to support activity learning, scenario requirements to activities links, semi-automated forces envelope generation, cognitive modeling, generative semi-automated forces behaviors and integration with DoN simulation and training systems. - Continue Selection for UAS Personnel (SUPer) - Construct unmanned aircraft operator selection and classification test batteries, including underlying data collection instruments within the DoN's APEX framework. - Continue UAS Control Station Human Machine Interface - Create Common Control Station information display design specifications that focus on reducing the information demands placed on unmanned aircraft system operators. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Initiate Decision Making-Learning Management System (DM-LMS) - Define existing Marine Corps measures/ standards of Decision Making (DM) and instructional method guidelines and develop software products to plan, assess, and track decision making skill development. - Initiate Digital Integrated Representation of Tactical Environment (DIRTE) - Define existing Marine Corps CONOPS for classroom and sustainment training and develop rapid terrain modeling and sketchpad software					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
products to enable small unit leaders and instructors to create effective decision making environments and scenarios. - Initiate Simulation Tailored Training and Assessment (ST2A) - Define existing Marine Corps situated tutor techniques and unobtrusive monitoring techniques and develop software and hardware prototypes to execute decision making program of instruction and scenarios in simulation. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Initiate Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Investigate and develop an approach to an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats.					
FY 2016 Plans: EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY - Complete Cognitive Fidelity Synthetic Environment - Design and develop virtual simulations that elicit the appropriate perceptual-cognitive responses for Naval aviation training. - Complete Tactics & Speech Capable Semi-Automated Forces - Demonstrate software that automatically generates doctrinally accurate semi-autonomous forces that are adaptive to training scenario events. - Complete Virtual-Constructive Representations on Live Avionics Displays - Test, evaluate, and refine the Live, Virtual, & Constructive (LVC) symbology used during experimentation and validation efforts. EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS) - Continue Manpower Planning and Optimization Toolset - Demonstrate software that assesses the risks and capabilities of varying levels of manpower authorizations to operate a specific platform design during various mission scenarios. - Continue Platform Design and Acquisition Toolset - Demonstrate software that assesses the trade space and cost commitments of different platform designs and manning compliments. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT) - Continue Dynamic, Adaptive & Modular Training for UAS - Design knowledge structures for integration with DoN simulation and training systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Selection for UAS Personnel (SUPer) - Construct unmanned aircraft operator selection and classification test batteries, including underlying data collection instruments within the DoN's APEX framework. - Continue UAS Control Station Human Machine Interface - Create Common Control Station information display design specifications that focus on supervisory control and the reduction of the information demands placed on unmanned aircraft system operators. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Continue Decision Making-Learning Management System (DM-LMS) - Define existing Marine Corps measures and standards of decision making and instructional method guidelines, and develop software products to plan, assess, and track decision making skill development. - Continue Digital Integrated Representation of Tactical Environment (DIRTE) - Define existing Marine Corps CONOPS for classroom and sustainment training and develop rapid terrain modeling and sketchpad software products that enable small unit leaders and instructors to create effective decision making environments and scenarios. - Continue Simulation Tailored Training and Assessment (ST2A) - Define existing Marine Corps situated tutor techniques and unobtrusive monitoring techniques, and develop software and hardware prototypes to execute decision making programs of instruction and scenarios in simulation. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Continue Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Develop threat response software models to support an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats. EC: CMP-FY16-01 OPERATIONAL PLANNING TOOL - Initiate Operational Planning Tool - Demonstrate software to facilitate the planning cycle structure used by Navy command and control planners to prepare mission plans that range from the Maritime Operations Centers down to maritime tactical units. ***FY 2017 Base Plans:*** EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Manpower Planning and Optimization Toolset - Develop software that produces a feasible set of shipboard event timelines, workload packages, and skills for each billet created for a given ship and system design. - Complete Platform Design and Acquisition Toolset - Demonstrate software to simulate the design and manpower interactions that are used to determine the trade spaces and cost commitments required for a given platform design and manning compliment. EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT) - Continue UAS Control Station Human Machine Interface - Deliver Human Machine Interface Prototype Software for supervisory control of unmanned systems to the submarine combat system. - Complete Selection for UAS Personnel (SUPer) - Develop and demonstrate unmanned aircraft operator selection and classification test batteries. - Complete Dynamic, Adaptive & Modular Training for UAS - Develop and demonstrate automated scenarios and clutter entity behaviors in the Navy's common training system technology for the Next Generation Threat System. EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM) - Continue Digital Integrated Representation of Tactical Environment (DIRTE) - Define Enterprise level Application Programming Interface (API) requirements to create Virtual Battlespace 2 (VBS2) terrain from government supplied source data (e.g., National Geospatial-Intelligence Agency products such as Digital Terrain Elevation Data and Digital Feature Analysis Data). - Continue Simulation Tailored Training and Assessment (ST2A) - Develop software and hardware prototypes to execute decision making programs of instructional scenarios in simulation. - Continue Decision Making-Learning Management System (DM-LMS) - Develop a Marine Corps Training Information Management System (MCTIMS) software prototype to provide repository and trend analysis of performance data to inform training readiness assessments, including the performance and development of individual Marines, small unit leaders, and small units over time. EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E) - Continue Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Demonstrate simulated Electromagnetic Environmental Effects on Fleet training and operational systems in a					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
networked Live, Virtual, and Constructive environment in a distributed scenario-driven Fleet Synthetic Training event. EC: CMP-FY16-01 OPERATIONAL PLANNING TOOL - Continue Operational Planning Tool - Develop software to assist Carrier Strike Group staffs that support comprehensive/collaborative planning through the use of decision support services, analytic tools, and common displays that assist planners during the creation of navigation and tactical plans. EC: CMP-FY17-01 MANPOWER, PERSONNEL & TRAINING STRATEGIC PLANNING APPLICATION - Initiate Manpower, Personnel & Training Planning Application - Develop decision support software to capture key interconnections, time delays and feedbacks between Manpower, Personnel, and Training stakeholders that serves as a common set of assumptions and boundaries for decision analyses. EC: CMP-FY17-02 FUTURE INTEGRATED TRAINING ENVIRONMENT (FITE) - Initiate Future Integrated Training Environment (FITE) - Develop technologies and techniques to integrate Marine Corps simulations to support Live, Virtual, and Constructive training events. ***FY 2017 OCO Plans:*** N/A					
Title: ENTERPRISE AND PLATFORM ENABLERS (EPE) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Enterprise and Platform Enablers (EPE) FNC pillar. The EPE Pillar develops cross-cutting, deliverable technologies that provide new capabilities for naval service platforms that lower acquisition, operations and maintenance costs, improve system safety and availability, and improve platform survivability. The FY 2015 to FY 2016 increase was due primarily due to an increase in work required to complete EPE-FY12-02, the planned ramp-up of EPE-FY15-02 and EPE-FY15-03. The FY 2016 to FY 2017 decrease was due primarily to the completion of EPE-FY10-01, EPE-FY12-01 and EPE-FY12-02, and the planned ramp-down of EPE-FY09-07 and EPE-FY11-01. ***FY 2015 Accomplishments:***	17.624	21.668	19.178	0.000	19.178

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EPE-FY09-01 Affordable Common Radar Architecture - Complete Affordable Common Radar Architecture - Develop, fabricate, integrate and test a low cost surface radar replacement system. EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION - Continue Advanced Material Propeller - Assess blade/hub joint strength, perform blade fatigue and deflection testing, and static and dynamic testing of the complex hub unit. EC: EPE-FY10-01: ADVANCED SHIPBOARD WATER DESALINATION - Continue Advanced Navy Reverse Osmosis System - 100K GPD (Formerly a compent technology of Advanced Navy Reverse Osmosis System) - Develop and test a 100K Gallons Per Day (GPD) robust reverse osmosis based water purification system for ship platforms. - Continue Advanced Navy Reverse Osmosis System - 4K GPD (Formerly a compent technology of Advanced Navy Reverse Osmosis System) - Develop and test a 4,000 Gallons Per Day (GPD) robust reverse osmosis based water purification system. EC: EPE-FY10-02 AFFORDABLE MODULAR PANORAMIC PHOTONICS MAST - Complete Modular Photonics Mast Housing - Resolve final testing issues and transition the Modular Photonics Mast Housing for submarines. EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY - Complete Advanced-Robust ICCP Anodes and Reference Cells - Complete reference cell performance down select. EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Continue Integrated Thermal Management System Design - Test scale panels in a relevant environment and determine integration issues. EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES - Continue Corrosion Resistant Surface Treatment - Complete development of single step coating product. - Continue Sprayable Acoustic Damping Systems - Develop product and complete corrosion testing of prototype Sprayable Acoustic Damping system.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS) - Continue IHSMS Fleet Structural Health Management Decision Tool (formerly known as Distributed Structural Micro-Sensor Nodes and Rotor Hot Spot Sensors and Integration) - Develop wireless energy harvesting sensors for rotorcraft structural health management, and evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots. EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT - Continue Tools for Predicting Array Operational Loading & Distribution - Collect lab and at-sea data to validate fully coupled predictive models for hydrodynamic effects on a towed array. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Advance testing for variable coating formulas and evaluate properties. - Continue Aluminum Alloy Corrosion Prediction Tool - Develop algorithm for 5000 series aluminum alloy degree of sensitization and for prediction of Mean Time to Repair. EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT - Initiate Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Conduct Navy gas turbine hot corrosion analysis and experimentation under shipboard environmental conditions and power scales. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Develop new test methods needed to evaluate new materials mitigation technology for submarines.					
FY 2016 Plans: EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION - Continue Advanced Material Propeller - Develop Full Scale Test Plan for the Collins Class Submarine. EC: EPE-FY10-01: ADVANCED SHIPBOARD WATER DESALINATION					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Advanced Navy Reverse Osmosis System - 100K GPD - Demonstrate and test a 100K Gallons Per Day (GPD) robust reverse osmosis based water purification system on ship platforms. - Complete Advanced Navy Reverse Osmosis System - 4K GPD - Demonstrate and test a 4,000 Gallons Per Day (GPD) robust reverse osmosis based water purification system. EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Continue Integrated Thermal Management System Design - Finalize testing of a scale model and begin integrating the panels to a ship deck for the final demonstration. EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES - Complete Corrosion Resistant Surface Treatment - Deliver impellers treated with Corrosion Resistant Surface Treatment to PMS-505 for installation on LCS. - Complete Sprayable Acoustic Damping Systems - Demonstrate and integrate spray applied damping systems for improved structural vibration control, total ownership cost reduction, improved platform performance, and reduced detectability. EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS) - Complete IHSMS Fleet Structural Health Management Decision Tool - Integrate structural health monitoring system into demonstration article, demonstrate structural health monitoring rotor hot-spot sensors and integration technologies, and evaluate system performance. EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT - Continue Tools for Predicting Array Operational Loading & Distribution - Develop a design for a highly instrumented towed array to be used in validating the predictive model of the forces operating on a towed array. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Conduct test and evaluation of prototype surface treatment and repair tools to enable aluminum alloy sensitization repair/desensitization technologies. - Continue Aluminum Alloy Corrosion Prediction Tool - Integrate a detection tool with sensitization prediction software as a singular tool with both detection and predictive capabilities to provide the time to repair aluminum ship structures.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT - Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Demonstrate, test, and down select advanced coating and alloy combinations that are suitable for higher temperature capable gas turbine operation. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Develop new test methods for materials being developed under the program.					
FY 2017 Base Plans: EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION - Complete Advanced Material Propeller - Conduct Full Scale Testing on a Collins Class Submarine. EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT - Complete Integrated Thermal Management System Design - Demonstrate feasibility of flight deck thermal management system during at-sea test. EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT - Continue Tools for Predicting Array Operational Loading & Distribution - Fabricate and use the previously designed highly instrumented towed array to validate the predictive model of the forces operating on a towed array. EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION - Continue Aluminum Alloy Corrosion Mitigation Technologies - Assess the effectiveness of the developed surface treatment and repair tools for desensitizing and repairing sensitized aluminum. - Continue Aluminum Alloy Corrosion Prediction Tool - Integrate the Degree of Sensitization (DoS) prediction algorithm software into the DoS detection tool. EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Demonstrate, test, and down-select advanced coatings and alloy combinations that are suitable for higher temperature marine gas turbine engine service in the marine environment. EC: EPE-FY15-03 SPECIAL HULL TREATMENT - Continue New Material(s) Development & Lab Characterization - Construct new test methods for the materials being developed. EC: EPE-FY16-01 ADVANCED TOPCOAT SYSTEM (ATS) - Initiate Advanced Topcoat Systems for Air Vehicle (ATS-AV) - Perform initial laboratory verification and qualification studies on modified primer and topcoat chemistries, including chemical analysis and material interaction compatibility verification. ***FY 2017 OCO Plans:*** N/A					
Title: EXPEDITIONARY MANEUVER WARFARE (EMW) ***Description:*** This R-2 Activity contains the Navy funded Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Expeditionary Maneuver Warfare (EMW) FNC Pillar. The EMW Pillar develops deliverable technologies that provide new capabilities in expeditionary maneuver warfare, including naval ground forces, with special emphasis on regular and irregular warfare in urban environments and combating terrorism. The FY 2015 to FY 2016 increase was due primarily to the initiation of EMW-FY16-01. The FY 2016 to FY 2017 decrease was due to the planned ramp down of EMW-FY12-02 and the continuation of EMW-FY12-03, EMW-FY14-01 and EMW-FY16-01 in PE 0603640M. ***FY 2015 Accomplishments:*** EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Implement distributed RF EW sensing and networked jamming techniques with multi-system tasking allocation in RF hardware for field testing during Marine Corp Training	8.363	10.392	3.060	0.000	3.060

