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**Department of Defense
Fiscal Year (FY) 2023 Budget Estimates**

April 2022



Navy

Justification Book Volume 1 of 5

Research, Development, Test & Evaluation, Navy

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The estimated cost of this report for the Department of the Navy (DON) is \$7,653.

The estimated total cost for supporting the DON budget justification material is approximately \$4,190,764 during the 2022 fiscal year. This includes \$88,845 in supplies and \$4,101,919 in labor.

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Navy • Budget Estimates FY 2023 • RDT&E Program

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Department of Defense Appropriations Act, 2023

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, \$24,078,718 to remain available for obligation until September 30, 2024.

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Department of Defense
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

		FY 2022 Division B Less Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Appropriation -----	FY 2021 (Base + OCO) -----	FY 2022 Supplementals Enactment -----			
Research, Development, Test & Eval, Navy	20,151,249	22,121,338			31,100
Total Research, Development, Test & Evaluation	20,151,249	22,121,338			31,100

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

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Department of Defense
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

Appropriation -----	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----
Research, Development, Test & Eval, Navy	31,100	22,152,438	24,078,718
Total Research, Development, Test & Evaluation	31,100	22,152,438	24,078,718

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Department of Defense
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Summary Recap of Budget Activities -----						
Basic Research	629,356	698,222				
Applied Research	1,139,067	1,283,117				
Advanced Technology Development	812,483	976,202				
Advanced Component Development & Prototypes	5,315,053	6,882,455				
System Development & Demonstration	5,734,697	5,574,543				
Management Support	1,469,017	1,078,994				
Operational Systems Development	5,027,213	5,599,259				31,100
Software and Digital Technology Pilot Programs	24,363	28,546				
Total Research, Development, Test & Evaluation	20,151,249	22,121,338				31,100
Summary Recap of FYDP Programs -----						
Strategic Forces	243,178	327,788				
General Purpose Forces	1,585,036	1,600,974				
Intelligence and Communications	788,430	623,802				
Research and Development	15,636,466	17,431,792				
Central Supply and Maintenance	41,841	41,359				
Administration and Associated Activities	3,189	1,747				

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

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Department of Defense
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
Summary Recap of Budget Activities -----			
Basic Research		698,222	589,192
Applied Research		1,283,117	971,814
Advanced Technology Development		976,202	865,755
Advanced Component Development & Prototypes		6,882,455	8,405,310
System Development & Demonstration		5,574,543	6,606,583
Management Support		1,078,994	1,132,670
Operational Systems Development	31,100	5,630,359	5,483,386
Software and Digital Technology Pilot Programs		28,546	24,008
Total Research, Development, Test & Evaluation	31,100	22,152,438	24,078,718
Summary Recap of FYDP Programs -----			
Strategic Forces		327,788	466,102
General Purpose Forces		1,600,974	1,739,645
Intelligence and Communications		623,802	656,960
Research and Development		17,431,792	19,484,008
Central Supply and Maintenance		41,359	28,381
Administration and Associated Activities		1,747	1,811

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Department of Defense
FY 2023 President's Budget
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(Dollars in Thousands)

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Space	35,128					
Classified Programs	1,817,981	2,093,876				31,100
Total Research, Development, Test & Evaluation	20,151,249	22,121,338				31,100

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

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Department of Defense
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(Dollars in Thousands)

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	-----	-----	-----
Space			
Classified Programs	31,100	2,124,976	1,701,811
Total Research, Development, Test & Evaluation	31,100	22,152,438	24,078,718

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Department of the Navy
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Summary Recap of Budget Activities						
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Space	35,128					
Classified Programs	1,817,981	2,093,876				31,100
Total Research, Development, Test & Evaluation	20,151,249	22,121,338				31,100

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Department of the Navy
FY 2023 President's Budget
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Total Obligational Authority
(Dollars in Thousands)

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

Line	Program Element No Number	Item ----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
1	0601103N	University Research Initiatives	01	139,627	174,898					U
2	0601152N	In-House Laboratory Independent Research	01	18,362						U
3	0601153N	Defense Research Sciences	01	471,367	523,324					U
	Basic Research			629,356	698,222					
4	0602114N	Power Projection Applied Research	02	37,925	43,013					U
5	0602123N	Force Protection Applied Research	02	203,609	222,388					U
6	0602131M	Marine Corps Landing Force Technology	02	53,711	64,112					U
7	0602235N	Common Picture Applied Research	02	42,219	51,477					U
8	0602236N	Warfighter Sustainment Applied Research	02	112,119	117,738					U
9	0602271N	Electromagnetic Systems Applied Research	02	89,516	91,041					U
10	0602435N	Ocean Warfighting Environment Applied Research	02	77,935	103,586					U
11	0602651M	Joint Non-Lethal Weapons Applied Research	02	6,150	6,405					U
12	0602747N	Undersea Warfare Applied Research	02	93,280	107,734					U
13	0602750N	Future Naval Capabilities Applied Research	02	165,813	198,233					U

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--	-----	-----	----	---	-----	-----	-----	-
1	0601103N		University Research Initiatives	01		174,898	90,076	U
2	0601152N		In-House Laboratory Independent Research	01				U
3	0601153N		Defense Research Sciences	01		523,324	499,116	U
			Basic Research		-----	-----	-----	
						698,222	589,192	
4	0602114N		Power Projection Applied Research	02		43,013	22,953	U
5	0602123N		Force Protection Applied Research	02		222,388	133,426	U
6	0602131M		Marine Corps Landing Force Technology	02		64,112	53,467	U
7	0602235N		Common Picture Applied Research	02		51,477	51,911	U
8	0602236N		Warfighter Sustainment Applied Research	02		117,738	70,957	U
9	0602271N		Electromagnetic Systems Applied Research	02		91,041	92,444	U
10	0602435N		Ocean Warfighting Environment Applied Research	02		103,586	74,622	U
11	0602651M		Joint Non-Lethal Weapons Applied Research	02		6,405	6,700	U
12	0602747N		Undersea Warfare Applied Research	02		107,734	58,111	U
13	0602750N		Future Naval Capabilities Applied Research	02		198,233	173,641	U

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--	-----	----	---	-----	-----	-----	-----	-----	-----	-
14	0602782N	Mine and Expeditionary Warfare Applied Research	02	33,228	42,160					U
15	0602792N	Innovative Naval Prototypes (INP) Applied Research	02	146,926	155,976					U
16	0602861N	Science and Technology Management - ONR Field Activities	02	76,636	79,254					U
		Applied Research		1,139,067	1,283,117					
17	0603123N	Force Protection Advanced Technology	03	26,648	36,161					U
18	0603271N	Electromagnetic Systems Advanced Technology	03	22,267	12,146					U
19	0603640M	USMC Advanced Technology Demonstration (ATD)	03	242,160	291,183					U
20	0603651M	Joint Non-Lethal Weapons Technology Development	03	12,882	13,429					U
21	0603673N	Future Naval Capabilities Advanced Technology Development	03	221,954	282,020					U
22	0603680N	Manufacturing Technology Program	03	58,437	77,236					U
23	0603729N	Warfighter Protection Advanced Technology	03	31,978	40,435					U
24	0603758N	Navy Warfighting Experiments and Demonstrations	03	39,540	60,167					U
25	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	1,905	1,981					U

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14	0602782N	Mine and Expeditionary Warfare Applied Research	02		42,160	31,649	U
15	0602792N	Innovative Naval Prototypes (INP) Applied Research	02		155,976	120,637	U
16	0602861N	Science and Technology Management - ONR Field Activities	02		79,254	81,296	U
	Applied Research			-----	1,283,117	971,814	
17	0603123N	Force Protection Advanced Technology	03		36,161	16,933	U
18	0603271N	Electromagnetic Systems Advanced Technology	03		12,146	8,253	U
19	0603640M	USMC Advanced Technology Demonstration (ATD)	03		291,183	280,285	U
20	0603651M	Joint Non-Lethal Weapons Technology Development	03		13,429	14,048	U
21	0603673N	Future Naval Capabilities Advanced Technology Development	03		282,020	251,267	U
22	0603680N	Manufacturing Technology Program	03		77,236	60,704	U
23	0603729N	Warfighter Protection Advanced Technology	03		40,435	4,999	U
24	0603758N	Navy Warfighting Experiments and Demonstrations	03		60,167	83,137	U
25	0603782N	Mine and Expeditionary Warfare Advanced Technology	03		1,981	2,007	U

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26	0603801N	Innovative Naval Prototypes (INP) Advanced Technology Development	03	154,712	161,444					U
		Advanced Technology Development		812,483	976,202					
27	0603128N	Unmanned Aerial System	04		16,167					U
28	0603178N	Large Unmanned Surface Vehicles (LUSV)	04	89,198	102,493					U
29	0603207N	Air/Ocean Tactical Applications	04	33,933	27,849					U
30	0603216N	Aviation Survivability	04	13,242	24,815					U
31	0603239N	Naval Construction Forces	04	2,251	5,290					U
32	0603251N	Aircraft Systems	04	481						U
33	0603254N	ASW Systems Development	04	18,029	20,598					U
34	0603261N	Tactical Airborne Reconnaissance	04	3,411	3,111					U
35	0603382N	Advanced Combat Systems Technology	04	55,364	35,310					U
36	0603502N	Surface and Shallow Water Mine Countermeasures	04	46,005	53,327					U
37	0603506N	Surface Ship Torpedo Defense	04	11,620	8,862					U
38	0603512N	Carrier Systems Development	04	7,406	7,182					U
39	0603525N	PILOT FISH	04	308,636	405,917					U
40	0603527N	RETRACT LARCH	04	48,391	44,076					U
41	0603536N	RETRACT JUNIPER	04	117,875	144,349					U

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26	0603801N	Innovative Naval Prototypes (INP) Advanced Technology Development	03		161,444	144,122	U
		Advanced Technology Development		-----	976,202	865,755	
27	0603128N	Unmanned Aerial System	04		16,167	96,883	U
28	0603178N	Large Unmanned Surface Vehicles (LUSV)	04		102,493	146,840	U
29	0603207N	Air/Ocean Tactical Applications	04		27,849	39,737	U
30	0603216N	Aviation Survivability	04		24,815	17,434	U
31	0603239N	Naval Construction Forces	04		5,290	1,706	U
32	0603251N	Aircraft Systems	04				U
33	0603254N	ASW Systems Development	04		20,598	15,986	U
34	0603261N	Tactical Airborne Reconnaissance	04		3,111	3,562	U
35	0603382N	Advanced Combat Systems Technology	04		35,310	18,628	U
36	0603502N	Surface and Shallow Water Mine Countermeasures	04		53,327	87,825	U
37	0603506N	Surface Ship Torpedo Defense	04		8,862	473	U
38	0603512N	Carrier Systems Development	04		7,182	11,567	U
39	0603525N	PILOT FISH	04		405,917	672,461	U
40	0603527N	RETRACT LARCH	04		44,076	7,483	U
41	0603536N	RETRACT JUNIPER	04		144,349	239,336	U

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42	0603542N	Radiological Control	04	745	761					U
43	0603553N	Surface ASW	04	1,113	1,144					U
44	0603561N	Advanced Submarine System Development	04	120,501	98,921					U
45	0603562N	Submarine Tactical Warfare Systems	04	10,293	14,059					U
46	0603563N	Ship Concept Advanced Design	04	121,491	136,074					U
47	0603564N	Ship Preliminary Design & Feasibility Studies	04	45,398	40,774					U
48	0603570N	Advanced Nuclear Power Systems	04	149,188	203,572					U
49	0603573N	Advanced Surface Machinery Systems	04	39,144	76,922					U
50	0603576N	CHALK EAGLE	04	56,443	79,797					U
51	0603581N	Littoral Combat Ship (LCS)	04	40,731	82,518					U
52	0603582N	Combat System Integration	04	17,273	17,322					U
53	0603595N	Ohio Replacement	04	308,433	311,231					U
54	0603596N	LCS Mission Modules	04	75,933	75,995					U
55	0603597N	Automated Test and Re-Test (ATRT)	04	33,641	37,805					U
56	0603599N	Frigate Development	04	79,963	100,203					U
57	0603609N	Conventional Munitions	04	9,505	7,296					U
58	0603635M	Marine Corps Ground Combat/ Support System	04	42,194	66,565					U

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Department of the Navy
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Total Obligational Authority
(Dollars in Thousands)

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

Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
42	0603542N	Radiological Control	04		761	772	U
43	0603553N	Surface ASW	04		1,144	1,180	U
44	0603561N	Advanced Submarine System Development	04		98,921	105,703	U
45	0603562N	Submarine Tactical Warfare Systems	04		14,059	10,917	U
46	0603563N	Ship Concept Advanced Design	04		136,074	82,205	U
47	0603564N	Ship Preliminary Design & Feasibility Studies	04		40,774	75,327	U
48	0603570N	Advanced Nuclear Power Systems	04		203,572	227,400	U
49	0603573N	Advanced Surface Machinery Systems	04		76,922	176,600	U
50	0603576N	CHALK EAGLE	04		79,797	91,584	U
51	0603581N	Littoral Combat Ship (LCS)	04		82,518	96,444	U
52	0603582N	Combat System Integration	04		17,322	18,236	U
53	0603595N	Ohio Replacement	04		311,231	335,981	U
54	0603596N	LCS Mission Modules	04		75,995	41,533	U
55	0603597N	Automated Test and Re-Test (ATRT)	04		37,805	9,773	U
56	0603599N	Frigate Development	04		100,203	118,626	U
57	0603609N	Conventional Munitions	04		7,296	9,286	U
58	0603635M	Marine Corps Ground Combat/ Support System	04		66,565	111,431	U

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(Dollars in Thousands)

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

Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
59	0603654N	Joint Service Explosive Ordnance Development	04	56,569	34,785					U
60	0603713N	Ocean Engineering Technology Development	04	6,137	8,774					U
61	0603721N	Environmental Protection	04	20,034	20,677					U
62	0603724N	Navy Energy Program	04	54,749	66,824					U
63	0603725N	Facilities Improvement	04	4,527	6,327					U
64	0603734N	CHALK CORAL	04	410,184	579,389					U
65	0603739N	Navy Logistic Productivity	04	3,739	669					U
66	0603746N	RETRACT MAPLE	04	277,771	295,295					U
67	0603748N	LINK PLUMERIA	04	477,609	663,780					U
68	0603751N	RETRACT ELM	04	86,839	82,241					U
69	0603764M	LINK EVERGREEN	04	184,322	264,394					U
70	0603790N	NATO Research and Development	04	6,717	5,805					U
71	0603795N	Land Attack Technology	04	5,734	4,017					U
72	0603851M	Joint Non-Lethal Weapons Testing	04	27,606	28,168					U
73	0603860N	Joint Precision Approach and Landing Systems - Dem/Val	04	30,853	22,950					U
74	0603925N	Directed Energy and Electric Weapon Systems	04	123,403	81,803					U

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

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Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
59	0603654N	Joint Service Explosive Ordnance Development	04		34,785	36,496	U
60	0603713N	Ocean Engineering Technology Development	04		8,774	6,193	U
61	0603721N	Environmental Protection	04		20,677	21,647	U
62	0603724N	Navy Energy Program	04		66,824	60,320	U
63	0603725N	Facilities Improvement	04		6,327	5,664	U
64	0603734N	CHALK CORAL	04		579,389	833,634	U
65	0603739N	Navy Logistic Productivity	04		669	899	U
66	0603746N	RETRACT MAPLE	04		295,295	363,973	U
67	0603748N	LINK PLUMERIA	04		663,780	1,038,661	U
68	0603751N	RETRACT ELM	04		82,241	83,445	U
69	0603764M	LINK EVERGREEN	04		264,394	313,761	U
70	0603790N	NATO Research and Development	04		5,805	8,041	U
71	0603795N	Land Attack Technology	04		4,017	358	U
72	0603851M	Joint Non-Lethal Weapons Testing	04		28,168	30,533	U
73	0603860N	Joint Precision Approach and Landing Systems - Dem/Val	04		22,950	18,628	U
74	0603925N	Directed Energy and Electric Weapon Systems	04		81,803	65,080	U

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Line	Program Element No Number	Item ----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
75	0604014N	F/A -18 Infrared Search and Track (IRST)	04	81,838	48,793					U
76	0604027N	Digital Warfare Office	04	34,943	46,769					U
77	0604028N	Small and Medium Unmanned Undersea Vehicles	04	37,754	79,947					U
78	0604029N	Unmanned Undersea Vehicle Core Technologies	04	43,561	64,860					U
79	0604030N	Rapid Prototyping, Experimentation and Demonstration.	04	11,697						U
80	0604031N	Large Unmanned Undersea Vehicles	04	60,446	65,672					U
81	0604112N	Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 - 80)	04	111,554	121,509					U
82	0604126N	Littoral Airborne MCM	04	17,433	18,669					U
83	0604127N	Surface Mine Countermeasures	04	18,050	12,507					U
84	0604272N	Tactical Air Directional Infrared Countermeasures (TADIRCM)	04	47,912	33,246					U
85	0604289M	Next Generation Logistics	04	4,827	8,071					U
86	0604292N	Future Vertical Lift (Maritime Strike)	04	5,038	8,274					U
87	0604320M	Rapid Technology Capability Prototype	04	5,514	11,555					U
88	0604454N	LX (R)	04	10,005	3,344					U

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Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
75	0604014N	F/A -18 Infrared Search and Track (IRST)	04		48,793	40,069	U
76	0604027N	Digital Warfare Office	04		46,769	165,753	U
77	0604028N	Small and Medium Unmanned Undersea Vehicles	04		79,947	106,347	U
78	0604029N	Unmanned Undersea Vehicle Core Technologies	04		64,860	60,697	U
79	0604030N	Rapid Prototyping, Experimentation and Demonstration.	04			57,000	U
80	0604031N	Large Unmanned Undersea Vehicles	04		65,672		U
81	0604112N	Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 - 80)	04		121,509	116,498	U
82	0604126N	Littoral Airborne MCM	04		18,669	47,389	U
83	0604127N	Surface Mine Countermeasures	04		12,507	12,959	U
84	0604272N	Tactical Air Directional Infrared Countermeasures (TADIRCM)	04		33,246	15,028	U
85	0604289M	Next Generation Logistics	04		8,071	2,342	U
86	0604292N	Future Vertical Lift (Maritime Strike)	04		8,274	5,103	U
87	0604320M	Rapid Technology Capability Prototype	04		11,555	62,927	U
88	0604454N	LX (R)	04		3,344	26,630	U

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Line	Program Element No Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
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89	0604536N	Advanced Undersea Prototyping	04	86,011	31,609					U
90	0604636N	Counter Unmanned Aircraft Systems (C-UAS)	04	2,518	5,529					U
91	0604659N	Precision Strike Weapons Development Program	04	78,493	89,513					U
92	0604707N	Space and Electronic Warfare (SEW) Architecture/Engineering Support	04	5,969	9,340					U
93	0604786N	Offensive Anti-Surface Warfare Weapon Development	04	45,462	70,792					U
94	0605512N	MEDIUM UNMANNED SURFACE VEHICLES (MUSVs))	04	53,402	60,020					U
95	0605513N	Unmanned Surface Vehicle Enabling Capabilities	04		119,560					U
96	0605514M	GROUND BASED ANTI-SHIP MISSILE	04	28,194	102,716					U
97	0605516M	LONG RANGE FIRES	04	54,373	88,479					U
98	0605518N	CONVENTIONAL PROMPT STRIKE (CPS)	04	747,354	1,325,232					U
99	0303354N	ASW Systems Development - MIP	04	9,151	8,536					U
100	0304240M	Advanced Tactical Unmanned Aircraft System	04	28,125	31,204					U
101	0304270N	Electronic Warfare Development - MIP	04	805	506					U
				-----	-----	-----	-----	-----	-----	
		Advanced Component Development & Prototypes		5,315,053	6,882,455					

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Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
89	0604536N	Advanced Undersea Prototyping	04		31,609	116,880	U
90	0604636N	Counter Unmanned Aircraft Systems (C-UAS)	04		5,529	7,438	U
91	0604659N	Precision Strike Weapons Development Program	04		89,513	84,734	U
92	0604707N	Space and Electronic Warfare (SEW) Architecture/Engineering Support	04		9,340	10,229	U
93	0604786N	Offensive Anti-Surface Warfare Weapon Development	04		70,792	124,204	U
94	0605512N	MEDIUM UNMANNED SURFACE VEHICLES (MUSVs))	04		60,020	104,000	U
95	0605513N	Unmanned Surface Vehicle Enabling Capabilities	04		119,560	181,620	U
96	0605514M	GROUND BASED ANTI-SHIP MISSILE	04		102,716	43,090	U
97	0605516M	LONG RANGE FIRES	04		88,479	36,693	U
98	0605518N	CONVENTIONAL PROMPT STRIKE (CPS)	04		1,325,232	1,205,041	U
99	0303354N	ASW Systems Development - MIP	04		8,536	9,856	U
100	0304240M	Advanced Tactical Unmanned Aircraft System	04		31,204	1,735	U
101	0304270N	Electronic Warfare Development - MIP	04		506	796	U
		Advanced Component Development & Prototypes		-----	6,882,455	8,405,310	

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(Dollars in Thousands)

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

Line	Program Element No Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
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102	0603208N	Training System Aircraft	05	4,299	5,864					U
103	0604038N	Maritime Targeting Cell	05							U
104	0604212N	Other Helo Development	05	22,579	49,312					U
105	0604214M	AV-8B Aircraft - Eng Dev	05	16,543	10,146					U
106	0604215N	Standards Development	05	4,053	4,082					U
107	0604216N	Multi-Mission Helicopter Upgrade Development	05	35,671	54,418					U
108	0604221N	P-3 Modernization Program	05	583	579					U
109	0604230N	Warfare Support System	05	14,541	13,167					U
110	0604231N	Command and Control Systems	05	117,688	122,913					U
111	0604234N	Advanced Hawkeye	05	268,681	348,360					U
112	0604245M	H-1 Upgrades	05	55,877	50,158					U
113	0604261N	Acoustic Search Sensors	05	45,697	49,057					U
114	0604262N	V-22A	05	128,400	105,729					U
115	0604264N	Air Crew Systems Development	05	20,740	20,746					U
116	0604269N	EA-18	05	104,003	59,674					U
117	0604270N	Electronic Warfare Development	05	123,447	136,593					U
118	0604273M	Executive Helo Development	05	93,878	41,847					U
119	0604274N	Next Generation Jammer (NGJ)	05	435,381	235,407					U

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

Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
102	0603208N	Training System Aircraft	05		5,864	15,128	U
103	0604038N	Maritime Targeting Cell	05			39,600	U
104	0604212N	Other Helo Development	05		49,312	66,010	U
105	0604214M	AV-8B Aircraft - Eng Dev	05		10,146	9,205	U
106	0604215N	Standards Development	05		4,082	3,766	U
107	0604216N	Multi-Mission Helicopter Upgrade Development	05		54,418	44,684	U
108	0604221N	P-3 Modernization Program	05		579	343	U
109	0604230N	Warfare Support System	05		13,167	12,337	U
110	0604231N	Command and Control Systems	05		122,913	143,575	U
111	0604234N	Advanced Hawkeye	05		348,360	502,956	U
112	0604245M	H-1 Upgrades	05		50,158	43,759	U
113	0604261N	Acoustic Search Sensors	05		49,057	50,231	U
114	0604262N	V-22A	05		105,729	125,233	U
115	0604264N	Air Crew Systems Development	05		20,746	43,282	U
116	0604269N	EA-18	05		59,674	116,589	U
117	0604270N	Electronic Warfare Development	05		136,593	141,138	U
118	0604273M	Executive Helo Development	05		41,847	45,645	U
119	0604274N	Next Generation Jammer (NGJ)	05		235,407	54,679	U

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Line	Program Element No Number	Item ----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
120	0604280N	Joint Tactical Radio System - Navy (JTRS-Navy)	05	223,551	234,434					U
121	0604282N	Next Generation Jammer (NGJ) Increment II	05	119,568	146,596					U
122	0604307N	Surface Combatant Combat System Engineering	05	346,832	331,820					U
123	0604311N	LPD-17 Class Systems Integration	05	904	904					U
124	0604329N	Small Diameter Bomb (SDB)	05	50,003	40,852					U
125	0604366N	Standard Missile Improvements	05	295,589	343,511					U
126	0604373N	Airborne MCM	05	10,436	10,881					U
127	0604378N	Naval Integrated Fire Control - Counter Air Systems Engineering	05	41,929	50,233					U
128	0604419N	Advanced Sensors Application Program (ASAP)	05	12,483	10,000					U
129	0604501N	Advanced Above Water Sensors	05	64,544	62,028					U
130	0604503N	SSN-688 and Trident Modernization	05	93,879	95,693					U
131	0604504N	Air Control	05	40,284	27,499					U
132	0604512N	Shipboard Aviation Systems	05	9,104	8,924					U
133	0604518N	Combat Information Center Conversion	05	12,333	11,631					U
134	0604522N	Air and Missile Defense Radar (AMDR) System	05	59,561	87,364					U

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Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
120	0604280N	Joint Tactical Radio System - Navy (JTRS-Navy)	05		234,434	329,787	U
121	0604282N	Next Generation Jammer (NGJ) Increment II	05		146,596	301,737	U
122	0604307N	Surface Combatant Combat System Engineering	05		331,820	347,233	U
123	0604311N	LPD-17 Class Systems Integration	05		904		U
124	0604329N	Small Diameter Bomb (SDB)	05		40,852	42,881	U
125	0604366N	Standard Missile Improvements	05		343,511	319,943	U
126	0604373N	Airborne MCM	05		10,881	10,882	U
127	0604378N	Naval Integrated Fire Control - Counter Air Systems Engineering	05		50,233	45,892	U
128	0604419N	Advanced Sensors Application Program (ASAP)	05		10,000		U
129	0604501N	Advanced Above Water Sensors	05		62,028	81,254	U
130	0604503N	SSN-688 and Trident Modernization	05		95,693	93,501	U
131	0604504N	Air Control	05		27,499	39,138	U
132	0604512N	Shipboard Aviation Systems	05		8,924	11,759	U
133	0604518N	Combat Information Center Conversion	05		11,631	11,160	U
134	0604522N	Air and Missile Defense Radar (AMDR) System	05		87,364	87,459	U

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135	0604530N	Advanced Arresting Gear (AAG)	05	63,702	147					U
136	0604558N	New Design SSN	05	233,335	486,938					U
137	0604562N	Submarine Tactical Warfare System	05	69,351	62,115					U
138	0604567N	Ship Contract Design/ Live Fire T&E	05	61,758	54,829					U
139	0604574N	Navy Tactical Computer Resources	05	3,798	4,290					U
140	0604601N	Mine Development	05	74,793	37,758					U
141	0604610N	Lightweight Torpedo Development	05	113,219	94,386					U
142	0604654N	Joint Service Explosive Ordnance Development	05	8,294	8,348					U
143	0604657M	USMC Ground Combat/Supporting Arms Systems - Eng Dev	05	28,472	42,144					U
144	0604703N	Personnel, Training, Simulation, and Human Factors	05	6,884	7,375					U
145	0604727N	Joint Standoff Weapon Systems	05	27,453						U
146	0604755N	Ship Self Defense (Detect & Control)	05	139,001	142,595					U
147	0604756N	Ship Self Defense (Engage: Hard Kill)	05	92,547	107,427					U
148	0604757N	Ship Self Defense (Engage: Soft Kill/EW)	05	82,933	65,307					U
149	0604761N	Intelligence Engineering	05	12,088	20,684					U

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Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
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135	0604530N	Advanced Arresting Gear (AAG)	05		147	151	U
136	0604558N	New Design SSN	05		486,938	307,585	U
137	0604562N	Submarine Tactical Warfare System	05		62,115	58,741	U
138	0604567N	Ship Contract Design/ Live Fire T&E	05		54,829	60,791	U
139	0604574N	Navy Tactical Computer Resources	05		4,290	4,177	U
140	0604601N	Mine Development	05		37,758	60,793	U
141	0604610N	Lightweight Torpedo Development	05		94,386	142,000	U
142	0604654N	Joint Service Explosive Ordnance Development	05		8,348	8,618	U
143	0604657M	USMC Ground Combat/Supporting Arms Systems - Eng Dev	05		42,144	45,025	U
144	0604703N	Personnel, Training, Simulation, and Human Factors	05		7,375	7,454	U
145	0604727N	Joint Standoff Weapon Systems	05			758	U
146	0604755N	Ship Self Defense (Detect & Control)	05		142,595	159,426	U
147	0604756N	Ship Self Defense (Engage: Hard Kill)	05		107,427	71,818	U
148	0604757N	Ship Self Defense (Engage: Soft Kill/EW)	05		65,307	92,687	U
149	0604761N	Intelligence Engineering	05		20,684	23,742	U