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Integrate new detection and countermeasure techniques with JCREW hardware for testing of enhanced, single platform effectiveness. EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICAL SYSTEM (MEMS) NAVIGATION SYSTEM - Continue Micro-Electro-Mechanical (MEMS) Inertial Navigation System - Design and fabricate a full Navigation System for hand-held targeting systems that will reduce target location error. EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE) - Continue Automated Processing for Spectral Exploitation and Dissemination (APSED) - Develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) image processing architecture that includes EO-to-HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation. - Continue Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Develop hardware for a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution. ***FY 2016 Plans:*** EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Using realistic scenarios, demonstrate tactical-level distributed jamming on multiple ground-based Electronic Warfare systems. - Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Employing realistic scenarios, demonstrate the simultaneous reception and transmission of Electronic Warfare and blue-force communication waveforms. EC: EMW-FY12-03 WIDE AREA SURGICAL AND PERSISTENT SURVEILLANCE (WASPS) CAPABILITIES FOR TIER 2/3 UAVs - Complete Tactical Nighttime Wide Area Surveillance, initiated in PE 0603640M - Conduct final demonstration and complete transition.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICAL SYSTEM (MEMS) NAVIGATION SYSTEM - Complete Micro-Electro-Mechanical (MEMS) Inertial Navigation System - Test and demonstrate a full Navigation System for hand-held targeting systems. EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE) - Complete Automated Processing for Spectral Exploitation and Dissemination (APSED) - Demonstrate an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) Image Processing architecture that includes EO to HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation. - Complete Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Demonstrate parts of the baseline design for a multi-model wide area sensor compatible with a small space, weight and power baseline. EC: EMW-FY16-01 DENSIFIED PROPELLANT FIRE FROM ENCLOSURE - CONFINED SPACE (FFE/CS) PROPULSION TECHNOLOGIES - Initiate Densified Propellant Fire From Enclosure - Confined Space (FFE/CS) Propulsion Technologies - Integrate rocket motor igniters with micro-electromechanical system ignition safety devices and multi-stage igniter plug designs to achieve warhead launch parameters.					
FY 2017 Base Plans: EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) - Complete Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Demonstrate tactical-level distributed jamming on multiple ground-based Electronic Warfare (EW) systems using realistic scenarios. - Complete Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Demonstrate the simultaneous reception and transmission of Electronic Warfare (EW) and blue-force communication waveforms using realistic scenarios. EC: EMW-FY16-01 DENSIFIED PROPELLANT FIRE FROM ENCLOSURE - CONFINED SPACE (FFE/CS) PROPULSION TECHNOLOGIES - Continued in PE 0603640M					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: EMW-FY17-01 HIGH RELIABILITY DPICM REPLACEMENT (HRDR) - Initiate High Reliability DPICM Replacement - Demonstrate with the 155mm M777A2 gun launch through modeling and simulation that High Reliability Dual-purpose Improved Conventional Munitions hardware will survive setback and gun balloting forces in order to activate the on-board power supply and initialize the arming sequence. ***FY 2017 OCO Plans:*** N/A					
Title: FORCE HEALTH PROTECTION (FHP)	14.946	16.797	15.048	0.000	15.048
Description: This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Force Health Protection (FHP) FNC pillar. The FHP Pillar develops deliverable technologies that provide new capabilities that provide Sailors and Marines with the best possible protection from operational threats by reducing morbidity and mortality when casualties occur. The FY 2015 to FY 2016 increase was due primarily to the planned ramp-up of FHP-FY13-03, FHP-FY14-01 and FHP-FY14-03. The FY 2016 to FY 2017 decrease was due primarily to the completion of FHP-FY11-01 and the planned ramp down of FHP-FY12-02, FHP-FY13-03 and FYP-FY14-01. ***FY 2015 Accomplishments:*** EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS) - Continue Multifunctional Blood Substitute (MFBS) - Formulate a resuscitation fluid that provides volume expansion and improves clotting in hemorrhaging combat casualties. EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM - Continue Automated Critical Care System (ACCS) - Develop autonomous hardware and software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario. EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue SEMPer Fi for Air Dysoxia - Research candidate drugs based on small and large animal testing for treatment of pulmonary hypertension. - Continue SEMPer Fi for Land Blast Kit -Perform small and large animal testing to validate therapeutic intervention and dosing with hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH - Continue Hypoxia Alert and Mitigation System - Utilize algorithms and early stage hardware prototypes to detect/predict onset of hypoxia or hypoxia-like symptoms for mountain operators, casualties, and aviators. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Begin early stage integration for fieldable wound cover to include novel outer cover materials and internal pharmaceutical coating that improve the clinical outcome of severe wounds. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Algorithm - Develop large animal injury profiles to design test parameters for an algorithm that integrates blast intensity data with cognitive impairment data to predict likelihood of brain injury after a given blast event. - Continue Neuro-Functional Assessment Tool - Integrate and test computer control interface subsystem for a non-psychometric device that detects and estimates severity of traumatic brain injury. - Continue Sensor - Develop preliminary hardware design of blast sensors that detects and quantifies acceleration, pressure, and impulse from a given blast event and outputs the data electronically.					
FY 2016 Plans: EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS) - Complete Multifunctional Blood Substitute (MFBS) - Formulate a resuscitation fluid that provides volume expansion and improves clotting in hemorrhaging combat casualties. EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Automated Critical Care System (ACCS) - Integrate down-selected hardware with an autonomous software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation scenario. EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA -Continue SEMPer Fi for Air Dysoxia - Perform down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypertension. - Continue SEMPer Fi for Land Blast Kit - Demonstrate an optimal treatment application and overall duration of therapeutic hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH - Continue Hypoxia Alert and Mitigation System - Execute laboratory testing to optimize hypoxia-detection algorithms intended for use in high altitude operations. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Integrate outer cover materials and an internal pharmaceutical coating into a single system to improve the clinical outcome of severe wounds on the battlefield. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Algorithm - Refine developmental algorithms using experimental data to integrate blast intensity data with cognitive impairment data to predict the likelihood of brain injury after single or multiple blast exposures. - Continue Neuro-Functional Assessment Tool - Identify and refine a non-psychometric device that detects and estimates the severity of traumatic brain injury. - Continue Sensor - Conduct optimization and testing of a self-powered blast sensor that detects and quantifies acceleration, pressure and impulse from a given blast event. ***FY 2017 Base Plans:*** EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Automated Critical Care System (ACCS) - Complete integration of software algorithms and hardware, and perform FDA tests/trials as required. EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA - Complete SEMPer Fi for Air Dysoxia - Finish down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypertension. - Complete SEMPer Fi for Land Blast Kit - Conduct final demonstration of an optimal treatment application and overall duration of therapeutic hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs. EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH - Complete Hypoxia Alert and Mitigation System - Adapt hypoxia alert system hardware/software to guide treatment of casualties in order to sustain performance during high-altitude mountain operations. EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL) - Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Integrate the bioactive coating and external conformal cover, conclude pre-clinical studies, and prepare for initiation clinical studies. EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST) - Continue Blast Load Assessment: Sense and Test (BLAST) (formerly sensor, algorithm, and neurofunctional assessment tool) - Formulate algorithms to guide medical evaluation decisions after exposure to potential traumatic brain injuries and provide scientific evidence for the development of safe blast exposure limits, enhance the neuro-functional assessment tool to discriminate between traumatic brain injury and other operational impacts, and integrate blast force data from the sensor into the predictive traumatic brain injury algorithm. EC: FHP-FY16-01 INCAPACITATION PREDICTION FOR READINESS IN EXPEDITIONARY DOMAINS - AN INTEGRATED COMPUTATIONAL TOOL (I-PREDICT)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate I-PREDICT - Incorporate the high strain rate characteristics of human tissues to allow accurate prediction of military type injuries. ***FY 2017 OCO Plans:*** N/A					
Title: FORCENET (FNT) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Forcenet (FNT) FNC Pillar. The FNT pillar develops deliverable technologies that provide new capabilities in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), networking, navigation, sensors, decision support, cyber-space, intelligence, and space technologies that will provide the architectural framework for naval warfare in the information age. The FY 2016 to FY 2017 increase was due primarily to the ramp up of FNT-FY14-02, FNT-FY15-01, FNT-FY15-02 and FNT-FY16-02, and the initiation of FNT-FY17-01, FNT-FY17-02 and FNT-FY17-04. ***FY 2015 Accomplishments:*** EC: FNT-FY10-02 ACTIONABLE INTELLIGENCE ENABLED BY PERSISTENT SURVEILLANCE - Complete Autonomous Unmanned Aerial Vehicle (UAV) Collision Avoidance System - Demonstrate autonomous collision avoidance system performance for all classes of aircraft or Unmanned Aerial Vehicles (UAV) in the National Airspace System (NAS). - Complete Ultra Wide Field of View (FOV) Area Surveillance System - Finish integration of flight-test optical hardware and image processing software into a prototype payload assembly. EC: FNT-FY10-03 SATELLITE COMMUNICATIONS (SATCOM) VULNERABILITY MITIGATION - Complete Multi-Link Common Data Link (CDL) System - Complete system integration and demonstration of a Multi-Link Common Data Link (CDL) System. EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE - Complete Pro-Active Computer Network Defense and Information Assurance (formerly known as Common Operational Security Decision System, Next Generation Security and Security Management Protocol, and Next Generation Sensors and Gateways) - Developed the Sensor anomaly detection algorithms and completed integration of the internal communication policy and messaging management modules for the COSDS, Gateway	53.637	51.657	59.633	0.000	59.633