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

Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
150	0604771N	Medical Development	05	38,264	31,467					U
151	0604777N	Navigation/ID System	05	48,237	50,037					U
152	0604800M	Joint Strike Fighter (JSF) - EMD	05	539	577					U
153	0604800N	Joint Strike Fighter (JSF) - EMD	05	240	262					U
154	0604850N	SSN(X)	05	990	29,548					U
155	0605013M	Information Technology Development	05	1,097	11,277					U
156	0605013N	Information Technology Development	05	249,778	271,085					U
157	0605024N	Anti-Tamper Technology Support	05	7,702	8,426					U
158	0605180N	TACAMO Modernization	05		50,592					U
159	0605212M	CH-53K RDTE	05	392,433	256,903					U
160	0605215N	Mission Planning	05	77,804	88,128					U
161	0605217N	Common Avionics	05	52,279	60,117					U
162	0605220N	Ship to Shore Connector (SSC)	05	12,335	6,320					U
163	0605327N	T-AO 205 Class	05	2,045	4,336					U
164	0605414N	Unmanned Carrier Aviation (UCA)	05	252,435	261,992					U
165	0605450M	Joint Air-to-Ground Missile (JAGM)	05	12,683	356					U
166	0605500N	Multi-mission Maritime Aircraft (MMA)	05	23,266	27,279					U

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

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Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
150	0604771N	Medical Development	05		31,467	3,178	U
151	0604777N	Navigation/ID System	05		50,037	53,209	U
152	0604800M	Joint Strike Fighter (JSF) - EMD	05		577	611	U
153	0604800N	Joint Strike Fighter (JSF) - EMD	05		262	234	U
154	0604850N	SSN(X)	05		29,548	143,949	U
155	0605013M	Information Technology Development	05		11,277	11,361	U
156	0605013N	Information Technology Development	05		271,085	290,353	U
157	0605024N	Anti-Tamper Technology Support	05		8,426	7,271	U
158	0605180N	TACAMO Modernization	05		50,592	554,193	U
159	0605212M	CH-53K RDTE	05		256,903	220,240	U
160	0605215N	Mission Planning	05		88,128	71,107	U
161	0605217N	Common Avionics	05		60,117	77,960	U
162	0605220N	Ship to Shore Connector (SSC)	05		6,320	2,886	U
163	0605327N	T-AO 205 Class	05		4,336	220	U
164	0605414N	Unmanned Carrier Aviation (UCA)	05		261,992	265,646	U
165	0605450M	Joint Air-to-Ground Missile (JAGM)	05		356	371	U
166	0605500N	Multi-mission Maritime Aircraft (MMA)	05		27,279	37,939	U

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(Dollars in Thousands)

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Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
167	0605504N	Multi-Mission Maritime (MMA) Increment III	05	178,681	162,884					U
168	0605611M	Marine Corps Assault Vehicles System Development & Demonstration	05	41,259	73,709					U
169	0605813M	Joint Light Tactical Vehicle (JLTV) System Development & Demonstration	05	2,490	2,005					U
170	0204202N	DDG-1000	05	216,951	112,576					U
171	0301377N	Countering Advanced Conventional Weapons (CACW)	05							U
172	0303267N	Auctioned Spectrum Relocation Fund	05	82,773						U
173	0303667N	Citizen Broadband Radio System	05	1,239						U
174	0303767N	AMBIT - Pre-Auctioned SRF	05	15,985						U
175	0304785N	ISR & Info Operations	05	107,964	136,134					U
176	0306250M	Cyber Operations Technology Development	05	24,539	23,768					U
		System Development & Demonstration		5,734,697	5,574,543					
177	0604256N	Threat Simulator Development	06	21,715	57,962					U
178	0604258N	Target Systems Development	06	9,882	20,113					U
179	0604759N	Major T&E Investment	06	104,170	96,617					U
180	0605152N	Studies and Analysis Support - Navy	06	3,051	3,108					U

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**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

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Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
167	0605504N	Multi-Mission Maritime (MMA) Increment III	05		162,884	161,697	U
168	0605611M	Marine Corps Assault Vehicles System Development & Demonstration	05		73,709	94,569	U
169	0605813M	Joint Light Tactical Vehicle (JLTV) System Development & Demonstration	05		2,005	2,856	U
170	0204202N	DDG-1000	05		112,576	197,436	U
171	0301377N	Countering Advanced Conventional Weapons (CACW)	05			12,341	U
172	0303267N	Auctioned Spectrum Relocation Fund	05				U
173	0303667N	Citizen Broadband Radio System	05				U
174	0303767N	AMBIT - Pre-Auctioned SRF	05				U
175	0304785N	ISR & Info Operations	05		136,134	135,366	U
176	0306250M	Cyber Operations Technology Development	05		23,768	37,038	U
		System Development & Demonstration		-----	5,574,543	6,606,583	
177	0604256N	Threat Simulator Development	06		57,962	29,430	U
178	0604258N	Target Systems Development	06		20,113	13,708	U
179	0604759N	Major T&E Investment	06		96,617	95,316	U
180	0605152N	Studies and Analysis Support - Navy	06		3,108	3,286	U

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Line	Program Element No Number	Item ----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
181	0605154N	Center for Naval Analyses	06	42,001	34,227					U
182	0605502N	Small Business Innovative Research	06	491,676						U
183	0605804N	Technical Information Services	06	1,405	934					U
184	0605853N	Management, Technical & International Support	06	109,329	108,055					U
185	0605856N	Strategic Technical Support	06	3,666	3,538					U
186	0605863N	RDT&E Ship and Aircraft Support	06	102,713	135,149					U
187	0605864N	Test and Evaluation Support	06	417,646	446,277					U
188	0605865N	Operational Test and Evaluation Capability	06	25,126	24,872					U
189	0605866N	Navy Space and Electronic Warfare (SEW) Support	06	15,127	17,653					U
190	0605867N	SEW Surveillance/Reconnaissance Support	06	8,559	8,065					U
191	0605873M	Marine Corps Program Wide Support	06	36,826	43,524					U
192	0605898N	Management HQ - R&D	06	38,826	35,614					U
193	0606355N	Warfare Innovation Management	06	31,977	38,958					U
194	0305327N	Insider Threat	06	2,133	2,581					U
195	0902498N	Management Headquarters (Departmental Support Activities)	06	1,546	1,747					U
196	0909980N	Judgment Fund Reimbursement	06	189						U

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

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Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	S e c
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181	0605154N	Center for Naval Analyses	06		34,227	40,624	U
182	0605502N	Small Business Innovative Research	06				U
183	0605804N	Technical Information Services	06		934	987	U
184	0605853N	Management, Technical & International Support	06		108,055	105,152	U
185	0605856N	Strategic Technical Support	06		3,538	3,787	U
186	0605863N	RDT&E Ship and Aircraft Support	06		135,149	173,352	U
187	0605864N	Test and Evaluation Support	06		446,277	468,281	U
188	0605865N	Operational Test and Evaluation Capability	06		24,872	27,808	U
189	0605866N	Navy Space and Electronic Warfare (SEW) Support	06		17,653	27,175	U
190	0605867N	SEW Surveillance/Reconnaissance Support	06		8,065	7,186	U
191	0605873M	Marine Corps Program Wide Support	06		43,524	39,744	U
192	0605898N	Management HQ - R&D	06		35,614	40,648	U
193	0606355N	Warfare Innovation Management	06		38,958	52,060	U
194	0305327N	Insider Threat	06		2,581	2,315	U
195	0902498N	Management Headquarters (Departmental Support Activities)	06		1,747	1,811	U
196	0909980N	Judgment Fund Reimbursement	06				U

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Line	Program Element No Number	Item ----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
197	0909999N	Financing for Cancelled Account Adjustments	06	1,454						U
		Management Support		1,469,017	1,078,994					
198	0603273N	Science & Technology for Nuclear Re-entry Systems	07							U
200	0604227N	HARPOON Modifications	07	694						U
201	0604840M	F-35 C2D2	07	378,495	515,746					U
202	0604840N	F-35 C2D2	07	377,005	486,962					U
203	0605520M	MARINE CORPS AIR DEFENSE WEAPONS SYSTEMS	07	119,512	61,381					U
204	0607658N	Cooperative Engagement Capability (CEC)	07	129,578	162,676					U
205	0101221N	Strategic Sub & Weapons System Support	07	121,171	186,998					U
206	0101224N	SSBN Security Technology Program	07	44,636	45,587					U
207	0101226N	Submarine Acoustic Warfare Development	07	37,250	59,752					U
208	0101402N	Navy Strategic Communications	07	40,121	35,451					U
209	0204136N	F/A-18 Squadrons	07	179,099	219,224					U
210	0204228N	Surface Support	07	32,533	13,733					U
211	0204229N	Tomahawk and Tomahawk Mission Planning Center (TMPC)	07	193,318	132,181					U

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Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
197	0909999N	Financing for Cancelled Account Adjustments	06				U
		Management Support			1,078,994	1,132,670	
198	0603273N	Science & Technology for Nuclear Re-entry Systems	07			65,735	U
200	0604227N	HARPOON Modifications	07				U
201	0604840M	F-35 C2D2	07		515,746	525,338	U
202	0604840N	F-35 C2D2	07		486,962	491,513	U
203	0605520M	MARINE CORPS AIR DEFENSE WEAPONS SYSTEMS	07		61,381	48,663	U
204	0607658N	Cooperative Engagement Capability (CEC)	07		162,676	156,121	U
205	0101221N	Strategic Sub & Weapons System Support	07		186,998	284,502	U
206	0101224N	SSBN Security Technology Program	07		45,587	50,939	U
207	0101226N	Submarine Acoustic Warfare Development	07		59,752	81,237	U
208	0101402N	Navy Strategic Communications	07		35,451	49,424	U
209	0204136N	F/A-18 Squadrons	07		219,224	238,974	U
210	0204228N	Surface Support	07		13,733	12,197	U
211	0204229N	Tomahawk and Tomahawk Mission Planning Center (TMPC)	07		132,181	132,719	U

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Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
212	0204311N	Integrated Surveillance System	07	112,574	84,037					U
213	0204313N	Ship-Towed Array Surveillance Systems	07	10,825	6,261					U
214	0204413N	Amphibious Tactical Support Units (Displacement Craft)	07	1,672	1,657					U
215	0204460M	Ground/Air Task Oriented Radar (G/ATOR)	07	21,563	45,221					U
216	0204571N	Consolidated Training Systems Development	07	70,518	52,741					U
217	0204575N	Electronic Warfare (EW) Readiness Support	07	39,502	55,528					U
218	0205601N	Anti-Radiation Missile Improvement	07	156,551	138,520					U
219	0205620N	Surface ASW Combat System Integration	07	28,085	28,804					U
220	0205632N	MK-48 ADCAP	07	69,418	100,759					U
221	0205633N	Aviation Improvements	07	122,884	144,621					U
222	0205675N	Operational Nuclear Power Systems	07	110,313	113,760					U
223	0206313M	Marine Corps Communications Systems	07	75,014	108,695					U
224	0206335M	Common Aviation Command and Control System (CAC2S)	07	4,311	12,869					U
225	0206623M	Marine Corps Ground Combat/Supporting Arms Systems	07	49,901	103,810					U

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Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
212	0204311N	Integrated Surveillance System	07		84,037	68,417	U
213	0204313N	Ship-Towed Array Surveillance Systems	07		6,261	1,188	U
214	0204413N	Amphibious Tactical Support Units (Displacement Craft)	07		1,657	1,789	U
215	0204460M	Ground/Air Task Oriented Radar (G/ATOR)	07		45,221	61,422	U
216	0204571N	Consolidated Training Systems Development	07		52,741	70,339	U
217	0204575N	Electronic Warfare (EW) Readiness Support	07		55,528	47,436	U
218	0205601N	Anti-Radiation Missile Improvement	07		138,520	90,779	U
219	0205620N	Surface ASW Combat System Integration	07		28,804	28,999	U
220	0205632N	MK-48 ADCAP	07		100,759	155,868	U
221	0205633N	Aviation Improvements	07		144,621	130,450	U
222	0205675N	Operational Nuclear Power Systems	07		113,760	121,439	U
223	0206313M	Marine Corps Communications Systems	07		108,695	114,305	U
224	0206335M	Common Aviation Command and Control System (CAC2S)	07		12,869	14,865	U
225	0206623M	Marine Corps Ground Combat/Supporting Arms Systems	07		103,810	100,536	U

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Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
226	0206624M	Marine Corps Combat Services Support	07	9,832	21,185					U
227	0206625M	USMC Intelligence/Electronic Warfare Systems (MIP)	07	29,983	37,695					U
228	0206629M	Amphibious Assault Vehicle	07	5,188	7,551					U
229	0207161N	Tactical AIM Missiles	07	5,715	23,881					U
230	0207163N	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	39,286	32,564					U
231	0208043N	Planning and Decision Aid System (PDAS)	07		3,101					U
235	0303109N	Satellite Communications (SPACE)	07	48,708						U
236	0303138N	Afloat Networks	07	36,380	36,879					U
237	0303140N	Information Systems Security Program	07	38,112	33,311					U
238	0305192N	Military Intelligence Program (MIP) Activities	07	6,136	7,514					U
239	0305204N	Tactical Unmanned Aerial Vehicles	07	7,108	9,837					U
240	0305205N	UAS Integration and Interoperability	07	61,198	5,000					U
241	0305208M	Distributed Common Ground/Surface Systems	07	21,500	29,749					U
242	0305220N	MQ-4C Triton	07	11,120	13,029					U

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Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
226	0206624M	Marine Corps Combat Services Support	07		21,185	26,522	U
227	0206625M	USMC Intelligence/Electronic Warfare Systems (MIP)	07		37,695	51,976	U
228	0206629M	Amphibious Assault Vehicle	07		7,551	8,246	U
229	0207161N	Tactical AIM Missiles	07		23,881	29,236	U
230	0207163N	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07		32,564	30,898	U
231	0208043N	Planning and Decision Aid System (PDAS)	07		3,101	3,609	U
235	0303109N	Satellite Communications (SPACE)	07				U
236	0303138N	Afloat Networks	07		36,879	45,693	U
237	0303140N	Information Systems Security Program	07		33,311	33,752	U
238	0305192N	Military Intelligence Program (MIP) Activities	07		7,514	8,415	U
239	0305204N	Tactical Unmanned Aerial Vehicles	07		9,837	10,576	U
240	0305205N	UAS Integration and Interoperability	07		5,000	18,373	U
241	0305208M	Distributed Common Ground/Surface Systems	07		29,749	45,705	U
242	0305220N	MQ-4C Triton	07		13,029	13,893	U