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
and the Sensors. Completed the Course-of-Action User Interface controls for the COSDS and integrated the topolgy data and IP fetching cabilities into the COSDS visualization mechanism. EC: FNT-FY11-05 NRL SPACE - Complete Multi-INT Tracking - Develop real-time fusion algorithms and visualization techniques to detect, track and visualize current and historical maritime vessel track data. - Complete Tagging - Develop real-time fusion algorithms and visualization techniques to detect, track and visualize current and historical maritime vessel track data. EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL) - Continue Mission-Based Waveform Controls & Networking - Integrate completed waveforms into host terminal having NSA certification for field testing demonstration. EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE - Continue Autonomous Information-Based Surveillance Control - Integrate and test information based algorithms for UAV routing and patching. - Continue Contextual Enterprise Information - Adapt the analytical services framework and continue development of real-time enterprise exploitation algorithms for transition and participation in Cloud LTE - Continue Mobile Autonomous ISR to C2 Synchronization - Develop enterprise distributed software and begin work on a generalized solution. EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Integrate distributed EW communication and coordination techniques with operational Naval Command and Control and Combat Systems used on surface platforms. EC: FNT-FY13-03 SILK THREAD - Continue Product 1 - Conduct Advanced Technology Development. - Continue Product 2 - Conduct Advanced Technology Development. EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Develop, test and modify algorithms to enable cross-domain information fusion and optimize use of remote sensing assets.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Detection & Classification Algorithms (DCA) - Develop, test and modify algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Integrate new methods and demonstrate via simulation performance in limited bandwidth environments. - Continue Data Exfiltration and Networked Platform Interaction - Integrate components and evaluate performance in a size, weight and power package consistent with a sonobuoy. EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Initiate Advanced AEW Electronic Protection - Integrate and test E2-D electronic protection techniques. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Initiate Naval Tactical Cloud Analytics (formerly know as ASW Naval Tactical Cloud, EXW Naval Tactical Cloud and IAMD Naval Tactical Cloud) - Develop, integrate and validate, through Limited Technology Experiments , enhanced ASW, Expeditionary Warfare (EXW) and IAMD situational awareness, decision support analytics, and widgets through mission focused exploitation of all relevant cross-domain data within the Naval Tactical Cloud. EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Initiate Compact, Scalable Integrated RF (Compact-SIRF) - Integrate new techniques for data conversion and distribution in low size, weight and power analog RF and digital hardware within compact system design. - Initiate Electronic Warfare Tactical Decision Aid (EW-TACAID) - Integrate an intuitive EW display with an onboard integrated adaptive high fidelity training capability to improve the warfighters' ability to manage increasingly complex RF environments. - Initiate Scalable Integrated RF for Submarines (SIRF-Sub) - Integrate new techniques for data conversion and distribution with RF and digital hardware components for insertion into the next generation submarine EW system.					
FY 2016 Plans: EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL) - Complete Mission-Based Waveform Controls & Networking - Port baseline waveform and Anti-Access/Area Denial enhancements to reference implementation hardware for field testing and demonstration.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE - Complete Autonomous Information-Based Surveillance Control - Complete integration and testing of information based algorithms for Unmanned Aerial Vehicle (UAV) routing and pathing. - Complete Contextual Enterprise Information - Adapt the analytical services framework and finalize development of real-time enterprise exploitation algorithms for transition and participation in cloud-oriented limited technology experiments. - Complete Mobile Autonomous ISR to C2 Synchronization - Transition to MARCORSYSCOM a service that can track mission task readiness as a function of addressed information fulfillments and unaddressed information deficits. EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Integrate interactive Electronic Warfare displays and alternate communications methods into Navy surface ship combat systems and command and control doctrine. EC: FNT-FY13-03 SILK THREAD - Continue Silk Thread Product 1 - Conduct advanced technology development. - Continue Silk Thread Product 2 - Conduct advanced technology development. EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Develop, test and modify algorithms to enable cross-domain information fusion and optimize use of remote sensing assets. - Continue Detection & Classification Algorithms (DCA) - Develop, test and modify algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Integrate new methods and demonstrate their performance via simulation in limited bandwidth environments. - Continue Data Exfiltration and Networked Platform Interaction - Integrate components with selected waveforms and evaluate communication performance in packages consistent with the size, weight and power constraints of sonobuoys and unmanned underwater vehicles.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Continue Advanced AEW Electronic Protection - Conduct integration and testing of E-2D Advanced Hawkeye electronic protection techniques. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Continue Data Focused Naval Tactical Cloud (formerly called Naval Tactical Cloud Analytics) - Develop, integrate and validate through Limited Technology Experiments, enhanced ASW, IAMD and EXW situational awareness, decision support analytics and planning algorithms and widgets through mission focused exploitation of all relevant cross-domain data within the Naval Tactical Cloud. EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Continue Compact, Scalable Integrated RF (Compact-SIRF) - Demonstrate in the laboratory an initial modular Radio Frequency functionality for Size, Weight and Power (SWaP) restricted platforms. - Continue Electronic Warfare Tactical Decision Aid (EW-TACAID) - Demonstrate an Electronic Warfare display with an onboard, integrated, and adaptive high fidelity training capability to improve the warfighters' ability to manage increasingly complex Radio Frequency environments. - Continue Scalable Integrated RF for Submarines (SIRF-Sub) - Demonstrate in the laboratory initial techniques for high speed data conversion and multi-function Radio Frequency processing. EC: FNT-FY16-01 BUGLE - Initiate Bugle - Develop and test algorithms for integration into communication systems. EC: FNT-FY16-02 COMBINED EO/IR SURVEILLANCE AND RESPONSE SYSTEM (CESARS) - Initiate Multispectral EO/IR Countermeasures against Advanced Threats (MEIRCAT) - Develop and test an integrated, multiband laser and sensor architecture that is scalable and modular. - Initiate Shipboard Panoramic EO/IR Cueing and Surveillance System (SPECSS) - Develop and test an open architecture design for a panoramic, staring, imaging system.					
FY 2017 Base Plans: EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE - Continue EW Battle Management (EWBM) - Integrate Blue and Red force monitoring in Electronic Warfare (EW) planning and execution, and Navy communication and control doctrine.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY13-03 SILK THREAD - Continue Silk Thread Product 1 - Conduct advanced technology development. - Continue Silk Thread Product 2 - Conduct advanced technology development. EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS - Complete Adaptive Multi-Int Correlation & Identification (AMICA) - Develop, test and modify algorithms to enable cross-domain information fusion and optimization of theater and tactical battlespace assets to conduct anti-surface warfare. - Complete Detection & Classification Algorithms (DCA) - Develop, test and modify algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions. EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES - Continue Adaptive TCPED for ASW Services - Develop algorithms and software to assure network connectivity for low latency data sharing and autonomous and adaptive Command and Control (C2) services for coordination of data collection and sharing. - Continue Data Exfiltration and Networked Platform Interaction - Demonstrate and assess the performance of the radio components and waveforms in the host platform in simulated environments. EC: FNT-FY14-03 EXCHANGE OF ACTIONABLE INFORMATION AT THE TACTICAL EDGE (EAITE) - Continue from PE 0603640M Actionable Information Tactical Applications from PE 0603640M - Develop algorithms to assess the content of a machine produced product to a reference Information Requirement (IR) ontology. EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP) - Continue Advanced AEW Electronic Protection - Implement techniques to improve Advanced Hawkeye E2-D electronic protection capability. EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD - Continue Data Focused Naval Tactical Cloud - Test and evaluate new analytic services based on multi-source correlation (Environment, Combat Systems, C2, ISR, EW, Cyber and national/offboard ISR) using property graphs, applying probabilistic analytic models for improved target detection and for historical and predictive analytics supporting ASW, IAMD and EXW amphibious missions.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP) - Continue Scalable Integrated RF for Submarines (SIRF-Sub) - Demonstrate the ability to simultaneously run and change in real time different Electronic Warfare/Electronic INTelligence (EW/ELINT) processing capabilities on the same modular hardware. - Continue Compact, Scalable Integrated RF (Compact-SIRF) - Demonstrate in the laboratory an initial modular Broadband Radio Frequency (RF) front end coupled to a small Intelligence, Surveillance, and Reconnaissance (ISR) collection payload. - Continue Electronic Warfare Tactical Decision Aid (EW-TACAID) - Develop an intuitive Electronic Warfare display with an onboard integrated adaptive training capability to improve the ability of Electronic Support Measures to manage increasingly complex Radio Frequency environments. EC: FNT-FY16-01 BUGLE - Continue Bugle - Develop and test algorithms for integration into communication systems. EC: FNT-FY16-02 Combined EO/IR Surveillance and Response System (CESARS) - Continue Shipboard Panoramic EO/IR Cueing and Surveillance System (SPECSS) - Begin fabrication of staring, panoramic situational awareness sensors. - Continue Multispectral EO/IR Countermeasures against Advanced Threats (MEIRCAT) - Begin fabrication of the high resolution sensor. EC: FNT-FY17-01 COMMUNICATIONS AND INTEROPERABILITY FOR INTEGRATED FIRES (CIIF) - Initiate Communications as a Service (CaaS) - Develop, emulate and prototype multi-commodity flow optimization techniques and routing/bridging between Internet Protocol (IP) and non-IP networks with end-to-end Quality of Service (QoS). - Initiate Mission-based Networking for DDS (MiND) - Develop power-control, medium-access control and network topology/routing to enhance bandwidth and scalability, while creating a new Internet Protocol (IP) interface and maintaining interoperability with legacy Cooperative Engagement Capability (CEC) systems. EC: FNT-FY17-02 SUBMARINE SIMULTANEOUS TRANSMIT AND RECEIVE (SUBSTAR) - Initiate Submarine Simultaneous Transmit and Receive (SubSTAR) - Verify concept of submarine broadband antenna enabling simultaneous transmit and receive capability.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: FNT-FY17-04 RESILIENT HULL/INFRASTRUCTURE MECHANICAL & ELECTRICAL SECURITY (RHIMES) - Initiate SCAMM - Develop and demonstrate software algorithms that protect naval Hull, Mechanical and Electrical (HM&E) systems against cyber threats. - Initiate SCRAM - Develop and demonstrate information shaping cyber capabilities for tactical platforms. ***FY 2017 OCO Plans:*** N/A					
Title: POWER AND ENERGY (P&E) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Power and Energy (P&E) FNC pillar. The P&E Pillar develops deliverable technologies that provide new capabilities in energy security, efficient power and energy systems, high energy and pulse power. The FY 2016 to FY 2017 increase was due primarily to the ramp-up of P&E-FY15-03 and the initiation of P&E-FY17-02. ***FY 2015 Accomplishments:*** EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER - Continue Renewable Thermal Engine - Continue fabrication and prototype assembly to include signature and susceptibility requirements as well as deployment/stowage mechanisms. EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Continue Air Independent Propulsion System - Integrate system components for packaging and demonstration in a prototype Unmanned Underwater Vehicle energy section hull. EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS - Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Conduct testing to Phase 1 metrics, select Phase 2 performer, and initiate Phase 2 development, to include reduced scale testing of candidate protection methods in a relevant power system environment. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY	10.603	10.024	16.641	0.000	16.641

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Compact High Density Tactical Energy Storage - Develop multifunction energy storage module control, interface, thermal management and containment subcomponents for tactical application. - Initiate Multi-Function High Density Shipboard Energy Storage - Develop full scale ship multifunction energy storage module control, interface, thermal management and containment subcomponents for shipboard applications.					
FY 2016 Plans: EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER - Complete Renewable Thermal Engine - Conduct full-scale testing and a TRL 6 demonstration, and deliver tactical power system prototype to USMC transition sponsor. EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Continue Air Independent Propulsion System - Conduct Phase II fuel cell energy system integration into a UUV energy section and conduct TRL-6 land-based testing and transition planning. EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS - Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Develop final Phase II design for prototype circuit protection devices and initiate development of the devices and the associated test environment. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY - Continue Compact High Density Tactical Energy Storage - Develop and test a multifunction energy storage module system, which integrates target subcomponent technologies. - Continue Multi-Function High Density Shipboard Energy Storage - Develop a subscale ship multi-function energy storage module integrated system and conduct initial shipboard testing.					
FY 2017 Base Plans: EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION - Complete Air Independent Propulsion System - Conduct Phase II fuel cell energy system integration into a UUV energy section and conduct TRL-6 land-based testing and transition planning. EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Select the appropriate 20kV semiconductor devices and develop the related circuit topology and fault sensing algorithms. EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY - Continue Multi-Function High Density Shipboard Energy Storage - Develop a ship multi-function energy storage module integrated system and complete development of a safe non-propagating battery subsystem. - Continue Compact High Density Tactical Energy Storage - Initiate development of a full scale multifunction energy storage module with hybrid power system interface. EC: P&E-FY17-02 TORPEDO ADVANCED PROPULSION SYSTEM (TAPS) - Initiate Torpedo Advanced Propulsion System (TAPS) - Initiate limited component development and testing. ***FY 2017 OCO Plans:*** N/A					
Title: SEA BASING (BAS) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Basing (BAS) FNC pillar. The BAS Pillar develops deliverable logistics, shipping and at-sea transfer technologies that provide new capabilities for projecting expeditionary force from the sea base and providing sea based joint operational independence through improved connector, at-sea transfer and shipboard logistical capabilities. The FY 2015 to FY 2016 decrease was due to the completion of BAS-FY07-02 and the planned ramp-down of BAS-FY11-01. The FY 2016 to FY 2017 decrease was due to the completion of BAS-FY11-01. ***FY 2015 Accomplishments:*** EC: BAS-FY07-02 SURFACE CONNECTOR VEHICLE TRANSFER - Complete Interface Ramp Technologies development - Conduct final American Bureau of Shipping (ABS) certification and testing of the JHSV ramp. EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE	11.693	3.934	0.000	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Advanced Mooring System - Conduct integration, testing, and demonstration of the Advanced Mooring System S&T demonstrator at full-scale in a relevant environment. - Continue Environmental Ship Motion Forecasting - Complete integration and testing of environmental and ship motion sensor and forecasting system. ***FY 2016 Plans:*** EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE - Complete Advanced Mooring System - Demonstrate a fully capable advanced mooring system and transition it to sponsors. - Complete Environmental Ship Motion Forecasting - Develop wave and ship motion forecasting technologies. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A					
Title: SEA SHIELD (SHD) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Shield (SHD) FNC pillar. The SHD Pillar develops deliverable technologies that provide new capabilities in theater air and missile defense, anti-submarine warfare, mine countermeasures, defensive surface warfare, global defensive assurance, anti-terrorism, and fleet/force protection. The FY 2015 to FY 2016 increase was due primarily to the planned ramp-up of SHD-FY14-04 and SHD-FY14-08, the delayed initiation of SHD-FY15-03, and the initiation of SHD-FY16-04, SHD-FY16-05, SHD-FY16-06, SHD-FY16-07 and SHD-FY16-OSD. The FY 2016 to FY 2017 decrease was due primarily to the completion of SHD-FY10-01, SHD-FY10-03, SHD-FY11-01, SHD-FY12-01 and SHD-FY12-03, the planned ramp down of SHD-FY13-05, SHD-FY14-02 and SHD-FY16-05, and the movement of SHD-FY16-OSD out of the FNC Program into PE 0603782N. ***FY 2015 Accomplishments:*** EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES	72.382	80.274	68.870	0.000	68.870

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Conduct hardware-in-the-loop testing of the ELGA guidance algorithm. - Continue Enhanced Maneuverability Missile Airframe (EMMA) - Conduct risk reduction rocket motor testing to demonstrate performance against exit criteria. EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM - Complete Integrated Forward looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Conduct forward looking sonar dual frequency synthetic aperture sonar algorithm development and conduct at-sea experimentation and demonstration. - Continue Long Range LFBB Sonar (AUV Platform Option) - Demonstrate at-sea performance of the Long Range LFBB sonar in a relevant environment. - Complete Very Shallow Water (VSW) Acoustic Color-Imaging Sonar - Conduct final testing required for transition. EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING - Continue Vector Sensor Towed Array - Develop and deliver a thin-line Vector Sensor Towed Array (VSTA) system and demonstrate thin-line twin-line capability in a single array. - Complete Vector Sensor Towed Array Signal Processing - Deliver sonar signal processing hardware and software for experimentation and transition into the Advanced Processor Build for FY-17. EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM - Continue Torpedo Common Hybrid Fuzing System - Conduct system integration, field testing and demonstration of a prototype system. EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD) - Continue Radar Resource Manager for IAMD - Conduct end-to-end testing to validate algorithms. EC: SHD-FY12-03 SONAR AUTOMATION - Continue Active Sonar Automation - Develop tools, utilizing new algorithms, for use in current active sonar systems that improve operator performance and reduce workload.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Passive Sonar Automation - Develop tools utilizing new algorithms for use in current passive sonar systems that improve operator performance and reduce operator workload when used against quiet submarines in the presence of clutter. EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Continue Compact Modular Sensor-Processing Suite (CMSS) - Integrate LIDAR into compact configuration and initiate data collection flight tests. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Continue Cooperative Networked Radar - Integrate and test cross platform radar operation. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8 - Continue Next Generation Multistatic Active Capability (NGMAC) - Improve and evaluate the performance of hardware and software for use in improving the Multistatic Active Capability sonobuoys and P-8A signal processing. - Continue Unmanned Targeting Air System (UTAS) - Integrate Compact magnetometers into the Unmanned Air System (UAS) candidates and develop test plans for a maneuver table to compare Tier 1 and Tier 2 UAS's for the ASW mission. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Continue USV-based Mine Neutralization (formerly called Drifting Mine Neutralization Technology) - Develop and modify processing and hardware for neutralization technologies. Continue MCM Payload Automation for Data Analysis (Formerly a technology component of MCM Payload Automation) - Integrate and modify technologies for mine countermeasures automatic target recognition. - Continue MCM Payload Automation for Planning (Formerly a technology component of MCM Payload Automation) - Integrate and modify processing, autonomy, and control technologies for mine warfare environmental decision aid library. - Continue Single Sortie MCM Detect-to-Engage Payload - Design and develop launch, recovery, communication, recharging systems, and associated algorithms/vehicle payload support hardware. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue ATT Timeline Compression (ATTTC) - Conduct real-time coding of bistatic detection and automatic preset/launch sequence. - Continue Concept C Countermeasure - Conduct hardware fabrication. - Continue HVU Mounted Sonar - Begin component prototype development of transducer array and electronics. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS) - Continue Autonomous Threat Detection and Localization - Build initial AUWS sensor nodes and integrate them into the Build initial AUWS sensor nodes. - Continue Remote Command & Control - Build and integrate the AUWS communications packages into the AUWS nodes, and conduct functional testing. - Continue Tactical Positioning & Fire Control - Build the AUWS node deployment modules, integrate into a UUV test-bed, and conduct functional testing. EC: SHD-FY14-08 TERMINATOR (T3) - Continue Terminator S - Conduct modeling and simulation testing of the algorithm in a realistic environment. - Continue Terminator E - Conduct modeling and simulation testing of the algorithm in a realistic environment. - Continue Terminator R - Conduct modeling and simulation testing of the algorithm in a realistic environment. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Initiate Hyper Velocity Projectile - Design, fabricate and begin assembly of hypervelocity projectiles in preparation for full-up launch to validate common interfaces for powder gun and railgun launch.					
FY 2016 Plans: EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES - Complete Enhanced Lethality Guidance Algorithms (ELGA) - Demonstrate and validate the guidance algorithm with respect to exit criteria. - Complete Enhanced Maneuverability Missile Airframe (EMMA) - Demonstrate the dual pulse rocket motor and integrated thrust vector control, and deliver the final rocket motor design. EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM - Complete Long Range LFBB Sonar (AUV Platform Option) - Perform final system demonstration and exit event.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING - Complete Vector Sensor Towed Array - Finalize the demonstration of a thin, twin-line capability in a single array. EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM - Complete Torpedo Common Hybrid Fuzing System - Conduct final field testing, demonstrate a prototype system, and transition the system to acquisition for engineering development. EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD) - Complete Radar Resource Manager for IAMD - Conduct a final demonstration of the Radar Resource Manager and validate the technology deliverable with respect to exit criteria. EC: SHD-FY12-03 SONAR AUTOMATION - Complete Active Sonar Automation - Evaluate and deliver algorithms for use in current active sonar systems that improve operator performance and reduce workload. - Complete Passive Sonar Automation - Evaluate and deliver algorithms for use in current passive sonar systems that improve operator performance and reduce workload when used against quiet submarines in the presence of clutter. EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Continue Compact Modular Sensor-Processing Suite (CMSS) - Demonstrate multi-sensor detection of ocean mines from a manned helicopter. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Continue Cooperative Networked Radar - Conduct integration and testing for cross platform radar operation. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8 - Continue Next Generation Multistatic Active Capability (NGMAC) - Improve and evaluate the performance of hardware and software for use in improving the Multistatic Active Capability sonobuoys and P-8A signal processing.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete Unmanned Targeting Air System (UTAS) - Integrate compact magnetometers into Unmanned Air System (UAS) candidates and develop test plans for a maneuver table to compare Tier 1 and Tier 2 UAS's for the ASW mission. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Continue MCM Payload Automation for Data Analysis - Develop and extend adaptive Automatic Target Recognition approaches to advanced environmental models supporting Net-centric Sensor Analysis for MIW (NSAM). - Continue MCM Payload Automation for Planning - Develop and extend adaptive Automatic Target Recognition approaches to advanced environmental models supporting the Mine-warfare Environmental Decision-Aid Library (MEDAL). - Continue Single Sortie MCM Detect-to-Engage Payload - Design and develop launch, recovery, communications, and recharging systems, and associated algorithms and vehicle payload support hardware. - Continue USV-based Mine Neutralization - Develop and modify the processing and hardware for neutralization technologies. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE - Continue Concept C Countermeasure - Develop test plan for array design improvements. - Continue ATT Timeline Compression (ATTTC) - Begin in-water demonstrations. - Complete HVU Mounted Sonar - Complete array electronics and fabricate the first transmit/receive panels, validating performance in a lake test. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS) - Continue Autonomous Threat Detection and Localization - Develop and integrate node deployment modules and the weapons payload, and conduct functional testing. - Continue Remote Command & Control - Develop communications package improvements and conduct functional component and system testing. - Continue Tactical Positioning & Fire Control - Conduct testing and evaluation, and integrate improved sensor node hardware and detection, classification, localization and targeting algorithms. EC: SHD-FY14-08 TERMINATOR (T3) - Continue Terminator S (formerly Terminator E, R and S) - Validate the Ship Self-Defense System (SSDS) algorithm and the fire control loop concept using modeling and simulation tools.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: SHD-FY15-03 AUTOMATION FOR UXV-BASED MCM - Initiate MCM Task Force Planning - Extend algorithms for squadron-level planning and re-planning. - Initiate Expeditionary MCM Automated Data Analysis - Develop advanced automatic target recognition capabilities for Synthetic Aperture Sonar (SAS) and closed-aperture SAS. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Continue Hyper Velocity Projectile - Design, fabricate and begin assembly of hypervelocity projectiles in preparation for a full-up launch to validate common interfaces for powder gun and railgun launch. EC: SHD-FY16-04 SHIP-LAUNCHED EW EXTENDED ENDURANCE DECOY (SEWEED) - Initiate Ship-launched EW Extended Endurance Decoy (SEWEED) - Build mockups of the fuselage, rotor and antenna cavity for RF payload antenna isolation experiments. EC: SHD-FY16-05 SURFACE SHIP PERISCOPE DETECTION AND DISCRIMINATION (SSPDD) - Initiate Surface Ship Periscope Detection and Discrimination (SSPDD) - Customize hardware interfaces for assembly and integration of system level components. EC: SHD-FY16-06 NEXT GENERATION AIRBORNE PASSIVE SYSTEM (NGAPS) - Initiate Next Generation Airborne Passive System (NGAPS) - Develop algorithms and hardware for field communications control, health monitoring, mission planning and contact separation and correlation. EC: SHD-FY16-07 SOFTKILL PERFORMANCE AND REAL-TIME ASSESSMENT (SPARTA) - Initiate Softkill Performance and Real-Time Assessment (SPARTA) - Develop and optimize performance assessment algorithms, and align them with a pending system requirements review. EC: SHD-FY16-OSD MODULAR UNDERSEA EFFECTORS (MUSE) - Initate Modular UnderSea Effectors (MUSE) - Commence design of delivery and mooring approaches, technologies to integrate UUV-based and encapsulated undersea weapons, and prototyping of advanced sensors.					
FY 2017 Base Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES - Complete Compact Modular Sensor-Processing Suite (CMSS) - Complete Compact Modular Sensor-Processing Suite (CMSS) - Demonstrate multi-sensor detection of ocean mines from a manned helicopter. EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR - Complete Cooperative Networked Radar - Test and demonstrate software algorithms and techniques for cross-platform radar operation deliver enhanced sensitivity. EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8 - Complete Next Generation Multistatic Active Capability (NGMAC) - Demonstrate the Next Generation Multistatic Active Capability sonobuoys in a relevant at sea Navy environment. EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES - Complete USV-based Mine Neutralization - Perform final system demonstration of Neutralizer Test Bed and associated technologies. - Complete Single Sortie MCM Detect-to-Engage Payload - Perform final system demonstration of launch, recovery, communications, recharging systems, and associated algorithms/vehicle payload support hardware. - Complete MCM Payload Automation for Data Analysis - Demonstrate system-level Automatic Target Recognition (ATR) capability at technology development exit event. - Complete MCM Payload Automation for Planning - Demonstrate component level risk analysis in war game exit event. EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE - Continue ATT Timeline Compression (ATTTC) - Conduct in-water component testing and data collection. - Continue Concept C Countermeasure - Conduct bench testing of array design improvements and prepare for in-water tests. EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS) - Continue Tactical Positioning & Fire Control - Demonstrate node deployment modules & weapons payload integration. - Continue Autonomous Threat Detection and Localization - Develop final sensor node hardware/software and perform functional testing.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Remote Command & Control - Demonstrate an integrated communications package. EC: SHD-FY14-08 TERMINATOR (T3) - Continue Terminator S (formerly Terminator E, R and S) - Validate the Ship Self-Defense System (SSDS) algorithm and the fire control loop concept using modeling and simulation tools. EC: SHD-FY15-03 AUTOMATION FOR UXV-BASED MCM - Continue MCM Task Force Planning - Develop approach to automate data management from Naval message traffic to support re-planning, scheduling, and situational awareness. - Continue Expeditionary MCM Automated Data Analysis - Extend in situ retraining algorithms to multi-band advanced sonar systems. EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE - Continue Hyper Velocity Projectile - Design, fabricate and begin assembly of hypervelocity projectiles in preparation for a full-up launch to validate common interfaces for powder gun and railgun launches. EC: SHD-FY16-04 SHIP-LAUNCHED EW EXTENDED ENDURANCE DECOY (SEWEED) - Continue Ship-launched EW Extended Endurance Decoy (SEWEED) - Build mockups of the fuselage, rotor, and antenna cavity for RF payload antenna isolation experiments. EC: SHD-FY16-05 SURFACE SHIP PERISCOPE DETECTION AND DISCRIMINATION (SSPDD) - Continue Surface Ship Periscope Detection and Discrimination (SSPDD) - Customize hardware interfaces for assembly and integration of system level components. EC: SHD-FY16-06 NEXT GENERATION AIRBORNE PASSIVE SYSTEM (NGAPS) - Continue Next Generation Airborne Passive System (NGAPS) - Integrate algorithms with hardware for field communications, control, health monitoring, mission planning and contact separation and correlation. EC: SHD-FY16-07 SOFTKILL PERFORMANCE AND REAL-TIME ASSESSMENT (SPARTA) - Continue Softkill Performance and Real-Time Assessment (SPARTA) - Develop and optimize performance assessment algorithms and align them with a pending system requirements review. EC: SHD-FY16-OSD MODULAR UNDERSEA EFFECTORS (MUSE)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued in PE 0603782N. EC: SHD-FY17-02 AUTONOMOUS UNMANNED SURFACE VEHICLES FOR MINE WARFARE (MIW) - Initiate Autonomous Situational Awareness and Hazard Avoidance System for USVs - Integrate autonomous control on an Unmanned Surface Vehicle (USV) and demonstrate at-sea. - Initiate High Temperature Superconducting (HTS) Magnetic Influence Sweep Payload for USVs - Integrate the superconducting system on an Unmanned Surface Vehicle (USV) and demonstrate at-sea. - Initiate Underway Refueling and Data Transfer for USVs and RMMVs - Integrate underway refueling and data transfer technology with Unmanned Surface Vehicles (USVs) and Remote Multi-Mission Vehicles (RMMVs) and demonstrate at-sea. EC: SHD-FY17-05 DEEP RELIABLE ACOUSTIC PATH EXPLOITATION SYSTEM (DRAPES) - Initiate Deep Reliable Acoustic Path Exploitation System (DRAPES) - Integrate algorithms and hardware for undersea communications, health monitoring, and contact separation and correlation. ***FY 2017 OCO Plans:*** N/A					
Title: SEA STRIKE (STK) ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE. The Sea Strike (STK) FNC pillar develops deliverable technologies that provide new capabilities in power projection and deterrence, precise and persistent offensive power, weapons, aircraft, and expeditionary warfare. The FY 2015 to FY 2016 decrease was due primarily to the completion of STK-FY09-03, STK-FY11-01 and STK-FY11-02. The FY 2016 to FY 2017 increase was due primarily to the planned ramp-up of STK-FY15-01, STK-FY15-02, STK-FY16-01 and STK-FY17-04. ***FY 2015 Accomplishments:*** EC: STK-FY09-03 ENHANCED WEAPONS TECHNOLOGIES - Complete Counter Air Defense Improvements - Finish propulsion system, manufacture hardware, cast propellant grains, assemble rocket motors and test in both performance and insensitive munitions conditions.	46.205	45.365	47.467	0.000	47.467

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue High Speed Components - Resolve testing issues and prepare for additional testing required for transition. EC: STK-FY11-01 STRIKE ACCELERATOR - Complete Strike Accelerator - Transition new technologies that enable utilizing tactical aircraft Radar and forward looking infrared sensors to quickly identify and target maritime threats at extended range. EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP) - Complete Identification and Defeat of EA Systems (IDEAS) - Integrate and test highly robust EW techniques that protect U.S. forces from Advanced Electronic Attack Systems. - Complete Network "Sentric" Electronic Protection (EP) - Integrate and test techniques for APG-79 electronic protection. EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE - Continue Coherent Electronic Attack for Submarines (CEAS) - Integrate robust and highly advanced electronic attack techniques to provide a collaborative electronic attack capability against surface targets. EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Integrate and test algorithms for moving maritime RF identification. EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION - Continue Hostile Fire Suppression System - Continue visible dazzle effectiveness requirements experiments. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Conduct Phase I demonstration. EC: STK-FY13-04 AIM-9X ENABLERS (AXE) - Continue SMOKE - Develop an advanced kinematic improvement to the AIM-9X Sidewinder missile. EC: STK-FY14-01 BANK SHOT - Continue Bank Shot - Develop the software architecture and associated algorithms that provide for fusion of passive sensor data.					