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

Line	Program Element No Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
--	-----	----	---	-----	-----	-----	-----	-----	-----	-
243	0305231N	MQ-8 UAV	07	28,968	33,543					U
244	0305232M	RQ-11 UAV	07	537	533					U
245	0305234N	Small (Level 0) Tactical UAS (STUASL0)	07	8,773	1,772					U
246	0305239M	RQ-21A	07	10,853						U
247	0305241N	Multi-Intelligence Sensor Development	07	60,211	59,252					U
248	0305242M	Unmanned Aerial Systems (UAS) Payloads (MIP)	07	5,000	9,274					U
249	0305251N	Cyberspace Operations Forces and Force Support	07	33,454	36,378					U
250	0305421N	RQ-4 Modernization	07	129,164	134,323					U
251	0307577N	Intelligence Mission Data (IMD)	07		907					U
252	0308601N	Modeling and Simulation Support	07	8,494	9,772					U
253	0702207N	Depot Maintenance (Non-IF)	07	35,435	35,030					U
254	0708730N	Maritime Technology (MARITECH)	07	6,406	6,329					U
255	1203109N	Satellite Communications (SPACE)	07	35,128						U
9999	9999999999	Classified Programs		1,817,981	2,093,876				31,100	U
		Operational Systems Development		5,027,213	5,599,259					
256	0608013N	Risk management Information - Software Pilot Program	08	13,394	13,703					U

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

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Department of the Navy
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

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

Line	Program Element No Number	Item ----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
243	0305231N	MQ-8 UAV	07		33,543		U
244	0305232M	RQ-11 UAV	07		533	1,234	U
245	0305234N	Small (Level 0) Tactical UAS (STUASL0)	07		1,772	3,761	U
246	0305239M	RQ-21A	07				U
247	0305241N	Multi-Intelligence Sensor Development	07		59,252	56,261	U
248	0305242M	Unmanned Aerial Systems (UAS) Payloads (MIP)	07		9,274	9,780	U
249	0305251N	Cyberspace Operations Forces and Force Support	07		36,378	36,505	U
250	0305421N	RQ-4 Modernization	07		134,323	163,277	U
251	0307577N	Intelligence Mission Data (IMD)	07		907	851	U
252	0308601N	Modeling and Simulation Support	07		9,772	9,437	U
253	0702207N	Depot Maintenance (Non-IF)	07		35,030	26,248	U
254	0708730N	Maritime Technology (MARITECH)	07		6,329	2,133	U
255	1203109N	Satellite Communications (SPACE)	07				U
9999	9999999999	Classified Programs		31,100	2,124,976	1,701,811	U
		Operational Systems Development			5,630,359	5,483,386	
256	0608013N	Risk management Information - Software Pilot Program	08		13,703	12,810	U

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Department of the Navy
FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

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

Line	Program Element No Number	Item -----	Act ---	FY 2021 (Base + OCO) -----	FY 2022 Less Supplementals Enactment -----	FY 2022 Division B Division C P.L.117-43 Enactment* -----	FY 2022 Division B P.L.117-70 Enactment** -----	FY 2022 Division A P.L. 117-86 Enactment*** -----	FY 2022 Division N P.L. 117-103 Enactment**** -----	S e c -
257	0608231N	Maritime Tactical Command and Control (MTC2) - Software Pilot Program	08	10,969	14,843					U
		Software and Digital Technology Pilot Progr		24,363	28,546					
				20,151,249	22,121,338					
		Total Research, Development, Test & Eval, Navy								

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

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FY 2023 President's Budget
Exhibit R-1 FY 2023 President's Budget
Total Obligational Authority
(Dollars in Thousands)

				FY 2022		S	
Line	Program			Total	FY 2022	e	
No	Element	Item	Act	Supplemental	Total	c	
--	-----	----	---	Enactment	Enactment	Request	
				-----	-----	-----	
257	0608231N	Maritime Tactical Command and Control (MTC2) - Software Pilot Program	08		14,843	11,198	U
		Software and Digital Technology Pilot Progr		-----	-----	-----	
					28,546	24,008	
				-----	-----	-----	
Total Research, Development, Test & Eval, Navy					22,152,438	24,078,718	

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19	03	0603640M	MC Advanced Technology Demo.....	Volume 1 - 381
20	03	0603651M	JT Non-Lethal Wpns Tech Dev.....	Volume 1 - 431
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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy</i> / BA 1: <i>Basic Research</i>					R-1 Program Element (Number/Name) PE 0601103N / <i>University Research Initiatives</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	139.627	174.898	90.076	-	90.076	122.489	124.939	127.444	129.993	Continuing	Continuing
0000: <i>University Research Initiatives</i>	0.000	112.597	117.448	90.076	-	90.076	122.489	124.939	127.444	129.993	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	27.030	57.450	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	84.480

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to ensure the technological advantage of U.S. Naval forces. ONR fosters scientific research necessary for the discovery, development and delivery of new technologies. Often this research is done in partnership with academia. This program includes support for multidisciplinary basic research in a wide range of naval relevant scientific and engineering disciplines that enables the U.S. Navy to maintain technological superiority and for the university research infrastructure to acquire the 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 lay the foundations for 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. This program supports Presidential Early Career Awards for Scientists and Engineers (PECASE) which are 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. The Minerva Research Initiative is funded in partnership with the Office of the Secretary of Defense to support basic social science and multi-disciplinary research aimed at improving national security and international stability. The goals of this program are to enhance connections between DoD and academia and build cultural and foreign area knowledge on topics ranging from the mechanisms of radicalization to geopolitical power projection strategies in a multi-polar world.

The missions of today's Sailors and Marines are enabled by the results of naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Basic Research, typically defined as systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. The work in this PE can be classified between Technology Readiness Level (TRL) 1 (basic principles observed and reported) and TRL 2 (technology concept and/or application formulation).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
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				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		144.102	117.448	0.000	-	0.000
Current President's Budget		139.627	174.898	90.076	-	90.076
Total Adjustments		-4.475	57.450	90.076	-	90.076
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	57.450			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-4.475	0.000			
• Program Adjustments		0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	90.076	-	90.076
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Defense University Research Instrumentation Program						
Congressional Add: Aircraft Fleet Readiness and Sustainment						
Congressional Add: University research initiatives						
Congressional Add: Coastal adapt. Res. for imp. coastal comm. and NWS earle military install. Resil						
Congressional Add: Navy aircraft fleet readiness and sustainment						
Congressional Add: Biocoherent energy transfer research						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Funding: No significant change.						
Technical: No significant change.						
Schedule: No significant change						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 1: Basic Research	R-1 Program Element (Number/Name) PE 0601103N / University Research Initiatives	
FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: University Research Initiatives	0.000	112.597	117.448	90.076	-	90.076	122.489	124.939	127.444	129.993	Continuing	Continuing
A. Mission Description and Budget Item Justification												
The Office of Naval Research's (ONR) mission is to ensure the technological advantage of U.S. Naval forces. ONR fosters scientific research necessary for the discovery, development and delivery of new technologies. Often this research is done in partnership with academia. This program includes support for multidisciplinary basic research in a wide range of naval relevant scientific and engineering disciplines that enables the U.S. Navy to maintain technological superiority and for the university research infrastructure to acquire the 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 lay the foundation for transition of results into Naval applications. The Defense University Research Instrumentation Program (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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Defense University Research Instrumentation Program (DURIP)								22.430	23.672	17.989	0.000	17.989
Description: DURIP funds are awarded to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator research grants. Individual grants range from \$50K to \$1.5M. Funding for DURIP efforts is awarded after the Office of the Secretary of Defense (OSD) selects and 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 billing occurs. It frequently takes several months for delivery and billing to be completed. DURIP is a one-year program.												
FY 2022 Plans:												
Funds will be awarded to support purchase or development of instrumentation to enhance Basic Research in various areas such as A Turboshaft Engine Test Stand for Particle Ingestion Research, Monitoring Decompression Illness during Undersea Missions, Sub Linear Machine learning, Acoustically equipped Gliders												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
for Marine Mammal, Metal Organic Chemical Vapor Deposition of Group III - Nitrides Oceanography Research Environment						
FY 2023 Base Plans: Funds will be awarded to support purchase or development of instrumentation to enhance Basic Research in various technical areas such as Micro-3-dimensional Printed Ion Traps, Networked Sensors for Observing the Air-Sea Interface, Atomic and Molecular Investigation of Corrosion for Prevention and Control, Atomic and Molecular Investigation of Corrosion for Prevention and Control, Versatile Legged Robots for Open-World Human-Robot Interaction in Mixed Initiative Teams, Interactions of Supersonic Projectiles with Large Droplets and Aerosol-laden Flows						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The FY22 to FY23 decrease in the budget request reflects reduced demand for DURIP grants resulting from delayed university execution to prior DURIP grants due to the Covid-19 pandemic. Fewer FY23 new DURIP awards are anticipated.						
Title: Multidisciplinary University Research Initiative (MURI)		78.860	82.156	63.257	0.000	63.257
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) Framework Priorities as described in the Naval Research and Development Framework. Funding for MURI efforts is awarded after Office of the Secretary of Defense (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 ramp up during the summer months. MURI projects make significant contributions to Navy and Department of Defense (DOD) objectives by speeding up scientific programs, by cross-fertilization of ideas, by hastening the transition of basic research to practical applications, and by training students in cross-disciplinary approaches to science and engineering research of importance to DoD. MURI projects are five-year programs.						
FY 2022 Plans:						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Support multidisciplinary research in areas such as molecular qubits, computer vision, ocean dynamics off rocky coasts, thermal transport, super-hard materials, social cyber-attack in social media, control theory of safe, cognitive, and learning systems. FY 2023 Base Plans: Continue to support research grants initiated in FY22 in the areas of Topologically-Protected Quantum Information, Molecular Doping of Organic Electronic Materials, Learning from Hearing, Hydrodynamics of Fish Schooling, Self-learning for Real-world Perception, Fundamental Non-equilibrium Processes in Weakly Ionized Hypersonic Flows, Understanding of Detonation Based Combustion in Multiphase Mixtures, Bioinspired Design of Energy-Self Sufficient Multi-functional Soft Material Systems, Systems-Level Foundations for Agile, Dynamic, and Ad Hoc Human Autonomy Teams, Environmental DNA-based Monitoring of the Marine Environment Continue to support multidisciplinary research in areas such as molecular qubits, computer vision, ocean dynamics off rocky coasts, thermal transport, super-hard materials, social cyber-attack in social media, control theory of safe, cognitive, and learning systems. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The FY22 to FY23 decrease in the budget request reflects reduced demand for FY23 incremental funds to existing multi-year MURI grants resulting from delayed university execution due to the Covid-19 pandemic. Fewer FY23 new MURI awards are also anticipated.						
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, awards a minimum of four new awards per year. PECASE is a five year program. FY 2022 Plans: Fund new basic research projects in Naval priority areas including statistical machine learning procedures that quantify sources of uncertainty in data analysis, nanophotonics and optical materials, deep learning for dexterous robotic manipulation, wireless communication and sensing systems.		8.457	8.916	6.775	0.000	6.775

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Support previous year ongoing basic research projects performed by early career investigators. FY 2023 Base Plans: - Continue to fund new basic research projects in Naval priority areas. - Continue to support previous year ongoing basic research projects performed by early career investigators. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The FY22 to FY23 decrease in the budget request reflects reduced demand for FY23 incremental funds to existing multi-year PECASE grants resulting from delayed university execution due to the Covid-19 pandemic. Fewer new FY23 PECASE awards are also anticipated.						
Title: Minerva Research Initiative (MRI) (Social Science Networking) Description: The Minerva Research Initiative is funded in partnership with the Office of the Secretary of Defense to support basic social science and multi-disciplinary research aimed at improving national security and international stability. The goals of this program are to enhance connections between DoD and academia and build cultural and foreign area knowledge on topics ranging from the mechanisms of radicalization to geopolitical power projection strategies in a multi-polar world. FY 2022 Plans: -Create novel techniques (e.g. social network analysis, social computational models, and, artificial Intelligence) that will enable the detection and source attribution of cyber malware incursions on large networked computer systems more quickly and accurately than is possible based on current manual approaches. -Discover large-data analytic techniques to detect and mitigate the occurrence of disinformation in social network systems more quickly and effectively than is currently possible. Techniques are sought that scale up to very large social networks and have the robustness to quickly adapt to emerging disinformation techniques. -Discover mechanisms of crowd manipulation, social hysteria, rumor and propaganda. FY 2023 Base Plans:		2.850	2.704	2.055	0.000	2.055

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 1		R-1 Program Element (Number/Name) PE 0601103N / <i>University Research Initiatives</i>		Project (Number/Name) 0000 / <i>University Research Initiatives</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Complete: Create novel techniques (e.g., social network analysis, social computational models, and, artificial Intelligence) that will enable the detection and source attribution of cyber malware incursions on large networked computer systems more quickly and accurately than is possible based on current manual approaches.</p> <p>Continue: Research large-data analytic techniques to detect and mitigate the occurrence of disinformation in social network systems more quickly and effectively than is currently possible. Techniques are sought that scale up to very large social networks and have the robustness to quickly adapt to emerging disinformation techniques. Discover mechanisms of crowd manipulation, social hysteria, rumor and propaganda.</p> <p>Initiate: Efforts to address novel conflict problems such as water security, malware, ransomware, social shifts relevant to national security issues, hybrid warfare and other novel conflict problems. This will include influence operations and social media threat vectors for information operations, recruitment and training issues and identity management.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The FY22 to FY23 decrease in the budget request reflects reduced demand for FY23 funds for continuing MRI grants resulting from delayed university execution due to the Covid-19 pandemic.</p>						
Accomplishments/Planned Programs Subtotals		112.597	117.448	90.076	0.000	90.076
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601103N / <i>University Research Initiatives</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	27.030	57.450	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	84.480