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Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Demonstrate software operability and inter-operability for flexible weapon behaviors at the salvo level in an Anti-Access, Area Denial environment. - Continue Collaborative Electronic Attack (CEA) - Integrate robust and highly advanced electronic attack techniques to provide a collaborative electronic attack capability against surface targets. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Initiate Synthetic Aperture Radar Electronic Protection - Integrate and test synthetic aperture radar electronic protection algorithms and techniques. EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Initiate Helicopter Active RPG Protection (HARP) - Demonstrate the technological feasibility of a Rocket Propelled Grenade (RPG) hard-kill defense system and its component operability on the MV-22. - Initiate Multi-Spectral EO/IR Seeker Defeat - Integrate existing and developmental EO/IR diode sources into the existing Counter Measure Jammer free space and fiber based optical designs. EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Initiate MUHV Autonomy Suite - Initiate open-loop testing of the autonomy suite. - Initiate MUHV Sensors, Navigation and Guidance - Initiate communication system open-loop testing. EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT) - Continue Extended-Range Targeting (E-RAT) - Develop concept and technology demonstration plans of subsystem models to assess the feasibility and operability of new technologies for targeting and fire control modes at extended ranges. EC: STK-FY17-04 ALPO - Initiate ALPO - Begin the technological feasibility and assessment phase of an advanced signal processing system.					
FY 2016 Plans: EC: STK-FY09-03 ENHANCED WEAPONS TECHNOLOGIES - Complete High Speed Components - Finish development and conduct final testing required for transition.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE - Complete Coherent Electronic Attack for Submarines (CEAS) - Develop prototype hardware and software for insertion of advanced electronic support and electronic attack techniques into a payload form factor consistent with compact applications, including submarine masts. EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Conduct integration and testing for moving maritime Radio Frequency identification algorithms. EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION - Complete Hostile Fire Suppression System - Demonstrate real-time reactive hostile shooter suppression in a field test demonstration. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Demonstrate and evaluate relevant algorithms during at-sea testing. EC: STK-FY13-04 AIM-9X ENABLERS (AXE) - Continue SMOKE - Design, develop and demonstrate an advanced propulsion system for a future Air-to-Air missile. EC: STK-FY14-01 BANK SHOT - Continue Bank Shot - Develop the software architecture and associated algorithms that provide for data fusion. EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Demonstrate software operability and inter-operability for flexible weapon behaviors at the salvo level in an Anti-Access, Area-Denial environment. - Continue Collaborative Electronic Attack (CEA) - Integrate and test highly advanced electronic attack techniques to provide an advanced collaborative electronic attack capability against surface targets. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Continue Synthetic Aperture Radar Electronic Protection - Conduct integration and testing of synthetic aperture radar electronic protection algorithms and techniques.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Continue Helicopter Active RPG Protection (HARP) - Demonstrate the technological feasibility of a Rocket Propelled Grenade (RPG) hard-kill defense system and its component operability on the MV-22. - Continue Multi-Spectral EO/IR Seeker Defeat - Develop Electro-Optical/Infrared (EO/IR) countermeasure high power sources and supporting optics that can be integrated into Joint and Allied systems. EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Continue MUHV Autonomy Suite - Conduct in-water autonomy open-loop testing. - Continue MUHV Sensors, Navigation and Guidance - Conduct in-water navigation system demonstrations (open and closed loop). EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT) - Continue Extended-Range Targeting (E-RAT) - Conduct concept and technology demonstrations of subsystem models to assess the feasibility and operability of new technologies for targeting and fire control modes at extended ranges. EC: STK-FY16-02 REACTIVE ELECTRONIC ATTACK MEASURES (REAM) - Initiate Reactive Electronic Attack Measures (REAM) - Develop a test bed for testing enhanced Radio Frequency sensing algorithms and an integration strategy for targeted transition systems. EC: STK-FY17-04 ALPO - Continue ALPO - Begin development of an advanced signal processing system in a relevant tactical environment.					
FY 2017 Base Plans: EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID - Continue Long Range Find, Fix and ID - Test and verify performance of algorithms for achieving Radio Frequency (RF) identification of moving maritime contacts. EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE - Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Evaluate system performance based during in-water testing.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
EC: STK-FY13-04 AIM-9X ENABLERS (AXE) - Continue SMOKE - Design, develop and demonstrate an advanced propulsion system for a future Air-to-Air missile. EC: STK-FY14-01 BANK SHOT - Complete Bank Shot - Develop the software architecture and associated algorithms that provide for data fusion. EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE) - Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Demonstrate software operability and interoperability for flexible weapon behaviors at the salvo level in an Anti-Access, Area-Denial environment. - Continue Collaborative Electronic Attack (CEA) - Perform lab testing of Collaborative Peer-to-Peer Adaptable Electronic Warfare (EW) Mission Prioritization and threat classification algorithms. EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP) - Continue Synthetic Aperture Radar Electronic Protection - Test algorithms and techniques to improve synthetic aperture radar electronic protection. EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) - Continue Helicopter Active RPG Protection (HARP) - Demonstrate the technological feasibility of a Rocket Propelled Grenade (RPG) hard-kill defense system and its component operability. - Continue Multi-Spectral EO/IR Seeker Defeat - Begin subcomponent design integration of the Electro-Optic (EO) source to be used in combination with an existing Infra-Red CounterMeasures (IRCM) Laser to support transition. EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV) - Continue MUHV Autonomy Suite - Conduct open-loop in-water demonstrations of autonomy algorithms for mission planning, waypoint navigation, and vehicle health assessment. - Continue MUHV Sensors, Navigation and Guidance - Conduct in-water demonstrations of multiband and hybrid sonar, inertial navigation, and fiber optic systems. EC: STK-FY16-01 EXTENDED-RANGE TARGETING (E-RAT)					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Extended-Range Targeting (E-RAT) - Conduct technology concept demonstrations of subsystem models to assess the feasibility and operability of new technologies for the targeting and fire control modes at extended ranges. EC: STK-FY16-02 REACTIVE ELECTRONIC ATTACK MEASURES (REAM) - Continue Reactive Electronic Attack Measures (REAM) - Design and integrate adaptive capabilities into an advanced prototype within an existing Electronic Attack (EA) suite subsystem and adaptive threat simulator. EC: STK-FY17-04 ALPO - Continue ALPO - Continue technology development of an advanced signal processing system in a relevant tactical environment. ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	252.971	258.562	249.092	0.000	249.092

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

As discussed in Section A, there are a significant number of FNC technology products within this PE. In all cases, these technology products support the Department of the Navy's FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs) that control the naval pillars of Sea Shield, Sea Strike, Sea Basing, Forcenet, Naval Expeditionary Maneuver Warfare, Enterprise and Platform Enablers, Power and Energy, Capable Manpower, and Force Health Protection. Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning and adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	4.835	7.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.835

A. Mission Description and Budget Item Justification

The efforts described in this Project address the Advanced Technology Development associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy's Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: ASW Research Prog - Cong	4.835	7.000
FY 2015 Accomplishments: Anti-Submarine Warfare (ASW) surveillance efforts have been successfully used to address field experimentation and algorithm development. FY2015 Details are classified but involve understanding upper ocean acoustic structure to address passive detection opportunities, numerical modeling to understand ocean clutter impeding detection and creating false alarms, and new sensor opportunities. Numerical modeling has been completed for the initial conops evaluation and are being provided to USN for consideration.		
FY 2016 Plans: Expand field experimentation into new environments to further refine understanding of upper ocean acoustical phenomena for passive detection.		
Congressional Adds Subtotals	4.835	7.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

In all cases, FNC technology products support the Department of the Navy's FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs). Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 9999 / *Congressional Adds*

technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning and adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680N *I (U)Manufacturing Technology Program*

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	0.000	0.000	57.074	56.712	-	56.712	57.797	58.832	60.706	60.711	Continuing	Continuing
1050: *Manufacturing Tech*	0.000	0.000	57.074	56.712	-	56.712	57.797	58.832	60.706	60.711	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Manufacturing Technology (ManTech) Program is intended to improve the productivity and responsiveness of the U.S. defense industrial base by funding the development, optimization, and transition of enabling manufacturing technologies to key naval suppliers. In general, investments transition emerging Science and Technology (S&T) results to acquisition programs; improve industrial capabilities in production, maintenance, repair and industrial base responsiveness; and advance manufacturing technology to reduce cost, improve performance, and responsiveness. Currently, the ManTech Program is focused on affordability improvements for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Key platforms currently targeted include: VIRGINIA Class Submarine (VCS)/ OHIO Replacement Program (ORP); DDG 51 Class Destroyer; CVN 78 Class Carrier; Joint Strike Fighter (JSF); and CH-53K Heavy Lift Helicopter. ONR ManTech helps these Navy programs achieve their respective affordability goals by transitioning developed manufacturing technology which, when implemented, results in needed cost reduction or cost avoidance.

This Program Element, new as of FY16, is the result of the re-alignment of funds from PE Industrial Preparedness 0708011N and the Manufacturing Science and Technology activity from PE 0603758N.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	0.000	57.074	57.955	-	57.955
Current President's Budget	0.000	57.074	56.712	-	56.712
Total Adjustments	0.000	0.000	-1.243	-	-1.243
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Rate/Misc Adjustments	0.000	0.000	-1.243	-	-1.243

Change Summary Explanation

Technical: Not applicable.
Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603680N / *(U)Manufacturing Technology Program*	Project (Number/Name) 1050 / *Manufacturing Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
1050: *Manufacturing Tech*	0.000	0.000	57.074	56.712	-	56.712	57.797	58.832	60.706	60.711	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Manufacturing Technology (ManTech) Program is intended to improve the productivity and responsiveness of the U.S. defense industrial base by funding the development, optimization, and transition of enabling manufacturing technologies to key naval suppliers. In general, investments transition emerging Science and Technology (S&T)results to acquisition programs; improve industrial capabilities in production, maintenance, repair and industrial base responsiveness; and advance manufacturing technology to reduce cost, improve performance, and responsiveness. Currently, the ManTech Program is focused on affordability improvements for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Key platforms currently targeted include: VIRGINIA Class Submarine (VCS)/ OHIO Replacement Program (ORP); DDG 51 Class Destroyer; CVN 78 Class Carrier; Joint Strike Fighter (JSF); and CH-53K Heavy Lift Helicopter. ONR ManTech helps these Navy programs achieve their respective affordability goals by transitioning developed manufacturing technology which, when implemented, results in needed cost reduction or cost avoidance.

This Program Element, new as of FY16, is the result of the re-alignment of funds from PE 0708011N and the Manufacturing Science and Technology R2A activity from PE 0603758N.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Composites Processing and Fabrication	0.000	6.000	5.871	0.000	5.871
Description: The primary technical goal of the Composites Processing and Fabrication activity is improving weapon systems affordability, enhancing weapon system effectiveness and improving reliability/war-fighter readiness through the increased utilization of composite materials and structures. This is being achieved through the development, maturation, and transition of affordable and robust manufacturing, assembly, and repair processes that fully exploit the benefits of composite materials. Concentration is on affordability for the following platforms: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter. Funding for FY 2016 and beyond has been re-aligned from PE 0708011N and PE 0603758N. At the R2A level, FY 2016 Funding of $4.800M from Composites Processing and Fabrication in PE 0708011N and funding of $1.200M from Manufacturing Technology S&T from PE06030758N has been re-aligned to PE 0603680N Composites Processing and Fabrication for a total of $6.000M.					
FY 2015 Accomplishments:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
FY 2016 Plans: - Initiate Composite Materials and Process Improvement Thrust for VCS/ORP Affordability Initiative. Includes efforts to develop/optimize composite materials fabrication technology for reduced cost VCS and ORP construction. - Initiate Composite Materials and Process Improvement Thrust for DDG-51 Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost DDG-51 construction. - Initiate Composite Materials and Process Improvement Thrust for CVN-78 Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost CVN-78 construction. - Initiate Composite Materials and Process Improvement Thrust for JSF Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost JSF construction. - Initiate Composite Materials and Process Improvement Thrust for CH-53K Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost CH-53K construction. - Initiate Composite Materials and Process Improvement Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components.					
FY 2017 Base Plans: - Continue Composite Materials and Process Improvement Thrust for VCS/ORP Affordability Initiative. Includes efforts to develop/optimize composite materials fabrication technology for reduced cost VCS and ORP construction. - Continue Composite Materials and Process Improvement Thrust for DDG-51 Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost DDG-51 construction. - Continue Composite Materials and Process Improvement Thrust for CVN-78 Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost CVN-78 construction. - Continue Composite Materials and Process Improvement Thrust for JSF Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost JSF construction. - Continue Composite Materials and Process Improvement Thrust for CH-53K Affordability Initiative. Includes efforts to develop / optimize composite materials fabrication technology for reduced cost CH-53K construction. - Continue Composite Materials and Process Improvement Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: Electronics Processing and Fabrication	0.000	11.500	11.253	0.000	11.253

Description: The primary technical goal of the Electronics Processing and Fabrication activity is improving electronic weapon systems affordability by developing and transitioning affordable, robust manufacturing processes and capabilities for electronics critical to defense applications over their full life-cycle. Efforts create new and improved electronics/electro-optics manufacturing processes for transition to the production floor. Emphasis is on affordability for the following shipbuilding platforms: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter.

Funding for FY 2016 and beyond has been re-aligned from PE 0708011N and PE 0603758N. At the R2A level, FY 2016 Funding of $10.543M from Electronics Processing and Fabrication in PE 0708011N and funding of $0.957M from Manufacturing Technology S&T from PE06030758N has been re-aligned to PE 0603680N Electronics Processing and Fabrication for a total of $11.500M.

FY 2015 Accomplishments:
N/A

FY 2016 Plans:
- Initiate Electronics/Electro-Optics Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for VCS and ORP construction.
- Initiate Electronics/Electro-Optics Thrust for DDG-51 Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for DDG-51 construction.
- Initiate Electronics/Electro-Optics Thrust for CVN-78 Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for CVN-78 construction.
- Initiate Electronics/Electro-Optics Thrust for JSF Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for JSF construction.
- Initiate Electronics/Electro-Optics Thrust for CH-53K Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for CH-53K construction.
- Initiate Electronics/Electro-Optics Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components.