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Defense University Research Instrumentation Program	9.653	35.000
FY 2021 Accomplishments: Purchased instrumentation and equipment used to enhance university research in the areas of photonics; materials included high-temperature materials, soft multi-material structures, and photomechanical materials; autonomous and robotic systems; optical quantum information; oceanography; electronics; atmospheric turbulence; and distributed energy.		
FY 2022 Plans: Purchase instrumentation and equipment used to enhance university research in the areas of photonics; materials included high-temperature materials, soft multi-material structures, and photomechanical materials; autonomous and robotic systems; optical quantum information; oceanography; electronics; atmospheric turbulence; and distributed energy.		
Congressional Add: Aircraft Fleet Readiness and Sustainment	7.723	0.000
FY 2021 Accomplishments: Purchase equipment through DURIP to develop capabilities in the following areas (1) Understand Effects of Process Parameters on the Performance of Thermoplastics in Airframe Structural Applications (2) Cold Spray Additive Manufacturing for Rapid Sustainment Initiatives (3) Advanced Thermoplastic Integrated Structures produced by Automated Tool-less Manufacturing (4) Fiber Patch Placement for Aircraft Applications with Complex Contours and (5) Autonomous Repair Verifications and Inspections.		
FY 2022 Plans: N/A		
Congressional Add: University research initiatives	9.654	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601103N / <i>University Research Initiatives</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> Supported collaborative university research into the understanding, detection, and prevention of Traumatic Brain Injuries. Also, supported grants to purchase instrumentation and equipment to enhance university basic research. <i>FY 2022 Plans:</i> Support collaborative university research into the understanding, detection, and prevention of Traumatic Brain Injuries. Also, support grants to purchase instrumentation and equipment to enhance university basic research.		
<i>Congressional Add:</i> Coastal adapt. Res. for imp. coastal comm. and NWS earle military install. Resil <i>FY 2021 Accomplishments:</i> N/A <i>FY 2022 Plans:</i> Congressional Interest Items not included in other Projects.	0.000	0.450
<i>Congressional Add:</i> Navy aircraft fleet readiness and sustainment <i>FY 2021 Accomplishments:</i> N/A <i>FY 2022 Plans:</i> Navy aircraft fleet readiness and sustainment basic research	0.000	8.000
<i>Congressional Add:</i> Biocoherent energy transfer research <i>FY 2021 Accomplishments:</i> N/A <i>FY 2022 Plans:</i> Conduct Biocoherent energy transfer basci research	0.000	4.000
Congressional Adds Subtotals	27.030	57.450

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	18.362	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.362
0000: In-House Lab Independent Res	0.000	18.362	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.362

Note

Effective in FY 2022, In-house Laboratory Independent Research (ILIR) efforts and associated requirements are realigned from Program Element (PE) 0601152N, Project 0000 to PE 0601153N, Project 3465, and Science, Technology, Engineering and Math (STEM) efforts are realigned to PE 0601153N, Project 0000.

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to ensure the technological advantage of U.S. Naval forces. ONR fosters scientific research necessary for the discovery, development and delivery of new technologies. Naval laboratories funded by ONR provide cutting-edge solutions and to Navy and national challenges. The In-house Laboratory Independent Research (ILIR) program provides opportunities to strengthen the Naval Science and Engineering (S&E) workforce capabilities through basic research conducted at the Naval Warfare Centers and Laboratories. These research efforts address high risk/high payoff warfighter science and technological needs, as well as attract the next generation of researchers to consider employment within the Department of the Navy. ILIR also provides opportunities for advanced degrees, technical publications, presentations, and patents. The Science and Engineering Apprenticeship Program (SEAP) and the Naval Research Enterprise Intern Program (NREIP) summer programs encourage students to pursue science and engineering careers, further their education via mentoring by laboratory personnel, and participate in research, which can lead to employment within the Department of the Navy.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Basic Research and systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. The work in this PE can be classified between Technology Readiness Level (TRL) 1 (basic principles observed and reported) and TRL 2 (technology concept and/or application formulation).

Due to the number of efforts in PE 0601152N, the programs described herein are representative of the work included in this PE.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy / BA 1: Basic Research		PE 0601152N / In-House Lab Independent Res			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	19.030	0.000	0.000	-	0.000
Current President's Budget	18.362	0.000	0.000	-	0.000
Total Adjustments	-0.668	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.668	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
Change Summary Explanation					
Not applicable					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: In-House Lab Independent Res	0.000	18.362	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.362
A. Mission Description and Budget Item Justification												
<p>The Office of Naval Research's (ONR) mission is to ensure the technological advantage of U.S. Naval forces. ONR fosters scientific research necessary for the discovery, development and delivery of new technologies. Naval laboratories funded by ONR provide cutting-edge solutions and to Navy and national challenges. The In-house Laboratory Independent Research program provides opportunities to strengthen the Naval Science and Engineering workforce capabilities through basic research conducted at the Naval Warfare Centers and Laboratories. These research efforts address high risk/high payoff warfighter science and technological needs, as well as attract the next generation of researchers to consider employment within the Department of the Navy. ILIR also provides opportunities for advanced degrees, technical publications, presentations, and patents. The Science and Engineering Apprenticeship Program (SEAP) and the Naval Research Enterprise Intern Program (NREIP) summer programs encourage students to pursue science and engineering careers, further their education via mentoring by laboratory personnel, and participate in research, which can lead to employment within the Department of the Navy.</p> <p>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. It addresses the S&T research areas of the Naval Research and Development Framework 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 and the Marine Corps Combat Development Command and enables technologies that significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities.</p>												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: In-House Laboratory Independent Research (ILIR)								16.184	0.000	0.000	0.000	0.000
Description: The In-house Laboratory Independent Research program provides opportunities to strengthen the Naval Science and Engineering workforce capabilities through basic research conducted at the Naval Warfare Centers and Laboratories. These research efforts address high risk/high payoff warfighter science and technological needs, as well as attract the next generation of researchers to consider employment within the Department of the Navy. ILIR also provides opportunities for advanced degrees, technical publications, presentations, and patents.												
FY 2022 Plans: N/A												
FY 2023 Base Plans:												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity 1319 / 1		R-1 Program Element (Number/Name) PE 0601152N / <i>In-House Lab Independent Res</i>		Project (Number/Name) 0000 / <i>In-House Lab Independent Res</i>	
B. Accomplishments/Planned Programs (\$ in Millions)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A					
FY 2023 OCO Plans: N/A					
Title: Science Technology Engineering and Math (STEM) Efforts at Navy Labs 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 Department of the Navy (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. FY 2022 Plans: N/A FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A	2.178	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	18.362	0.000	0.000	0.000	0.000
C. Other Program Funding Summary (\$ in Millions) N/A					
Remarks					
D. Acquisition Strategy Not applicable.					

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 1: Basic Research</i>					R-1 Program Element (Number/Name) PE 0601153N / <i>Defense Research Sciences</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	471.367	523.324	499.116	-	499.116	510.975	530.788	496.339	481.944	Continuing	Continuing
0000: <i>Defense Research Sciences</i>	0.000	445.302	472.992	479.583	-	479.583	491.052	510.466	475.610	460.800	Continuing	Continuing
3465: <i>In-House Lab Independent Res</i>	0.000	0.000	11.332	19.533	-	19.533	19.923	20.322	20.729	21.144	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	26.065	39.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	65.065

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established by Congress in 1946 to plan, foster and encourage scientific research in recognition of its paramount importance to the maintenance of American naval power and national security. ONR manages the Department of the Navy's (DON) portfolio of Basic Research, Applied Research and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safely. This Program Element (PE) supports the Basic Research portion of the Department of the Navy (DON) science and technology (S&T) portfolio, laying the foundation for new innovative technologies and future capabilities for naval warfighters. This PE's efforts include theoretical and experimental investigations directed toward increasing knowledge and understanding of the physical, chemical, engineering, environmental and life sciences. The huge majority of the research in this PE are performed by academia and government labs, both of which play significant roles in developing the S&T workforce of tomorrow in addition to delivery new knowledge and scientific discoveries.

This PE, and the rest of Naval S&T, supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework. In addition, ONR's S&T investment portfolio supports National Naval Responsibilities (NNR) critical to the naval services where the Navy has historically taken the lead (ocean acoustics, undersea weapons, naval engineering, undersea medicine and sea-based aviation) to ensure decisive naval capability in the maritime domain. Scientific breakthroughs within the current research activities:

Atmosphere & Space Sciences;
 Mathematics, Computer, & Information Sciences;
 Ocean Sciences;
 Materials/Processes;
 Human Systems;
 Medical/Biology;
 Science Addressing Hybrid Threats;
 Sensors, Electronics & Electronic Warfare (EW);
 Air, Ground & Sea Vehicles;
 Weapons; and

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 1: Basic Research		R-1 Program Element (Number/Name) PE 0601153N / Defense Research Sciences				
Science & Engineering Education, Career Development & Outreach lead to more advanced aspects of applied research and technology development and become solutions to Navy and Marine Corps technical challenges via the Future Naval Capabilities (FNCs) pipeline, and new capability options for the future via the Innovative Naval Prototypes (INPs) portfolio. Just as today's Sailors and Marines are enabled by past naval S&T investments, current investments hedge against uncertainty, providing the scientific basis for near-term solutions to commanders today and options for an unknown future.						
The work in this PE can be classified between Technology Readiness Level (TRL) 1 (basic principles observed and reported) and TRL 2 (technology concept and/or application formulation).						
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		487.048	484.421	0.000	-	0.000
Current President's Budget		471.367	523.324	499.116	-	499.116
Total Adjustments		-15.681	38.903	499.116	-	499.116
• Congressional General Reductions		-	-0.097			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	39.000			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-2.788	0.000			
• SBIR/STTR Transfer		-12.893	0.000			
• Program Adjustments		0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	499.116	-	499.116
Congressional Add Details (\$ in Millions, and Includes General Reductions)					FY 2021	FY 2022
Project: 9999: Congressional Adds						
Congressional Add: Basic Research					0.000	25.000
Congressional Add: Defense Research Sciences					14.480	0.000
Congressional Add: Silicon-Germanium-Tin Alloy Research					4.827	0.000
Congressional Add: Bio-inspired Engineering and Design for Naval Applications					2.896	3.000
Congressional Add: Predictive Modeling & Simulation for Next Gen Naval Undersea Vessel and Platform					1.931	0.000
Congressional Add: USV Batteries, Materials, and Additive Manufacturing					1.931	0.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 1: Basic Research</i>		R-1 Program Element (Number/Name) PE 0601153N / <i>Defense Research Sciences</i>	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2021	FY 2022
Congressional Add: <i>Generally-capable robotics for naval operations</i>		0.000	4.000
Congressional Add: <i>Multifunctional structural batteries</i>		0.000	2.000
Congressional Add: <i>Silicon-germanium-tin alloy research</i>		0.000	5.000
Congressional Add Subtotals for Project: 9999		26.065	39.000
Congressional Add Totals for all Projects		26.065	39.000
Change Summary Explanation Funding: Additional increase in total budget request includes programmed increased investment in Vehicle Technologies; Materials Research; Computational Sciences; Ocean Science; Electronic Materials; and Navy STEM HBCU/MI outreach. Technical: not applicable Schedule: not applicable --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Defense Research Sciences	0.000	445.302	472.992	479.583	-	479.583	491.052	510.466	475.610	460.800	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established by Congress in 1946 to plan, foster and encourage scientific research in recognition of its paramount importance to the maintenance of American naval power and national security. ONR manages the Department of the Navy's (DON) portfolio of Basic Research, Applied Research and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safely. This Program Element (PE) supports the Basic Research portion of the Department of the Navy (DON) science and technology (S&T) portfolio, laying the foundation for new innovative technologies and future capabilities for naval warfighters. This PE's efforts include theoretical and experimental investigations directed toward increasing knowledge and understanding of the physical, chemical, engineering, environmental and life sciences. The huge majority of the research in this PE are performed by academia and government labs, both of which play significant roles in developing the S&T workforce of tomorrow in addition to delivery new knowledge and scientific discoveries.

This PE, and the rest of Naval S&T, supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework. In addition, ONR's S&T investment portfolio supports National Naval Responsibilities (NNR) critical to the naval services where the Navy has historically taken the lead (ocean acoustics, undersea weapons, naval engineering, undersea medicine and sea-based aviation) to ensure decisive naval capability in the maritime domain. Scientific breakthroughs within the current research activities:

Atmosphere & Space Sciences;

Mathematics, Computer, & Information Sciences;

Ocean Sciences;

Materials/Processes;

Human Systems;

Medical/Biology;

Science Addressing Hybrid Threats;

Sensors, Electronics & Electronic Warfare (EW);

Air, Ground & Sea Vehicles;

Weapons; and

Science & Engineering Education, Career Development & Outreach

lead to more advanced aspects of applied research and technology development and become solutions to Navy and Marine Corps technical challenges via the Future Naval Capabilities (FNCs) pipeline, and new capability options for the future via the Innovative Naval Prototypes (INPs) portfolio. Just as today's Sailors and Marines are enabled by past naval S&T investments, current investments hedge against uncertainty, providing the scientific basis for near-term solutions to commanders today and options for an unknown future.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 1		R-1 Program Element (Number/Name) PE 0601153N / Defense Research Sciences	Project (Number/Name) 0000 / Defense Research Sciences				
The work in this PE can be classified between Technology Readiness Level (TRL) 1 (basic principles observed and reported) and TRL 2 (technology concept and/or application formulation).							
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Air, Ground and Sea Vehicles			54.209	56.749	56.993	0.000	56.993
Description: Sailors and Marines operate air, ground and sea vehicles in some of the most extreme environments on the planet. Basic research advances the capacity of naval platforms operating under, on and above the seas, and to project power ashore. Ongoing research in the Air, Ground and Sea Vehicles activity will increase platform performance, reliability, improve human-machine teaming, reduce the cost of at-sea operations and enhance the effectiveness of distributed maritime operations.							
The efforts research focus include: surface and subsurface 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 signature control; special aviation projects; environmental quality; logistics; power generation, energy conversion, and storage; and advancements in naval technology innovations.							
FY 2022 Plans: Aerospace Structures and Materials (Formerly Sea Based Aviation National Naval Responsibility) Research is focused on basic research for developing lightweight, reliable, survivable, sustainable, and affordable airframes for naval and marine corps aircraft and weapons. Research concentration areas are: - Galvanic corrosion and mitigation strategies for metallic airframes in naval environment. - Multiaxial fatigue of hybrid airframes. - High fidelity composites prediction methodologies that span multiple length scales. - Novel out of autoclave and out of oven curing technologies. - Short fiber thermoplastic composite forming and joining. - High strain rate characterization of materials. - Computer assisted iterative material development for armor applications - Lightweight material solutions for multifunctional structures for airframes and weapons							
Flight Dynamics & Control							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Research will develop theory and analysis methods to better understand the phenomena and natural dynamics of air vehicles operating in the marine environment. Collaborative research will improve our knowledge of control system interactions between piloted aircraft and human performance. Objectives of this basic research portfolio include: increase the operational envelop for air vehicles, tailor airframe dynamics with novel control effectors, improve threat engagement performance, develop fundamentals for coupled human/machine dynamics, adapt to variable airframe conditions, etc. The Focus areas are: - Multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state; - Robust and precise control in the presence of highly turbulent flow fields; - Algorithms to enable precise ship-relative navigation in GPS-denied environments. Aerodynamics Research will enhance understanding of Naval-unique aerodynamic challenges by developing advanced computational and experimental methods in the following Focus Areas: - Fully coupled aerodynamic interface between ships and aircraft; - Novel state-of-the-art in-situ diagnostics and reduced-order modeling of complex flow fields; - Advanced methods for manipulating precisely the flow fields around air vehicles operating in the maritime environment. - Innovative technologies enabling increased range and/or maneuverability suitable for aircraft operating from the maritime environment and attritable systems such as high-speed weapons. - Interactional and transitional aerodynamics of multi-rotor systems in complex fluid dynamic environments involving multi-body relative motion. Science of Autonomy and Control of Unmanned Systems Research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. This includes multi-disciplinary research into the science of autonomy and it focuses on four interrelated areas: - Scalable and robust distributed collaboration among autonomous systems; - Human/unmanned system collaboration; - Perception-based adaptation across uncertain naval environments; - Embodied and situated intelligence and architectures. - Expand research on agile, theory-based tools and methods for safe, assured, robust, verifiable, and trustable autonomy.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Naval Air Platform Propulsion, Power and Thermal Management (Formerly Air Platform Machinery and Systems) - Continue basic research to advance the technical superiority of Sea-Based Aviation - Propulsion, Power and Thermal management with emphasis on propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and hot section materials and coatings. - Continue basic research to improve the power density, fuel efficiency, speed, range and operating reliability of future large, medium and small engines. - Continue fundamental studies with Rotating Detonation Engines and integration into platforms and weapon systems using thermodynamic models, Computational Fluid Dynamics and sub-scale experiments. - Conduct basic research for high stage-loading and efficient turbomachinery including distortion tolerant fans, casing treatments and advanced methods in blade-disk aerodynamics; advanced cooling and thermal management for engines and auxiliary systems including new concepts of heat collection, distribution and rejection; advanced turbine engine materials and coatings; highly integrated propulsion inlets and exhausts and dust ingestion research, including modeling, separating, deposition, coatings and sensing. - Continue to improve jet engine material durability and temperature rate capabilities in both benign and corrosive environments. - Develop advanced radio-frequency based sensors to provide ingestion and foreign object damage sensing, as well as overall prognostics. Platform Design and Engineering Conduct basic research related to platform performance, platform autonomy and control, platform survivability and tactical submarine evolution plan (TSEP) S&T. - Efforts for platform performance, autonomy and control include, but are not limited to, the following: understanding, predicting and controlling turbulent free-surface and stratified wakes leading to mitigation, tools to accurately predict platform maneuvering performance supporting future designs, current platform operational tactics, platform control and "digital twins" and developing reliability-based knowledge and tools to improve performance and affordability of ship hull structural systems from cradle to grave. - Efforts for platform survivability and TSEP S&T include, but are not limited to, the following: structural acoustic and propulsor source characterization, developing signature mitigation technologies, providing state of the art signature and detection range prediction tools that accurately model platforms to emerging threats and developing wideband, light-weight, affordable low observable materials. Power, Energy & Propulsion						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Conduct basic research related to heat transfer and thermal management; power generation; energy storage; distribution and control; and motors and actuators.</p> <p>- Efforts include, but are not limited to, the following: wide band gap (WBG) materials growth for next generation power electronic devices, improving power density, efficiency and control authority of WBG SiC Power Electronic Building Blocks by increasing switching frequencies, developing multidisciplinary collaborative ship design tools and nanostructured heat transfer surfaces and materials for enhanced thermal transport.</p> <p>Sustainment and Logistics</p> <p>Conduct basic research to investigate maintenance technology, manufacturing and repair, sustainment technologies and advanced logistics.</p> <p>- Efforts include, but are not limited to, the following: corrosion control, condition-based maintenance and prognostics, repair and component replacement technologies, replenishment at sea and decision support.</p> <p>Materials</p> <p>- Pursue research in computer-aided material design; scarce materials mitigation strategies; electrochemical materials and functional polymeric materials, leading to technological underpinnings for advanced energy capture and power storage and distribution; structural materials for performance improvement and resiliency; identifying new nanoengineered materials and processing for naval applications.</p> <p>FY 2023 Base Plans:</p> <p>Aerospace Structures and Materials</p> <p>Research is focused on basic research for developing lightweight, reliable, survivable, sustainable, and affordable airframes for naval and marine corps aircraft and weapons.</p> <p>- Continue research on galvanic corrosion and mitigation strategies for metallic airframes in naval environment.</p> <p>- Continue efforts on multiaxial fatigue of hybrid airframes.</p> <p>- Continue research on high fidelity composites prediction methodologies that span multiple length scales.</p> <p>- Continue work on novel out of autoclave and out of oven curing technologies.</p> <p>- Continue research on short fiber thermoplastic composite forming and joining.</p> <p>- Continue work on high strain rate characterization of materials.</p> <p>- Continue computer assisted iterative material development for armor applications.</p> <p>- Continue investigating lightweight material solutions for multifunctional structures for airframes and weapons.</p> <p>Flight Dynamics & Control</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Research will develop theory and analysis methods to understand the phenomena and natural dynamics of air vehicles operating in the marine environment. Collaborative research will improve our knowledge of control system interactions between piloted aircraft and human performance.</p> <p>- Continue efforts to increase the operational envelop for air vehicles, tailor airframe dynamics with novel control effectors, improve threat engagement performance, develop fundamentals for coupled human/machine dynamics, adapt to variable airframe conditions.</p> <p>- Continue work on multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state.</p> <p>- Continue work designed to achieve robust and precise control in the presence of highly turbulent flow fields.</p> <p>- Continue developing algorithms to enable precise ship-relative navigation in GPS-denied environments.</p> <p>Aerodynamics</p> <p>Research will enhance understanding of Naval-unique aerodynamic challenges by developing advanced computational and experimental methods.</p> <p>- Continue researching the fully coupled aerodynamic interface between ships and aircraft.</p> <p>- Continue investigating novel state-of-the-art in-situ diagnostics and reduced-order modeling of complex flow fields.</p> <p>- Continue researching innovative technologies enabling increased range and/or maneuverability suitable for aircraft operating from the maritime environment and attritable systems such as unmanned aerial systems and high-speed weapons.</p> <p>- Continue research on the interactional and transitional aerodynamics of multi-rotor systems in complex fluid dynamic environments involving multi-body relative motion.</p> <p>Science of Autonomy and Control of Unmanned Systems</p> <p>Research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground.</p> <p>- Continue investigating the scalable and robust distributed collaboration among autonomous systems.</p> <p>- Continue research on human/unmanned system collaboration.</p> <p>- Continue work on perception-based adaptation across uncertain naval environments.</p> <p>- Continue investigating embodied and situated intelligence and architectures.</p> <p>- Continue developing theory-based tools and methods for safe, assured, robust, verifiable, and trustable autonomy.</p> <p>Propulsion, Power and Thermal Management</p>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Complete research in flow control in offset diffusers.</div> <div>- Continue research to advance the technical superiority of Naval Aircraft - Propulsion, Power and Thermal management with emphasis on propulsion cycles, subsystems, propulsion integration, turbo machinery and drive systems, and hot section materials and coatings.</div> <div>- Continue research to improve the power density, fuel efficiency, speed, range and operating reliability of future large, medium and small engines.</div> <div>- Continue studies with Rotating Detonation Engines and integration into platforms and weapon systems using thermodynamic models, Computational Fluid Dynamics and sub-scale experiments.</div> <div>- Continue research for high stage-loading and efficient turbomachinery including distortion tolerant fans, casing treatments and advanced methods in blade-disk aerodynamics; advanced cooling and thermal management for engines and auxiliary systems including new concepts of heat collection, distribution and rejection; advanced turbine engine materials and coatings; highly integrated propulsion inlets and exhausts and dust ingestion research, including modeling, separating, deposition, coatings and sensing.</div> <div>- Continue to improve jet engine material durability and temperature rate capabilities in both benign and corrosive environments.</div> <div>- Continue to develop advanced radio-frequency based sensors to provide ingestion and foreign object damage sensing, as well as overall prognostics.</div> <div>- Initiate research of fundamental modeling of distributed combustion in the turbine.</div> <div>Platform Design and Engineering</div> <div>Conduct basic research related to platform performance and platform autonomy and control. Efforts include, but are not limited to, the following:</div> <div>- Continue research related to Naval Engineering and Platform Design (NNR), Basic Surface Ship Dynamics, Propulsion Hydromechanics, Basic Subsurface Hydromechanics, Basic Surface Ship Hydrodynamics, Adaptive Control and Centers for Innovative Naval Technology</div> <div>- Continue and expand research associated with Digital Twin Science efforts.</div> <div>Conduct basic research related to platform survivability and tactical submarine evolution plan (TSEP) S&T. Efforts include, but are not limited to, the following:</div> <div>- Continue research related to Structural Reliability Science, Metamaterials, Structural Acoustic Science, Underwater Electromagnetic Signatures, Electromagnetic Signatures, Signature Management Science, Submarine Security S&T - Detectability and Submarine Security S&T - Susceptibility.</div> <div>Power, Energy & Propulsion</div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Conduct basic research related to heat transfer and thermal management, power generation, energy storage and power management, distribution and control, and power electronics and electro-magnetics. - Initiate basic research efforts related to climate resiliency and clean energy. Materials - Continue research related to enabling enhanced performance and resiliency of systems and platforms through a collection of related efforts. Work includes Corrosion Control Science (for conventionally and additive manufactured materials) for enhanced resiliency and sustainability of naval platforms and systems; Nano-Engineered Materials for extended performance and sustainability of legacy systems and platforms and emerging opportunities for structural and functional (optical, electro-active, etc.) properties that will enable new system designs; Scarce Materials Mitigation Strategies to explore new compositions to reduce requirements for certain elements; Electrochemical Materials and Functional Polymeric and Organic Materials to understand phenomenology that can be applied to more efficient energy capture and power storage and distribution for a wide distribution of naval emerging requirements, and Computer-Aided Material Design to accelerate research in all areas described here. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.						
Title: Atmosphere and Space Sciences Description: Effective Naval operations depend upon accurately understanding the maritime and littoral operating environment and predicting its characteristics at high spatial and temporal resolution in areas that may be inaccessible. Understanding atmospheric phenomena and their impact on the electromagnetic spectrum from the sea surface to space provides a significant warfighting advantage. Efforts include: Battlespace Environments, Marine Meteorology and Prediction and Space Research. These efforts support basic research on physical process studies, fundamental observations, data discovery, and modeling and forecasting of the atmosphere and space with the goal of improving the ability to predict the battlespace environment of the Navy and Marine Corps, anywhere on the globe. Emphasis is placed on the marine atmosphere, the tropics, polar regions, the upper atmosphere and ionosphere and other areas where new understanding is needed in order to overcome predictability barriers that limit the accuracy of current forecast models. Efforts are underway to understand the interactions of physics between the atmosphere, space, land, ocean and ice, represent these coupled processes in models, and extend them across scales from local to planetary, with the goal of		26.026	27.442	27.597	0.000	27.597

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
extending the skill of predictions up to seasonal and interannual timescales. Recent efforts have also focused on the processes that control tropical cyclone formation, structure and intensity changes and phenomena that affect electromagnetic and electro-optic signal propagation in the marine atmosphere and near space domains. Research results provide the foundation for improved global and regional forecasts of the operational environment and for development of next-generation, fully coupled, high resolution prediction systems. Research areas evolve in response to priorities of the Oceanographer of the Navy. FY 2022 Plans: Battlespace Environments - Continue to improve the quality of the environmental analysis and prediction provided in support of warfighters by assessing the impact of the atmosphere and ionosphere-thermosphere-magnetosphere on the performance of sensors, platforms and weapon systems, and by advancing our basic understanding of atmospheric processes across spatial scales and the interactions of the atmosphere with the land, sea, wave, ice, and thermosphere. - Continue to exploit environmental observations and to characterize environmental processes more accurately, thus providing improved forecast models for the Navy and Marine Corps in regions where operations take place including: the littoral zone, where complex topography and air-sea-land contrasts impact the environment on very short time and space scales; the tropics and sub-tropics; and the Arctic, where longer time scale atmospheric changes affect short-term weather events. - Initiate new research on atmospheric or Earth system coupled processes that are not well understood, including cloud and aerosol interaction, marine boundary layer and coastal prediction, and diurnal and mesoscale variability to improve their representation in forecast models. - Continue to investigate the distribution, transport and time evolution of aerosols in the atmosphere and their impact on atmospheric visibility and laser propagation. - Initiate new research on coupled processes in the high atmosphere, between the troposphere and stratosphere and the stratosphere and ionosphere and their effect on weather and space weather prediction. Marine Meteorology and Prediction - Continue the Land-Air-Sea Interaction research initiative to improve our understanding and prediction of coupled near-shore atmospheric and oceanographic phenomena impacting naval littoral operations. - Continue to investigate key physical processes, including clouds and moisture phenomena, in order to improve their representation in atmospheric predictive models. Efforts will be focused on those phenomena that affect the predictability of parameters of highest relevance to naval operations.						