FY 2017 Base Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continue Electronics/Electro-Optics Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for VCS and ORP construction. - Continue Electronics/Electro-Optics Thrust for DDG-51 Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for DDG-51 construction. - Continue Electronics/Electro-Optics Thrust for CVN-78 Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for CVN-78 construction. - Continue Electronics/Electro-Optics Thrust for JSF Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for JSF construction. - Continue Electronics/Electro-Optics Thrust for CH-53K Affordability Initiative. Includes efforts to improve electronics/electro-optics affordability for CH-53K construction. - Continue Electronics/Electro-Optics Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components. ***FY 2017 OCO Plans:*** N/A					
Title: Metals Processing and Fabrication ***Description:*** The primary technical goal of the Metals Processing and Fabrication activity is to develop affordable, robust manufacturing and repair processes/capabilities for metals and special materials critical to Navy weapon system applications. Major areas that support this objective include: processing methods, special materials, joining, machining, coating/cladding, assembly, and inspection and compliance resulting in reduced cost of fabrication for components. Emphasis is on affordability for the following platforms: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter. This activity also includes the development, optimization, and transition of repair technology for the repair, overhaul, and sustainment of key navy systems. Funding for FY 2016 and beyond has been re-aligned from PE 0708011N. At the R2A level, FY 2016 Funding of $15.500M from Metals Processing and Fabrication in PE 0708011N has been re-aligned to PE 0603680N Metals Processing and Fabrication. ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:***	0.000	15.500	15.168	0.000	15.168

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Metals Processing Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve affordability for VCS and ORP construction. - Initiate Metals Processing Thrust for DDG-51 Affordability Initiative. Includes efforts to improve affordability for DDG-51 construction. - Initiate Metals Processing Thrust for CVN-78 Affordability Initiative. Includes efforts to improve affordability for CVN-78 construction. - Initiate Metals Processing Thrust for JSF Affordability Initiative. Includes efforts to improve affordability for JSF construction. - Initiate Metals Processing Thrust for CH-53K Affordability Initiative. Includes efforts to improve affordability for CH-53K construction. - Initiate Metals Processing Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components. - Initiate Repair Technology (RepTech) Thrust to develop, optimize, and transition repair technology for key naval platforms at depots and logistics centers.					
FY 2017 Base Plans: - Continue Metals Processing Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve affordability for VCS and ORP construction. - Continue Metals Processing Thrust for DDG-51 Affordability Initiative. Includes efforts to improve affordability for DDG-51 construction. - Continue Metals Processing Thrust for CVN-78 Affordability Initiative. Includes efforts to improve affordability for CVN-78 construction. - Continue Metals Processing Thrust for JSF Affordability Initiative. Includes efforts to improve affordability for JSF construction. - Continue Metals Processing Thrust for CH-53K Affordability Initiative. Includes efforts to improve affordability for CH-53K construction. - Continue Metals Processing Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components. - Continue Repair Technology (RepTech) Thrust to develop, optimize, and transition repair technology for key naval platforms at depots and logistics centers.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: Manufacturing Enterprise/Other	0.000	24.074	24.420	0.000	24.420

Description: The Manufacturing Enterprise / Other activity includes: (1) efforts targeted towards improving, in general, the manufacturing enterprise for the production of key naval platforms (both shipbuilding and aircraft), (2) energetic efforts, (3) naval research enterprise and laboratory support for key projects, and (4) technical program support. Manufacturing Enterprise addresses the development, optimization, and transition of manufacturing enterprise technology to key naval platform suppliers. Emphasis is on affordability for the following shipbuilding platforms: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter.

Manufacturing enterprise technology areas include, but are not limited to Design for Producibility/Design for Manufacturability; development of build/assembly strategies; modeling and simulation technologies; model-based tools and approaches to optimize producibility; intelligent manufacturing planning and factory execution; elimination of inefficiencies in design optimization, material usage, labor utilization, work flow, etc.; supply chain procedures and improvements (such as network centric manufacturing capabilities to facilitate resilient and adaptable supply chains); development of more efficient structural fabrication product lines; and inspection technologies. Energetics efforts concentrate on developing energetics solutions to ensure the availability of safe, affordable, and quality energetics products largely in support of Program Executive Office (PEO) Integrated Warfare Systems (IWS).

Funding for FY 2016 and beyond has been re-aligned from PE 0708011N and PE 0603758N. At the R2A level, FY 2016 Funding of $1.200M from Metals Processing and Fabrication, $3.581M from Corporate Investments and $13.955M from Other all in PE 0708011N and funding of $5.338M from Manufacturing Technology S&T from PE 0603758N has been re-aligned to PE 0603680N Manufacturing Enterprise/Other for a total of $24.074M.

FY 2015 Accomplishments:
N/A

FY 2016 Plans:
- Initiate Manufacturing Enterprise Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve affordability for VCS and ORP construction.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate Manufacturing Enterprise Thrust for DDG-51 Affordability Initiative. Includes efforts to improve affordability for DDG-51 construction. - Initiate Manufacturing Enterprise Thrust for CVN-78 Affordability Initiative. Includes efforts to improve affordability for CVN-78 construction. - Initiate Manufacturing Enterprise Thrust for JSF Affordability Initiative. Includes efforts to improve affordability for JSF construction. - Initiate Manufacturing Enterprise Thrust for CH-53K Affordability Initiative. Includes efforts to improve affordability for CH-53K construction. - Initiate Manufacturing Enterprise Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components. - Initiate Energetics Thrust for PEO IWS and Other Acquisition Programs. Includes energetics efforts to support PEO IWS and other acquisition programs. - Initiate efforts to provide naval research enterprise and laboratory support for key projects. - Initiate efforts to provide technical engineering support for the ManTech Program.					
FY 2017 Base Plans: - Continue Manufacturing Enterprise Thrust for VCS/ORP Affordability Initiative. Includes efforts to improve affordability for VCS and ORP construction. - Continue Manufacturing Enterprise Thrust for DDG-51 Affordability Initiative. Includes efforts to improve affordability for DDG-51 construction. - Continue Manufacturing Enterprise Thrust for CVN-78 Affordability Initiative. Includes efforts to improve affordability for CVN-78 construction. - Continue Manufacturing Enterprise Thrust for JSF Affordability Initiative. Includes efforts to improve affordability for JSF construction. - Continue Manufacturing Enterprise Thrust for CH-53K Affordability Initiative. Includes efforts to improve affordability for CH-53K construction. - Continue Manufacturing Enterprise Thrust for other high interest NAVSEA, NAVAIR, and Marine Corps platforms and components. - Continue Energetics Thrust for PEO IWS and Other Acquisition Programs. Includes energetics efforts to support PEO IWS and other acquisition programs. - Continue efforts to provide naval research enterprise and laboratory support for key projects. - Continue efforts to provide technical engineering support for the ManTech Program.					
FY 2017 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *(U)Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Accomplishments/Planned Programs Subtotals	0.000	57.074	56.712	0.000	56.712

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Efforts are focused on affordability improvements (both acquisition and life-cycle) for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Currently, the majority of Navy ManTech efforts are focused on affordability improvements for: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter.

E. Performance Metrics

The ManTech Program's overall goal is to transition production technology to reduce the cost of Navy weapon systems. Metrics are currently collected on the cost savings per hull or per aircraft for each of the primary affordability platforms: VIRGINIA Class Submarine/OHIO Replacement Program (VCS/ORP), DDG-51 Class Destroyer, CVN-78 Class Carrier, Joint Strike Fighter (JSF), and CH-53-K Heavy Lift Helicopter.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603729N *I Warfighter Protection Adv Tech*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	39.374	36.299	4.789	-	4.789	4.878	4.877	4.878	4.879	Continuing	Continuing
2914: *Warfighter Protection Adv Tech*	0.000	4.727	4.799	4.789	-	4.789	4.878	4.877	4.878	4.879	Continuing	Continuing
9999: *Congressional Adds*	0.000	34.647	31.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	66.147

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This program supports the development and demonstration of field medical equipment and technologies to improve warfighter safety and to enhance personnel performance under adverse conditions. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. These projects support future capabilities within the Force Health Protection Program, a Future Naval Capability (FNC) that will provide technology options for the future Navy and Marine Corps by reducing morbidity and mortality when casualties occur.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	40.538	4.807	4.894	-	4.894
Current President's Budget	39.374	36.299	4.789	-	4.789
Total Adjustments	-1.164	31.492	-0.105	-	-0.105
• Congressional General Reductions	-	-0.008			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	31.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.165	0.000			
• Rate/Misc Adjustments	0.001	0.000	-0.105	-	-0.105

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603729N *I Warfighter Protection Adv Tech*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *CW Bill Young Marrow Donor Program*	30.461	31.500
Congressional Add: *Naval Special Warfare Performance and Injury Prevention Program*	4.186	0.000
Congressional Add Subtotals for Project: 9999	34.647	31.500
Congressional Add Totals for all Projects	34.647	31.500

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603729N / *Warfighter Protection Adv Tech*	Project (Number/Name) 2914 / *Warfighter Protection Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2914: *Warfighter Protection Adv Tech*	0.000	4.727	4.799	4.789	-	4.789	4.878	4.877	4.878	4.879	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes for Health (NIH) focuses on the basic science of disease processes and not product development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection program a Future Naval Capability (FNC) that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: NAVAL NOISE-INDUCED HEARING LOSS (NIHL)	4.727	4.799	4.789	0.000	4.789
Description: The goal of this program is to reduce the incidence of NIHL by nearly 100%. This program employs a total systems engineering approach that includes advancements in medical technology, jet engine physics, personal protective equipment, and mitigation analyses.					
FY 2015 Accomplishments: Noise Induced Hearing Loss: - Continued advanced research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Continued advanced research to reduce noise at the source, jet engine quieting and flight deck noise reduction. - Continued advanced research to improve personal protective equipment technology. - Continued advanced research to study the incidence and susceptibility of NIHL and tinnitus, and to evaluate mitigation strategies. Regenerative Medicine: - Continued program with Army, in regenerative medicine (Armed Forces Institute of Regenerative Medicine (AFIRM II).					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603729N / *Warfighter Protection Adv Tech*	**Project (Number/Name)** 2914 / *Warfighter Protection Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated program, with Army, in regenerative medicine (Armed Forces Institute of Regenerative Medicine (AFIRM II). ***FY 2016 Plans:*** Noise Induced Hearing Loss: - Continue all efforts of FY 2015, less those noted as completed above Regenerative Medicine: - Continue all efforts of FY 2015, less those noted as completed above ***FY 2017 Base Plans:*** Noise Induced Hearing Loss: Continue all efforts of FY 2016, less those noted as completed above Regenerative Medicine: - Continue all efforts of FY 2016, less those noted as completed above ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	4.727	4.799	4.789	0.000	4.789

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Efforts within this PE are measured at two levels. At the lower level, each is measured against technical and financial milestones on a monthly basis. Annually, each project is reviewed in depth for technical and transition performance by the Chief of Naval Research (CNR).

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603729N / *Warfighter Protection Adv Tech*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	34.647	31.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	66.147

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: CW Bill Young Marrow Donor Program	30.461	31.500
FY 2015 Accomplishments: During FY15, four new transplant centers joined the Radiation Injury Treatment Network (RITN) resulting in a total composition of 61 transplant centers, 6 donor centers, and 7 cord blood banks. The new centers that joined RITN included: 1. Univ. of Colorado-Aurora (CO), 2. Northwestern University (IL), 3. Emory University (GA), and 4. North Shore University (NY). In 2015, the National Marrow Donor Program (NMDP) donor centers, including Department of Defense (DoD) and recruitment groups, recruited 191,016 minority race and 197,626 Caucasian donors, for a total of 388,642 U.S. donors added to the registry. Navy funding supported the HLA typing of 83,099 donors (excluding DoD) of this culturally diverse group (48% minority). During FY15, bone marrow donor centers (including Department of Defense (DoD)) and recruitment groups recruited 102,147 minority race and 98,976 Caucasian donors for a total of 201,123 U.S. donors added to the registry. Navy funding supported the HLA typing of 72,603 donors (excluding DoD), of this culturally diverse group (52% minority) and these numbers continue to accumulate.		
FY 2016 Plans: National Marrow Donor Program (NMDP) will continue to expand participation of transplant centers increasing the enrollment of volunteer donors to the national registry. Hospitals that participate in both the NMDP Network of treatment centers as well as the NDMS managed by the Department of Health and Human Services. Scientific Advances: Continue improvements in accuracy of the NMDP scientific and clinical matching system, Haplogic III and linked to the NMDP clinical data system (Phoenix).		
Congressional Add: Naval Special Warfare Performance and Injury Prevention Program	4.186	0.000
FY 2015 Accomplishments: This effort continued the data collection with US Naval Special Warfare at NSW Group 2 and Group 4 (Little Creek, VA), NSW Combatant-Craft Crewman (SWCC) Special Boat Team 22 (Stennis, MS) and the NSW Center/SEAL Qualification Training (Coronado, CA) to strategically maximize human capital by reducing the rate of unintentional musculoskeletal injury, sharpen battlefield performance, optimize		

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603729N / *Warfighter Protection Adv Tech*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
military readiness, extend the tactical life cycle of the Operator, and enhance quality of life of the Operator after service. The effort with Marine Corps Special Operations Command (MARSOC) continued. Expansion of SPEAR database: This database will help consolidate research done by the University of Pittsburgh and enable efficient and consistent data collection across the USSOCOM Enterprise Human Performance Program. This data collection on each individual type of SOF Operator will allow the Human Performance Program to effectively provide consistent and valid research-based injury prevention and performance optimization solutions that will enable the design of training programs uniquely tailored to the needs of special operators in the most productive and cost effective manner possible. Completion of this work for each SOF Component will also fill in the gaps of previously funded scientific research. Close Quarters Combat Performance Metrics (CQC): Development of cognitive and physiological metrics to measure performance in a specific USSOCOM Operators task: Close Quarters Combat (CQC). Further, this work will improve the operational effectiveness of the Human Performance Program by developing measures of physiological and tactical individual and team performance in order to mitigate errors and improve cognitive performance in a CQC task using Navy Special Warfare (NSW) Operators. SOF Operator Availability & Performance Optimization: For research to maximize SOF Operator readiness and availability: This work will identify strategies to maximize mean time between injuries and minimize mean time to repair, so as to maximize SOF Operator availability and performance. Analyses of Operator injury history and Human Performance Program participation will attempt to identify ways to increase individual Operator availability so as to contribute to increase readiness for SOF units. ***FY 2016 Plans:*** N/A		
Congressional Adds Subtotals	34.647	31.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603729N / *Warfighter Protection Adv Tech*	**Project (Number/Name)** 9999 / *Congressional Adds*

E. Performance Metrics

Congressional Interest Items not included in other Projects.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603747N *I Undersea Warfare Advanced Tech*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	9.639	13.748	25.880	-	25.880	39.877	56.276	75.961	87.200	Continuing	Continuing
2916: *Undersea Warfare Advanced Technology*	0.000	9.639	13.748	25.880	-	25.880	39.877	56.276	75.961	87.200	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this PE. The related technologies being developed are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. The focus is on leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	9.985	13.748	22.592	-	22.592
Current President's Budget	9.639	13.748	25.880	-	25.880
Total Adjustments	-0.346	0.000	3.288	-	3.288
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.346	0.000			
• Program Adjustments	0.000	0.000	3.855	-	3.855
• Rate/Misc Adjustments	0.000	0.000	-0.567	-	-0.567

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603747N *I Undersea Warfare Advanced Tech*

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603747N / *Undersea Warfare Advanced Tech*	Project (Number/Name) 2916 / *Undersea Warfare Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2916: *Undersea Warfare Advanced Technology*	0.000	9.639	13.748	25.880	-	25.880	39.877	56.276	75.961	87.200	Continuing	Continuing

A. Mission Description and Budget Item Justification

All Navy advanced technology developments in undersea target detection, classification, localization, tracking and neutralization are funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Naval Forces UUV Development	9.639	13.748	25.880	0.000	25.880
Description: Develop critical technology for Long Endurance LDUUV to meet 30+ days. Critical technology includes Energy, Autonomy, and Endurance. INP - Large Displacement UUV (LDUUV) Funding increase for FY 2015 to FY 2016 due to an increased development of reliable technology for 30 days for LDUUV. Funding increase for FY 2016 to FY 2017 is due to increase development of technologies for a longer range LDUUV. Leverages endurance technologies developed under PE 0602747N with continue development. Increase AT SEA TESTING to mature technologies to increase LD-UUV technology range. ***FY 2015 Accomplishments:*** - Initiate the development and demonstrate Autonomy technology that will provide the ability to avoid undersea static obstacles, operate in a variety of currents, and adapt to local environment to maintain station. - Initiate Endurance technology that will develop and demonstrate endurance technology that will investigate new reliability strategy to operate for 30 days. ***FY 2016 Plans:*** - Continue all efforts from FY 2015, less those noted as completed above. - Initiate Select UUV for ASW mission and measure it's characteristics.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603747N / *Undersea Warfare Advanced Tech*	**Project (Number/Name)** 2916 / *Undersea Warfare Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate design and construction at sea test article for Virtual Acoustic Senor Array. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete design and construction at sea test article for Virtual Acoustic Sensor Array. - Initiate at sea tests of the Virtual Acoustic Sensor Array ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	9.639	13.748	25.880	0.000	25.880

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Improve target detection, localization, and tracking and increase attack capabilities by providing the following capabilities:
- Localization of 85% or more of enemy submarines in far forward or contested waters with false locations of less than 10% of total calls.
- Effective cueing of an attack from a distance of up to 200nm.
- Improvement of the Lightweight Torpedo (Mk 54). Specific improvements are classified.
- Extending deep water active distributed system lifetime to a few months with a probability of detection (Pd) of 90% within 4 hours (field configuration) or 90% per crossing (barrier configuration), with a False Alarm Rate (FAR) of no more than 4/day.
- Delivery from a Vertical Takeoff Unmanned Air Vehicle (VTUAV) and/or a long-range, high-speed Unmanned Air Vehicle (UAV) a compact undersea weapon capable of a high Probability of Kill (PK) given precise target localization.
- Detection and localization performance with a single-line vector sensor array nominally equivalent or superior to that of two coherently processed TB-29A arrays. Acquisition costs to be competitive with the cost of a current TB-29A and at least 30% less than the cost of two arrays. Sensor and telemetry packaging will be adequate to achieve neutral buoyancy in an existing TB-29A form factor with array power efficiency greater than 75%. Array handling will be compatible with the existing TB-29 handling system.

Increase sensor to shooter performance and the effective lifetime of distributed ASW search systems by:

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603747N / *Undersea Warfare Advanced Tech*	**Project (Number/Name)** 2916 / *Undersea Warfare Advanced Technology*

- Achieving a drifting active distributed system lifetime of at least two days in areas of tactical significance while maintaining required system performance with a minimum number of sensor nodes.
- Maintaining an effective lifetime of a month for mobile active distributed systems when subjected to the action of eddies from a major ocean current.
- Predicting reseed 6 hours before performance degrades.
- Holding the Area of Uncertainty (AOU) to no larger than 10 nm2 for an hour after initial detection through the control of the coherent sources.

Through a combination of better Anti-Submarine Warfare (ASW) command-level training and improved operator training provide the following:
- Improve the ability of active sonar operators to detect targets and reject potential false alarms compared to current simulation based training.
- Increase Pd by 50%.
- Provide a decrease in FAR by a factor of two.
- Provide a reduction in the probability of a hit on a High Value Unit (HVU) by a factor of two.
- Improve the ability of the ASW Commander to position assets to increase coverage, reduce active system interference and deal effectively with competing missions.
- Reduce training cost by greater than 80% and increase the frequency of training opportunities by greater than 600% relative to live training.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603758N *I Navy Warfighting Exp & Demo*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	55.363	65.946	60.550	-	60.550	84.122	93.270	117.192	154.271	Continuing	Continuing
2918: *Navy Warfighting Experiments and Demo*	0.000	55.363	65.946	60.550	-	60.550	84.122	93.270	117.192	154.271	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) addresses the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and sea trial exercises. The key aspects of this PE are divided into four areas: (1) SwampWorks develops and demonstrates newly invented or recently discovered technologies that address emergent and enduring operational problems in an accelerated timeframe; (2) Naval Warfare Experimentation develops rapid prototypes and provides them to the warfighter for experimentation during laboratory and operational demonstrations; (3) TechSolutions develops rapid response science and technology prototypes addressing Fleet/Force needs identified by Sailors and Marines at the deckplate level; (4) Operations Analysis provides the Navy and Marine Corps the means to identify capability needs that can be addressed with science and technology solutions, and (5) Manufacturing Technology Science and Technology (S&T) to accelerate recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Funding increased in FY2016 in order to accommodate increased Naval Warfare Experimentation to support emergent opportunities to meet fleet needs with potential technology solutions and SwampWorks due to the increased research and fleet interest in the areas of Autonomy, Electromagnetic Warfare and the exploitation of unmanned systems.

Note: For Manufacturing Technology S&T, the funds in FY2016 ($7.495M) and beyond have moved to new PE 0603680N Manufacturing Technology Program.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603758N *I Navy Warfighting Exp & Demo*		
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	53.876	66.041	61.995	-	61.995
Current President's Budget	55.363	65.946	60.550	-	60.550
Total Adjustments	1.487	-0.095	-1.445	-	-1.445
• Congressional General Reductions	-	-0.095			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.303	0.000			
• SBIR/STTR Transfer	-0.816	0.000			
• Program Adjustments	0.000	0.000	-0.118	-	-0.118
• Rate/Misc Adjustments	0.000	0.000	-1.327	-	-1.327

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603758N / *Navy Warfighting Exp & Demo*	Project (Number/Name) 2918 / *Navy Warfighting Experiments and Demo*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2918: *Navy Warfighting Experiments and Demo*	0.000	55.363	65.946	60.550	-	60.550	84.122	93.270	117.192	154.271	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, Fleet Battle Experiments (FBEs), Limited Objective Experiments (LOEs) and sea trial exercises.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: ONR EXPERIMENTATION	20.571	21.688	22.352	0.000	22.352
Description: The objective of this project is to capitalize on recent technology breakthroughs to integrate components and subsystems into prototypes for field experiments and/or tests in simulated or actual environments. The use of Navy Warfare Development Command (NWDC) Fleet Experimentation (FLEX) events is encouraged and the net results are to gain the knowledge that only an experiment can provide. Funding increase in FY2016 will support emergent opportunities to meet fleet needs with potential technology solutions including demonstrations and experimentation with Directed Energy and High Energy Laser Weapons Systems. ***FY 2015 Accomplishments:*** - Continued concept based technology program efforts. - Continued experimentation efforts with technologies developed in SwampWorks/TechSolutions. - Continued to identify promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation. - Continued development and demonstration of real time situational awareness technologies such as battlespace enhanced mixed reality. - Continued technology experimentation for Total Ownership Cost (TOC) reduction such as the advanced aircraft top coats and topside corrosion control. - Continued efforts to develop, demonstrate and experiment with technologies to meet current or emerging operational needs. - Initiated demonstrations and experimentation with Directed Energy (DE) and High Energy Laser (HEL) advanced weapons systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603758N / *Navy Warfighting Exp & Demo*	**Project (Number/Name)** 2918 / *Navy Warfighting Experiments and Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Successfully conducted an experiment to demonstrate unmanned surface vehicle swarming technologies in collaboration with the warfighter, laboratories and operational forces. ***FY 2016 Plans:*** - Continue all efforts of FY2015 unless noted as completed above. - Demonstrate unmanned air vehicle swarming technologies in collaboration with the warfighter, laboratories and operational forces. ***FY 2017 Base Plans:*** - Continue all efforts of FY2016 unless noted as completed above. - Initiate experimentation initiatives to support high impact Fleet efforts - Leverage fleet experimentation venues in order to optimize development efforts and gain greater fleet/force feedback of developing technologies. ***FY 2017 OCO Plans:*** N/A					
Title: OPERATIONS ANALYSIS ***Description:*** The objective of this project is to provide operational analysis through studies, analyses, gaming and experimentation to identify Navy and Marine Corps capability needs that can be addressed with S&T solutions. The effort includes core analysis of S&T programs, military utility/capability gaps analyses, war gaming, structured experimentation events, the articulation of the results of that analysis and wargaming, and the development of innovation strategies and messages resulting from these analyses. Recent work includes participation in SIMEX design, data collection and analysis events; wargame design in support of the ONR Office of Technology; analytical, strategic planning, and wargaming support; organizing and conducting workshops and symposia that increase innovation outreach; and participating in Red Teaming and conceptual analysis. Funding increase in FY2017 will accommodate increased efforts needed to support increased experimentation planning and execution and robust concept development efforts in support of the Innovative Naval Prototyping program. ***FY 2015 Accomplishments:*** - Continued to conduct Military Utility Analyses of Future Naval Capability technologies. - Continued to conduct capability gaps analyses to identify areas that can be addressed with products from the S&T portfolio.	1.746	2.178	3.112	0.000	3.112

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603758N / *Navy Warfighting Exp & Demo*	**Project (Number/Name)** 2918 / *Navy Warfighting Experiments and Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued to conduct SIMEX development, execution, data collection and analysis. - Continued to conduct war-game design in support of the ONR Office of Technology. - Successfully conducted a war-game to identify capability needs for the NEMESIS Innovative Naval Prototype, operational personnel participated to ensure S&T solutions were focused on capabilities needed in electronic warfare. ***FY 2016 Plans:*** - Continue all efforts of FY2015 unless noted as completed above. - Conduct a war-game to identify capability needs for the medium displacement unmanned surface vehicle, utilize operational personnel to ensure S&T solutions are focused on capabilities needed for unmanned systems. ***FY 2017 Base Plans:*** - Continue all efforts of FY2016 unless noted as completed above. - Initiate new efforts in support of Fleet/Force. ***FY 2017 OCO Plans:*** N/A					
Title: SWAMPWORKS ***Description:*** SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. The general nature of these efforts are high risk/high reward and constitute a leap ahead in capability or technology. Some of these technologies may become part of a follow-on technology development, may end up in the hands of the warfighter for Fleet/Force experimentation, or may culminate in a significant Fleet/Force exercise that demonstrates capability then transitions into the Acquisition Program of Record (POR). Funding increase in FY2016 is due to the increased research in Directed Energy (Solid State Laser - Technology Maturation, or SSL-TM). This investment was a single year investment and thus the decrease from FY2016 to FY2017. ***FY 2015 Accomplishments:*** - Continued to identify enduring and emergent operational barriers identified by naval leadership and responded with relevant technology developments and demonstrations. - Continued disruptive commercial technology studies at varied military, government, and educational institutions.	22.004	32.064	25.086	0.000	25.086