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none"> - Investigate new and non-conventional observational data sources and explore novel methodologies to assimilate these data into operational predictive models. - Conduct deployment of observing systems in the upper troposphere, middle and upper atmosphere and the near-space environment, providing information that will allow us to extend our prediction systems into the middle and upper atmosphere and provide longer and higher fidelity forecasts that will impact naval mission planning. - Continue using major observing experiments to understand the processes that contribute to the poorly predicted rapid intensification of tropical cyclones. - Continue field and modeling initiatives that focus on the origin, evolution and effects of Arctic cyclones believed to have a strong influence on Arctic sea ice motion and extent. <p>Space Research</p> <p>Perform innovative sensor development and physics-based modeling and forecasting R&D (research and development) that is integrated across three environmental areas: geospace, heliospace, and high-energy space. R&D efforts are motivated and guided by innovative concepts for future resilient, distributed Naval operations, with metrics to increase technology readiness and rapid prototyping, for accelerated delivery. The programs include:</p> <p>Geospace:</p> <ul style="list-style-type: none"> - Continue research into affordable small-sat sensors to investigate and specify the three dimensional structure and evolution of the electromagnetic signal propagation environment in the ionosphere, including ionospheric bubbles. Employ stereo imaging and tomographic reconstruction to access the three dimensional structure and evolution of the upper atmosphere and ionosphere, relevant to Naval communications, intelligence, surveillance and reconnaissance, and geolocation. - Continue development of our understanding and computational representation of upper atmospheric, ionospheric relevant plasma processes and their coupling to the lower atmosphere and solar inputs, towards a future physics-based ionospheric prediction capability for Naval forces. - Initiate a small-sat investigation into improved ionospheric observation and understanding through use of new signal processing approaches, based on anomalous refraction of Global Navigation System transmissions. <p>Heliospace:</p> <ul style="list-style-type: none"> - Continue efforts to advance the understanding, and advance the forecastability of, the solar radiation and particle fluxes, and magnetic fields. Investigate how they influence the near-Earth environment and the relevant Naval systems that rely on that environment. <p>High-Energy Space:</p> <ul style="list-style-type: none"> - Continue efforts to understand particle acceleration mechanisms in high energy solar flares by studying gamma-ray and neutron emissions that are measured in space. 					

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate efforts to leverage millisecond pulsars as stabile timing sources for precision navigation and timing applications.</p> <p>FY 2023 Base Plans:</p> <p>Battlespace Environments</p> <p>- Continue to improve the quality of the environmental analysis and prediction provided in support of warfighters, including the assessment of the impact of the atmosphere and ionosphere-thermosphere-magnetosphere on the performance of sensors, platforms and weapon systems, and the advancement of our basic understanding of atmospheric processes across spatial scales and the interactions of the atmosphere with the land, sea, wave, ice, and thermosphere.</p> <p>- Continue to exploit environmental observations and to characterize environmental processes more accurately, thus providing improved forecast models for the Navy and Marine Corps in regions where operations take place, including: the littoral zone, where complex topography and air-sea-land contrasts impact the environment on very short time and space scales; the tropics and sub-tropics; and the Arctic, where longer time scale atmospheric changes affect short-term weather events.</p> <p>- Continue research on the coupled processes in the high atmosphere, between the troposphere and stratosphere and the stratosphere/mesosphere and ionosphere and their effect on weather and space weather prediction.</p> <p>- Continue research on atmospheric or Earth system coupled processes that are not well understood, including cloud and aerosol interaction, marine boundary layer and coastal prediction, and diurnal and mesoscale variability to improve their representation in forecast models.</p> <p>Marine Meteorology and Prediction</p> <p>-Continue to investigate key physical processes, including clouds and moisture phenomena to improve their representation in atmospheric predictive models.</p> <p>-Continue exploration of new and non-conventional observational data sources and novel methodologies for their assimilation into operational predictive models.</p> <p>-Continue deployment of observing systems in the upper troposphere, middle and upper atmosphere and the near- space environment to allow extension of prediction systems into the middle and upper atmosphere and provide longer and higher fidelity forecasts.</p> <p>-Continue observing experiments to understand the processes that contribute to the poorly predicted rapid intensification of tropical cyclones.</p> <p>-Continue field and modeling initiatives that focus on the origin, evolution and effects of Arctic cyclones believed to have a strong influence on Arctic sea ice motion and extent.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Continue to investigate the distribution, transport and time evolution of aerosols in the atmosphere and their impact on atmospheric visibility and laser propagation.</p> <p>-Complete the Land-Air-Sea Interaction research initiative to improve understanding and prediction of coupled near- shore atmospheric and oceanographic phenomena impacting naval littoral operations.</p> <p>-Initiate new research in cloud processes, predictability and uncertainty and utilization of nontraditional space-based and airborne sensors towards these goals.</p> <p>Space Research</p> <p>Perform innovative sensor development and physics-based modeling and forecasting integrated across three environmental space areas: geospace, heliospace, and high-energy space.</p> <p>Geospace:</p> <p>- Continue research into affordable small-sat sensors to investigate and specify the three dimensional structure and evolution of the electromagnetic signal propagation environment in the ionosphere, including ionospheric bubbles. Employ stereo imaging and tomographic reconstruction to access the three dimensional structure and evolution of the upper atmosphere and ionosphere, relevant to Naval communications, intelligence, surveillance and reconnaissance, and geolocation.</p> <p>- Continue development of our understanding and computational representation of upper atmospheric, ionospheric relevant plasma processes and their coupling to the lower atmosphere and solar inputs, towards a future physics-based ionospheric prediction capability.</p> <p>- Continue a small-sat investigation into improved ionospheric observation and understanding through use of new signal processing approaches, based on anomalous refraction of Global Navigation System transmissions.</p> <p>Heliospace:</p> <p>- Continue efforts to advance the understanding, and advance the forecastability of, the solar radiation and particle fluxes, and magnetic fields. Investigate how they influence the near-Earth environment and the relevant Naval systems that rely on that environment.</p> <p>- Continue to investigate efforts to improve solar event warning times, using newly available observations.</p> <p>- Continue efforts to understand particle acceleration mechanisms in high energy solar flares by studying gamma-ray and neutron emissions that are measured in space.</p> <p>- Continue efforts to leverage millisecond pulsars as stabile timing sources for precision navigation and timing applications.</p> <p>- Initiate efforts to improve solar event warning times, using newly available observations.</p> <p>High-Energy Space:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate efforts to investigate new high-energy radiation and neutron detector materials for space-based observations.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.						
Title: Science Addressing Hybrid Threats		23.361	24.460	24.248	0.000	24.248
Description: Naval expeditionary forces increasingly face hybrid adversaries using conventional weapons combined with terror, crime, cyber, information operations, etc. A hybrid adversary is flexible and adapts quickly to synchronize advanced state weapons systems, disruptive commercial technologies, cheap expedient homemade weapons, and a variety of novel tactics. The Sciences Addressing Hybrid Threats (SAHT) (formerly Counter Improvised Explosive Device (IED)) activity seeks to establish and nurture science to counter these growing challenges, while collaborating with and leveraging results from more traditional Naval research portfolios.						
The SAHT Sciences program provides research for Naval Forces to fight hybrid threats and adversaries in expeditionary operations. Naval Expeditionary Forces need science advances to address a range of research challenges that result from physical and operational environmental limitations so harsh that solutions push basic discovery and invention. Naval Forces able to operate amphibiously and in the littoral will have all of their capabilities exposed to degrading sea and land physical effects. Expeditionary forces must be agile and lethal but will be constrained by size, weight, and power requirements and must be sustained across large areas.						
Research efforts include: machine perception, reasoning and collaborative behavior; artificial intelligence enabling future intelligent systems; optics, electronics, and photonics research to enable revolutionary spectral awareness in small low power sensors; computer and network science to enable expeditionary computing; fundamental chemistry and materials science research to advance technologies to support sustainment; materials research to explore and improve armor and structural materials; electrochemical energy conversion and storage research to sustain the force; chemistry and physics to provide disruptive energetics for expeditionary fires; and biology, physiology, and cognitive sciences addressing Naval Expeditionary warfighter capabilities.						
FY 2022 Plans:						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Conduct basic research in sensors and sensing technologies to enable stand-off detection and rapid neutralization of explosive hazards in multiple expeditionary mission environments while maintaining operational tempo.</div> <div>- Continue to extend exploring concepts, techniques and methods, for the design, growth, and characterization of electronic and electro-optic sensors to counter improvised explosive devices (IEDs).</div> <div>- Continue research into reconstructing human physiological features from audio samples based upon brain science to pair vocal tract features with identifiable facial characteristics.</div> <div>- Continue research into enabling secure and efficient sharing of computer hardware accelerators in systems restricted by size, weight, area and power.</div> <div>- Conduct research novel energetic materials that provide order of magnitude increases over current conventional energetics in reactive, explosive, and propulsive phenomena including high-energy ingredient synthesis, modeling, characterization, and the fundamentals of initiation mechanisms for these materials.</div> <div>- Conduct research to explore new, rugged, low cost, and high specific power sources, for example solar cell technologies, including investigation into the stability of the solar cells.</div> <div>-Conduct research and develop theories for creating swarming behavior in heterogeneous multi-domain autonomous systems.</div> <div>- Discover methods to identify coherent courses of action from Artificial Intelligence (AI) agents.</div> <div>- Formalize Artificial Intelligence (AI) hybrid learning theories for the purpose of creating heterogeneous multi-agent collaborative autonomy.</div> <div>- Conduct work in immersive sciences for automated methods for generating content, behaviors, and conduct research studies to examine questions of training effectiveness to increase understanding and use of Mixed Reality for naval applications.</div> <div>FY 2023 Base Plans:</div> <div>- Continue basic research in sensors and sensing technologies to enable stand-off detection and rapid neutralization of explosive hazards in multiple expeditionary mission environments while maintaining operational tempo.</div> <div>- Continue research into reconstructing human physiological features from audio samples based upon brain science to pair vocal tract features with identifiable facial characteristics.</div> <div>- Continue research into enabling secure and efficient sharing of computer hardware accelerators in systems restricted by size, weight, area and power.</div> <div>- Continue work in immersive sciences for automated methods for generating content and behaviors, and conduct research studies to examine questions, such as usability and training effectiveness, to increase understanding and use of Extended Reality (XR) technologies for naval applications.</div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue research into methods to identify coherent courses of action with effective outcomes using Artificial Intelligence (AI) agents.</div> <div>- Continue investigating learning theories to enable complex, collaborative, human-robot interactions.</div> <div>- Continue research for modeling autonomy, for the purpose of creating systems that operate in complex undersea/surface/land/air/space domains.</div> <div>- Continue research methods that model how diverse autonomous systems interact with each other in complex environments.</div> <div>- Continue work on means and methods for evaluating the reliability and effectiveness of collective decision making by autonomous systems and humans.</div> <div>- Continue researching the creation of Artificial Intelligence (AI) hybrid learning theories for the purpose of creating heterogeneous multi-agent collaborative autonomy.</div> <div>- Continue research to create theories for multi-agent collaborative autonomy that mimic the organizational principles found in social insects/birds/fishes.</div> <div>- Complete exploring concepts, techniques and methods, for the design, growth, and characterization of electronic and electro-optic sensors to counter improvised explosive devices (IEDs).</div> <div>- Initiate a follow-on and focused research effort on investigation on security aspect of non-volatile main memory usage for future computing systems.</div> <div>- Initiate research to provide fundamental understanding of biological olfactory sensing and processing of relevant odor representation in order to apply toward chemical sensor design and processing principles.</div> <div>- Initiate research of ultra-low size, weight, and power communications in a contested environment.</div> <div>- Initiate research to explore robotic behaviors for locating and mitigating threats from hazards in building clearing.</div> <div>- Initiate a follow-on and focused research effort for the machine learning investigation of multifactorial information environment parameters in order to automate the process of detecting, identifying and distinguishing intent.</div> <div>- Initiate a follow-on and focused research effort for discovery research on multi-class, multi-objective deep reinforced learning algorithms with automated training.</div> <div>FY 2023 OCO Plans: N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</div>						
Title: Human Systems		18.142	20.907	20.310	0.000	20.310

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: Sailors and Marines operate across multiple domains: under, on and above the seas. This Activity focuses on understanding the human aspects of Naval operations with the objective of planning and execution for mission success. The long-term goal of this research is to increase total system performance by maximizing the effectiveness of human-machine systems to ensure mission effectiveness.</p> <p>Research areas include: attention and decision making in goal-directed behaviors, computational and neural foundations of cognitive skills and underlying processes, information exchange processes in human-human and human-machine teaming tasks, human interactions with autonomous systems, preparation and adaptation to novel challenge, new approaches to training and training assessment, personnel assessment, information conflicts, and humanitarian assistance/disaster relief.</p> <p>FY 2022 Plans:</p> <p>Command Decision Making</p> <p>- Conduct basic research to identify the components of Naval missions or tasks (e.g. environmental, logistical) that will impact mission planning and re-planning and, therefore, mission success. The long-term goal is to develop tools that are proactive in providing relevant information to support tactical to strategic decision making.</p> <p>Cognitive Science for Human-Machine Teaming</p> <p>- Conduct basic research to understand the foundation of human intelligence that enables innate functions, such as communication, social interaction, and context understanding. Empirical research in computational modeling and natural language processing will support the framework and architecture necessary to develop higher-level intelligence in robotic and autonomous systems. The long-term goal of these efforts is to develop machines that are not just tools that extend human capabilities, but also teammates that enable better team performance.</p> <p>Schoolhouse Training</p> <p>- Conduct basic research to discover novel theories, methodologies, and models for learning. This research will identify enabling technologies to improve generalized problem solving (e.g., adaptive generalized tutors that introduce new content and facilitate deeper understanding that applies to other knowledge areas) and decision making under risk and uncertainty; and characterize (e.g., the magnitude and time course of skill decay), model, and predict skill decay in Navy-relevant areas to provide appropriate training interventions. The long-term goal of these efforts is to develop enabling technologies that will assist warfighters in generalized problem solving, rapid learning, and skill retention.</p>						