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603758N / *Navy Warfighting Exp & Demo*	**Project (Number/Name)** 2918 / *Navy Warfighting Experiments and Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued high risk/high payoff projects to explore significant leap-ahead capabilities. - Continued efforts to develop technologies to meet current or emerging operational needs. - Continued investment in submarine control surface technologies. - Continued investment in advanced electronic warfare technologies; projects are expected to be classified at a higher level. - Continued efforts to develop and demonstrate technologies to meet current or emerging operational needs to include vision enhancement, electronic warfare, diving technologies. - Continued efforts that develop and/or demonstrate advanced technologies in support of Fleet issue in an accelerated timeframe. ***FY 2016 Plans:*** - Continue all efforts of FY2015 unless noted as completed above. - Initiate additional projects in the area of Autonomy, Electromagnetic Warfare and exploitation of unmanned systems - Pursue emergent technology opportunities to support high impact pacific pivot efforts. ***FY 2017 Base Plans:*** - Continue all efforts of FY2016 unless noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: TECH SOLUTIONS ***Description:*** TechSolutions develops rapid response Science and Technology (S&T) solutions to immediate Fleet/Force needs identified by individual warfighters at the deckplate level. Sailors, Marines and Science Advisors submit their issues throughout the year via the TechSolutions website, email, phone, or chain of command. Projects are initiated as requests are received and are completed in approximately twelve to eighteen months, resulting in a prototype demonstration of TRL 6 or higher. ***FY 2015 Accomplishments:*** - Completed CVN 360 degree Surveillance System providing improved EO/IR situational awareness of the local area to CVN personnel and Virginia class Diesel Generator 3D Trainer - Continued development of projects that provide solutions to problems identified by Science Advisors and the Fleet/Force to address emergent critical needs.	9.056	10.016	10.000	0.000	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603758N / *Navy Warfighting Exp & Demo*	**Project (Number/Name)** 2918 / *Navy Warfighting Experiments and Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Rapidly responded to the needs of our warfighters. Some examples include a Submarine Electronic Sonar Tacaid that automates dated procedures that utilize mechanical devices, beyond the line of sight control for the UAS Scan Eagle, and a low light aiming system for the 60mm lightweight mortar ***FY 2016 Plans:*** - Continue all efforts of FY2015 unless noted as completed above. - Continue development of projects that will provide solutions to address emergent critical needs. - Develop, demonstrate and deliver technical solution prototypes to projects initiated in the previous fiscal year. ***FY 2017 Base Plans:*** - Continue all efforts of FY2016 unless noted as completed above. - Initiate rapid response S&T projects in direct support of Fleet/Force needs. ***FY 2017 OCO Plans:*** N/A					
Title: MANUFACTURING TECHNOLOGY S&T ***Description:*** The Manufacturing Technology S&T program accelerates recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms which assists in meeting performance and platform affordability goals - both acquisition and life-cycle. This supports a critical goal of the Navy, meeting the affordability goals of major acquisition platforms, by accelerating emerging manufacturing technology. The funds in FY2016 ($7.495M) and beyond have moved to new PE 0603680N Manufacturing Technology Program. The funding has been distributed to R2 activities within that PE as follows: $1.200 Composites Processing and Fabrication, $0.957M to Electronics Processing and Fabrication, $5.338M to Manufacturing Enterprise/Other. ***FY 2015 Accomplishments:*** - Continued/accelerated recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms. ***FY 2016 Plans:*** - Funds moved to new PE 0603680N Manufacturing Technology Program.	1.986	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603758N / *Navy Warfighting Exp & Demo*	**Project (Number/Name)** 2918 / *Navy Warfighting Experiments and Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
The funding has been distributed to R2 activities within that PE as follows: $1.200M Composites Processing and Fabrication, $0.957M to Electronics Processing and Fabrication, $5.338M to Manufacturing Enterprise/Other. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	55.363	65.946	60.550	0.000	60.550

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Overall metric goals are to transition the 6.3 advanced technology projects into acquisition programs of record, demonstrate successful technologies to enable new operational concepts, and enable the production of technology products such as proofs of concept and manufacturing packages. The performance of the work funded in this PE is reviewed at several levels to ensure that the investment is relevant and productive. At the macroscopic level, the investment is coordinated with Navy Warfare Development Command and Commander, Fleet Forces Command to address the goals and objectives identified for sea trials and Limited Objective Experiments (LOEs). At the microscopic level, the work funded in this PE is reviewed periodically by the Program Manager to ensure the investment is meeting the goals defined for each project. This review includes feedback collected from the warfighter community on all sea trials and LOEs to support the Program Manager's assessment of the value and relevance of each investment. Furthermore, the entire program is reviewed yearly by the Chief of Naval Research.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	1.931	3.491	15.167	-	15.167	15.470	12.971	13.415	1.959	Continuing	Continuing
2917: *Shallow Water MCM Demos*	0.000	1.931	1.991	15.167	-	15.167	15.470	12.971	13.415	1.959	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	1.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.500

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015) and investment directions as defined by Department of Defense (DoD) Directive 5160.62 "Single Manager Responsibility for Military Explosive Ordnance Disposal Technology and Training (EODT&T)" and approved by the DoD Explosive Ordnance Disposal (EOD) Program Board (Sep 2012). This strategy is based on needs and capabilities from Navy and Marine Corps guidance, input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). The strategy is also based on the unique needs and capabilities identified by the Joint Requirements Oversight Council (JROC) and the DoD EOD Program Board. It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval and Joint EOD forces in the 21st century. The strategy focuses and aligns Naval S&T with Naval missions, DoD EOD S&T with Joint EOD missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE primarily develops and demonstrates prototype Mine Countermeasures (MCM), Expeditionary Warfare and Joint EOD system components that support capabilities enabling Naval and Joint EOD Forces to influence operations ashore. Adversarial nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littorals. They also have the capability to develop or modify explosive devices such as mines and unexploded ordnance to construct Improvised Explosive Devices (IEDs) for the purpose of targeting Joint Forces. Real world operations have demonstrated the requirement to quickly counter the mine threat. Current operations have also demonstrated the requirement to quickly counter the threat from explosive hazards and IEDs during DoD operations. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. Advanced technologies must enable Joint EOD forces to detect/locate, gain access, diagnose, render safe, neutralize, recover, exploit and dispose of a broad spectrum of explosive hazards including unexploded ordnance and IEDs. This program supports the advanced development and integration of sensors, processing, warheads, and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the advanced development and integration of sensors and tools for standoff capabilities such as detection and location of IEDs (particularly in dismounted operations), dismounted diagnosis of buried munitions and other explosive hazards, precision render safe and neutralization of surface munitions and other explosive hazards, and enhanced access to IEDs. It supports the MCM-related FNC Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship To Objective Maneuver (STOM) key transformational capability within Sea Strike.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy	Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology*

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	2.000	1.991	2.000	-	2.000
Current President's Budget	1.931	3.491	15.167	-	15.167
Total Adjustments	-0.069	1.500	13.167	-	13.167
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	1.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.069	0.000			
• Program Adjustments	0.000	0.000	13.500	-	13.500
• Rate/Misc Adjustments	0.000	0.000	-0.333	-	-0.333

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	0.000	1.500
Congressional Add Subtotals for Project: 9999	0.000	1.500
Congressional Add Totals for all Projects	0.000	1.500

Change Summary Explanation

The increase in FY 2017 is due to the transfer of the Advanced Sea Mines Future Naval Capability (FNC) effort SHD-FY16-OSD Modular Undersea Effectors (MUSE) from PE 0603673N Future Naval Capabilities Advanced Technology Development.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	Project (Number/Name) 2917 / *Shallow Water MCM Demos*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
2917: *Shallow Water MCM Demos*	0.000	1.931	1.991	15.167	-	15.167	15.470	12.971	13.415	1.959	Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE develops and demonstrates prototype technology for Mine Countermeasures (MCM), US Naval sea mining, and Expeditionary Warfare and Joint EOD system components that support capabilities enabling Naval and Joint EOD Forces to influence operations ashore. Adversarial nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littorals. They also have the capability to develop or modify explosive devices such as mines and unexploded ordnance to construct Improvised Explosive Devices (IEDs) for the purpose of targeting Joint Forces. Real world operations have demonstrated the requirement to quickly counter the mine threat. Current operations have also demonstrated the requirement to quickly counter the threat from explosive hazards and IEDs during DoD operations. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. Advanced technologies must enable Joint EOD forces to detect/locate, gain access, diagnose, render safe, neutralize, recover, exploit and dispose of a broad spectrum of explosive hazards including unexploded ordnance and IEDs. This program supports the advanced development and integration of sensors, processing, warheads, and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the advanced development and integration of sensors and tools for standoff capabilities such as detection and location of IEDs (particularly in dismounted operations), dismounted diagnosis of buried munitions and other explosive hazards, precision render safe and neutralization of surface munitions and other explosive hazards, and enhanced access to IEDs. It supports advanced development for battlespace shaping weapons including advanced undersea weapons. It supports the MCM related FNC Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship To Objective Maneuver (STOM) key transformational capability within Sea Strike.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Joint EOD Demos	1.931	1.991	1.957	0.000	1.957
Description: This activity focuses on developing and demonstrating technologies to support a standoff or remote capability for detection and location, diagnosis, render safe, neutralization and enhanced access. Efforts include: electromagnetic, electro-optical, and acoustic sensors and systems for detection of explosive threat components including explosives, device housings/containers, and triggering mechanisms, standoff identification and confirmation of trace explosives, fusion of multi-sensor input for high confidence detection and diagnosis of buried threats, highly dexterous manipulators and imitative controllers for lightweight, efficient (strength/weight ratio) dual manipulator systems integrated onto EOD robots for enhanced access, enhanced robotic autonomy to support EOD missions, data compression and visualization techniques to support precise render safe and neutralization, and neutralization devices containing reactive materials to neutralize devices with low collateral damage.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
This S&T investment supports the Joint Requirements Oversight Council (JROC) and DoD EOD Program Board validated requirements for Joint EOD missions. This S&T investment provides critical S&T transitions to acquisition programs. This investment in Joint EOD S&T is reported annually to the DoD EOD Program Board. This S&T investment is documented in the DoD EOD Applied Research Program Plan which is reviewed and approved annually by the DoD EOD Program Board. ***FY 2015 Accomplishments:*** - Continued development of a laser interferometric sensor/system that can be integrated onto various platforms including EOD robots for detection and/or diagnosis of buried objects. - Continued development of highly dexterous dual manipulator systems (manipulators, controllers) that can be integrated onto EOD robots for precision render safe and neutralization missions. - Continued development of a Resonance Raman (single or dual wavelength) detector for standoff detection of trace explosives that can be integrated into a handheld device or onto an EOD robot. ***FY 2016 Plans:*** - Continue all efforts from FY 2015, less those noted as completed above. - Initiate development of sensors that can be integrated into a handheld device or onto an EOD robot to detect deeply buried objects. - Initiate development of excavation tools and techniques that can be integrated into a handheld device or onto an EOD robot for precision recovery and diagnosis of buried objects. - Initiate development of neutralization tools and technigues that can be deployed by an EOD technician or integrated onto an EOD robot for effective target neutralization with low collateral damage to surrounding infrastructure. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Initiate development of a robotic system demonstrator for stand-off detection of trace and bulk explosive materials. - Initiate development of a robotic system demonstrator for autonomous grasping and manipulation. ***FY 2017 OCO Plans:*** N/A					
Title: Mine Technology	0.000	0.000	13.210	0.000	13.210

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: This activity focuses on developing and demonstrating technology to support on-demand battlespace shaping through advanced undersea weapons. Efforts include command & control (C2), remote control, advanced sensing technologies, compatibility with unmanned delivery options, detection & classification, and targeting solutions. The increase in FY 2017 is due to the transfer of the Advanced Sea Mines FNC effort SHD-FY16-OSD Modular UnderSea Effectors (MUSE), to Technology Maturation (TM)-ONR Advanced Sea Mines, from PE 0603673N Future Naval Capabilities Advanced Technology Development. ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** N/A ***FY 2017 Base Plans:*** - Initiate development of advanced sensing technologies - Initiate development of command & control and advanced detection & classification technologies ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	1.931	1.991	15.167	0.000	15.167

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall metrics of this advanced technology program are the development of technologies supporting the Mine and Expeditionary Warfare challenges of reducing the MCM tactical timeline from months to days and eliminating the need for Navy divers and manned equipment to enter minefields. Another important metric is the scheduled transition of 6.3 advanced technology projects from the FNCs program into Navy and Marine Corps acquisition programs at agreed upon Technology

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

Readiness Levels. Technology-specific metrics include: Mine warfare data fusion capabilities yielding a 10%-25% reduction in time and risk to mine hunting activities; Mine hunting sensors - Probability of Detection = 95%, Probability of Identification of Proud Mines = 90%, Probability of Classification of Buried Mines = 80%; Unmanned Systems for MCM sized for inclusion in the Littoral Combat Ship Mine Warfare Mission Package; MCM sensors sized, packaged and capable of 12 hour missions with a search rate greater than .05 square nautical mines per hour; Mine sweeping: Modular magnetic and acoustic influence sweeping systems packaged for deployment from Unmanned Surface Vehicles; Minesweeping single sortie coverage > 9.4 square nautical miles at 20 nautical miles per hour during a 4 hour mission up to Sea State 3; Surface-laid mine and obstacle breaching capability > 90% in the Beach Zone (BZ) using unitary warheads, and > 80% in the Surf Zone (SZ).

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	1.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.500

A. Mission Description and Budget Item Justification

This congressional increase further develops and demonstrates technologies to support a standoff or remote capability for detection and location, diagnosis, render safe, neutralization and enhanced access. Efforts include: electromagnetic, electro-optical, and acoustic sensors and systems for detection of explosive threat components including explosives, device housings/containers, and triggering mechanisms, standoff identification and confirmation of trace explosives, fusion of multiple-sensor input for high confidence detection and diagnosis of buried threats, highly dexterous manipulators and imitative controllers for lightweight, efficient (strength/weight ratio) dual manipulator systems integrated onto EOD robots for enhanced access, enhanced robotic autonomy to support EOD missions, data compression and visualization techniques to support precise render safe and neutralization, and neutralization devices containing reactive materials to neutralize devices with low collateral damage.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: Program Increase	0.000	1.500
FY 2015 Accomplishments: N/A		
FY 2016 Plans: - Expand development of sensors that can be integrated into a handheld device or onto an EOD robot to detect deeply buried objects - Expand development of excavation tools and techniques that can be integrated into a handheld device or onto an EOD robot for precision recovery and diagnosis of buried objects - Expand development of neutralization tools and techniques that can be deployed by an EOD technician or integrated onto an EOD robot for effective target neutralization with low collateral damage		
Congressional Adds Subtotals	0.000	1.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This activity supports the development and transition of technologies to PMS-408 for Joint Service missions. This S&T investment supports the Joint Requirements Oversight Council (JROC) and DoD EOD Program Board validated requirements for Joint EOD missions. This S&T investment provides critical S&T transitions to

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 9999 / *Congressional Adds*

the acquisition programs managed by PMS-408. This investment in Joint EOD S&T is reported annually to the DoD EOD Program Board. This S&T investment is documented in the DoD EOD Applied Research Program Plan which is reviewed and approved annually by the DoD EOD Program Board.