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<p>Computational Neuroscience</p> <p>- Conduct basic research to identify and understand neural circuits and pathways that will be used to develop models of sensorimotor control and spatial navigation. The long-term goal is to understand the neural foundation of intrinsic cognitive skills, such as attention, memory formation, perception, and problem solving in order to develop novel intelligent systems.</p> <p>Human Interaction with Autonomous Systems and Human-Machine Teaming</p> <p>- Explore principles of warfighter collaboration with autonomous and mission-capable robotic systems.</p> <p>- Conduct basic research to explore training of robots to perform complex manipulation skills using machine learning and human demonstration. The long-term goal is to provide better interfaces with autonomous systems, as well as provide transfer of control of autonomous platforms and payloads amongst operators.</p> <p>Attention in Sensory Processing and Intelligent Sensing:</p> <p>- Conduct basic research in novel deep-learning techniques applied to computer vision. The long-term goal is rapid and accurate object identification in any Naval-relevant environment.</p> <p>Social, Cultural, and Behavioral Modeling</p> <p>- Conduct basic research to improve current methods (e.g., algorithms, models) for detecting adversarial information maneuvers across social media platforms. The result will produce a better understanding of how covert actors inflict hysteria, crowd manipulation and group polarization on vulnerable audiences. The long-term goal is to gain a better understanding of how human sociocultural behavior informs and affects operational solutions in Naval-relevant contexts.</p> <p>Social Networks and Computational Social Science</p> <p>- Conduct basic research to improve the computational efficiency and effectiveness in modeling human behavior, perception of information, and cyber warfare. Investigate novel techniques for effective information environment exploitation and strategic communication. The long-term goal is to understand the impact of the digital information age on the Naval response to conflict, civil instability, and humanitarian assistance.</p> <p>Manpower, Personnel, Training and Education for Future Warfighting:</p> <p>- Conduct basic research to understand the underlying sociological, experiential, psychological, and neurobiological concepts that optimize an individual's intellectual readiness and adaptability to military-relevant emerging technology (e.g. Artificial Intelligence, autonomous systems). Investigate new modeling approaches to support management of the Naval workforce including through novel means of real-time monitoring, observation,</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>and comprehension of unit behavioral health. The long-term goal is to establish a cohesive strategy for optimizing the readiness and effectiveness of the human capital enterprise.</p> <p>FY 2023 Base Plans:</p> <p>Command Decision Making</p> <ul style="list-style-type: none">- Continue context-based decision making research for mission planning & execution.- Complete research to explore Command and Control (C2) human-machine collaboration and management of algorithms that adapt recommendations using machine learning (ML).- Complete work to utilize machine learning algorithms for analysis and forecasting of "what if" planning scenarios.- Initiate research for creating Collaborative Artificial Intelligence and investigate methods that enable algorithms to learn task procedures and task context from human explanations.- Initiate research into methods to "close-the-loop" where decision support AI can explain recommendations and context to the user. <p>Cognitive Science for Human-Machine Teaming</p> <ul style="list-style-type: none">- Continue research to understand the foundation of human intelligence that enables cognitive functions, such as communication, social interaction, and context understanding.- Continue research in computational modeling and natural language processing to support the framework and architectures necessary to develop higher-level intelligence in robotic and autonomous systems.- Complete work into modeling structured goals for monitoring the performance of autonomous agents. <p>Schoolhouse Training</p> <ul style="list-style-type: none">- Continue efforts to create novel models for learning aimed at producing durable learning.- Continue to create skill decay models that can be used to predict when refresher training is needed for maintenance procedures.- Continue to investigate individual differences to optimize training techniques.- Continue efforts to understand how to facilitate the acquisition of generalized problem solving.- Complete research that created computationally-executable model of processes required for training dynamic maintenance tasks. Elements include attention, planning, memory, and motor action.- Complete research to measure the impact of video games on enhancing cognitive and perceptual skills.- Initiate researching neuro-psychometric tests that can reliably predict complex skill learning (e.g., second language & computer programing).- Initiate research to discover neuro-imaging analytical techniques to assess learning from written passages.						

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate work to create new training techniques for spatial ability which facilitates learning STEM skills.</p> <p>Computational Neuroscience</p> <p>- Continue research to identify and understand neural circuits and pathways that will be used to develop models of sensorimotor control and spatial navigation. The long-term goal is to understand the neural foundation of intrinsic cognitive skills, such as attention, memory formation, perception, and problem solving in order to develop novel intelligent systems.</p> <p>- Complete research on neural basis of spatial navigation.</p> <p>- Initiate efforts to explore the neural basis of the control of reaching, grasping and manipulation to inform robotics.</p> <p>Human Interaction with Autonomous Systems</p> <p>- Continue exploring the principles of warfighter collaboration with autonomous and mission-capable robotic systems.</p> <p>- Continue research to explore training of robots to perform complex manipulation skills using machine learning and human demonstration. The long-term goal is to provide better interfaces with autonomous systems, as well as provide transfer of control of autonomous platforms and payloads amongst operators.</p> <p>- Complete the analysis of human impressions (e.g., trust) of robotic teammates.</p> <p>- Initiate research exploring the combination of robot mobility with dexterous manipulation in assisting humans on Naval relevant tasks, such as shipboard maintenance and building clearing of hazards.</p> <p>Attention in Sensory Processing and Intelligent Sensing</p> <p>- Continue efforts on attention in intelligent sensing with a focus on the auditory modality, both with reflected and radiated acoustic signals on underwater targets.</p> <p>- Complete research in novel, brain-inspired deep-learning techniques applied to computer vision.</p> <p>- Initiate explorations into novel Artificial Intelligence-based approaches for Adaptive Training.</p> <p>Social, Cultural, and Behavioral Modeling</p> <p>- Continue research to improve current methods (e.g., algorithms, models) for detecting adversarial information maneuvers across social media platforms.</p> <p>- Complete research on detection of computer algorithms (bots) that manipulate social media traffic to influence content.</p> <p>- Initiate research on emerging and novel threats in cyberspace and in key military operations to include humanitarian assistance/disaster relief, civil stability, counter-terrorism and countering influence operations.</p>					

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<p>- Initiate work to explore anthropological, sociological and socio-psychological research to improve blunting, mitigating and defeating influence operations against US interests abroad.</p> <p>Social Networks and Computational Social Science</p> <p>- Continue research to improve techniques in influence discernment, and the creation of effective communications strategies in the face of information conflict, modeling human behavior, the perception of information and cyber warfare.</p> <p>- Complete research on global models to monitor and explore social media.</p> <p>- Initiate research to explore social science methods and techniques to detect, mitigate, blunt, and defeat influence campaigns.</p> <p>- Initiate research and models on the impact of hybrid warfare and geo-political shifts on the future of conflict in the next decade.</p> <p>Manpower, Personnel, Training and Education for Future Warfighting</p> <p>- Continue research to understand the underlying mechanisms that optimize an individual's intellectual readiness and adaptability to military-relevant emerging technologies (e.g., Artificial Intelligence, autonomous systems) or novel operational challenges.</p> <p>- Continue research to improve psychometric properties of selection/assessment for high performance in military settings.</p> <p>- Continue research to improve analytical approaches to understand human behavior based on unstructured, interdependent, and complex data. The long-term goal is to establish a cohesive strategy for optimizing the readiness and effectiveness of the human capital enterprise.</p> <p>- Complete research evaluating the feasibility of virtual reality (VR) and augmented reality (AR) gaming technology to improve mental health outcomes and transition research results.</p> <p>- Initiate research exploring innovative technologies for real-time sensing and observation of individual behavioral responses to social and operational stressors.</p> <p>- Initiate research into methods to predict and detect destructive social behaviors, with a focus on novel theoretical frameworks and approaches, conducive to application in military settings.</p> <p>- Initiate research to create integrated modeling approaches to support management of the Naval workforce, leveraging real-time monitoring, observation, and comprehension of unit behavioral health.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
There is no significant change from FY 2022 to FY 2023.						
Title: Mathematics, Computer, and Information Sciences		53.712	60.256	61.701	0.000	61.701
Description: This activity includes basic research efforts directed toward increasing scientific, mathematical, and computational foundations for integrated command, control, communications, cyber intelligence, surveillance, reconnaissance and targeting. The purpose is to sustain U.S. Naval Science and Technology (S&T) superiority, provide new technological concepts for the maintenance of naval power and national security, and help avoid scientific surprise.						
Efforts include: Scientific foundations and understanding for robust communications and networking; foundations for novel computing hardware, including nanoscale materials, emerging devices and circuits, emerging computational architecture and nanofabrication; basic research on novel techniques for controlling quantum states; algorithms for analyzing massive datasets in real time and heterogeneous information integration; science base and computational methods for building versatile intelligent agents; theory, algorithms and tools for decision support; mathematical optimization for resource allocation and usage; modeling and computation of complex physical phenomena; computation and information foundations for cyber defense; secure and reliable information infrastructure for command and control; information assurance; and research to extend state-of-the-science in artificial intelligence for the unique challenges of the Naval domain.						
FY 2022 Plans:						
Communications and Networking						
Continue developing the scientific foundation and understanding of wireless communications and networking technologies that enable the naval warfighter to maintain access to mission critical information in contested environments.						
Research thrust areas include:						
Tactical Communications:						
- Continue developing new techniques for wireless distributed computing and device-to-device communication.						
- Complete development of new algorithmic framework for signal retrieval using non-uniform sparse array geometries.						
- Complete novel wireless communications methods across air-water boundary.						
- Initiate novel coding and modulation techniques to improve the efficiency, capacity and/or resilience of wireless communications.						
Tactical Networks						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue research on demonstrations of systems having a quantum advantage in the solution of optimization problems and quantum simulation of complex physical systems.</div> <div>- Initiate research on the utilization of photonic and phononic devices for high performance quantum information processing.</div> <div>Mathematical Data Science</div> <div>- Continue basic research in mathematics, probability, statistics, signal processing, machine learning, data engineering, and information theory.</div> <div>- Continue to develop advanced algorithms for analyzing massive datasets in real time, identify real patterns and avoid false positives.</div> <div>- Continue to develop advanced methods that can integrate and extract common features from large heterogeneous domains.</div> <div>- Initiate research on privacy in complex networks.</div> <div>Machine Learning, Reasoning and Intelligence</div> <div>- Continue developing the science base and computational methods for building versatile intelligent agents, which can function autonomously in uncertain, unstructured, uncontrolled, open-world environments, and can collaborate seamlessly with humans and other agents.</div> <div>- Continue basic research in developing new mathematical methods for principled design of deep learning architectures and analysis of their behavior. This program is expected to develop techniques for predicting performance learning-based systems, to improve their generalization abilities, and to reduce the need for empirical verification.</div> <div>-Initiate basic research for developing robust computer vision systems, based on human vision, for automated understanding of surveillance imagery, perception for autonomous agents, and managing image/video libraries for after-action analysis and planning.</div> <div>Mathematical Optimization and Operations Research</div> <div>- Continue investigations on discrete and nonlinear-continuous programs for which input parameters are known with certainty, but for which the acquisition of optimal decision strategies can be computationally intensive.</div> <div>- Continue research on optimizing stochastic programs that, due to incomplete or partial information, have input parameters that are not known with certainty.</div> <div>- Continue to identify exploitable mathematical structures within specific decision problems for the purpose of devising superior solution algorithms.</div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Complete advances to special continuous nonconvex programs wherein both the objective to be optimized and the restrictions that enforce the system characteristics are expressed in terms of decision variables that are allowed to realize a continuum of values.</div><div>- Complete advances to stochastic optimization that include a framework for distributed decomposition of different classes of large-scale problems, and the solving of real-size instances of nonlinear chance-constrained stochastic programs.</div><div>- Complete the development of new families of cutting planes that effectively remove infeasible or non-optimal solutions from consideration.</div><div>- Initiate new methods for strategically formulating and solving optimization problems that arise in resource allocation, logistics, and system planning.</div><div>- Initiate new techniques that utilize convex optimization and duality theory to solve non-convex optimization problems.</div></div> <div>Applied and Computational Analysis</div> <div><div>- Conduct basic research in developing analytical and computational tools for models of physical phenomena of critical interest to the Navy waves, flows, materials, structures and information processing.</div><div>- Continue to develop robust, reliable and near-real-time computational models for predicting environmental behavior in atmospheric and oceanic processes.</div><div>- Continue to develop theoretical and computational tools to predict the onset of extreme events, whether in materials, such as formation of shocks, cracks and other discontinuities.</div><div>- Continue to develop reduced models to enable speed up of computational models in acoustics, electromagnetics and optics, in regimes of special interest to the Navy.</div><div>- Initiate research to develop mathematically rigorous algorithms for employing variable-precision computations in very large-scale multi-physics problems.</div></div> <div>Cyber Security and Complex Software Systems</div> <div><div>- Continue to investigate and develop novel computing concepts that lead toward robust, resilient, and dependable cyber systems.</div><div>- Continue further development of tools and environment for programmability of heterogeneous multiple instruction set architecture systems.</div><div>- Continue to explore novel application of ONR's concept of hybrid, formal-statistical machine learning (Learn2Reason) in cyber security and software systems environment.</div><div>- Continue to explore physics-based approaches to various security aspect of cyber-physical systems, including authentication, vulnerability testing, and exploit resilience.</div></div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Continue critical emphasis on improving scalability and capability of bottom-up formal analysis that would enable users to prove security properties about binaries directly.</div><div>- Complete research on computer-driven exploration of cryptographic algorithms, as the work has been successful in changing community thinking.</div><div>- Initiate research on novel methods for attack surface maneuver for cyber physical systems and systems with complex apertures and sophisticated sensing apparatus, to include lightweight decoy synchronization and other resilience techniques.</div></div> <div>Science of Artificial Intelligence:<div><div>- Explore principled frameworks for integrating domain knowledge and machine learning for fast, robust learning of diverse complex concepts and tasks with light supervision.</div><div>- Explore artificial intelligence to advance the scientific understanding of collaborative, complex decision-making that is typical of naval command decision making. Explore formal verification and validation methods for artificial intelligence in the naval domain to enhance trust. Explore explainable artificial intelligence to enhance human-machine collaboration. Explore decentralized perception and planning in dynamic environments to develop a unified framework perception and planning for resources distributed across multiple platforms, autonomous systems and agents. Explore new brain-inspired artificial intelligence algorithms and architecture that provide richer computational capabilities than current deep learning networks, with an emphasis on memory systems and higher vision. Explore neuromorphic spiking neuron hardware designs based on brain models that are suitable for future edge computing and signal processing in small naval platforms. Explore autonomous problem solving and curiosity driven search for robust performance under unexpected conditions.</div></div></div> <div>Information Technology:<div><div>- Continue development of improved methods for producing, analyzing, and securing Naval software systems.</div><div>- Continue to design new concepts for future Naval tactical communication systems and networks.</div><div>- Continue research in intelligent autonomy and improved interaction with autonomous systems, and improved methods for information analysis, fusion, and presentation.</div></div></div> <div>FY 2023 Base Plans:<div>Communications and Networks<div><div>- Continue developing the scientific foundation and understanding of wireless communications and networking technologies that enable the naval warfighter to maintain access to mission critical information in contested environments. Research thrust areas include Tactical Communications and Tactical Networks.</div></div></div></div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Tactical Communications - Continue developing new techniques for wireless distributed computing and device-to-device communication. - Continue novel coding and modulation techniques to improve the efficiency, capacity and/or resilience of wireless communications.						
Tactical Networks - Continue developing a feedback control model to determine the limit of fast adaptive traffic engineering. - Continue investigations in to new algorithms, protocols and middleware for dynamic and scalable multi-hop ad hoc wireless networking in contested environments. - Continue Artificial Intelligence/Machine Learning techniques for multi-dimensional Quality-of-Service optimization. - Continue development of cognitive methods and algorithms to maintain network resiliency under link disruptions without adding excess overhead.						
Spectrum Superiority / Networked Sensing - Continue efforts exploring advanced photonics techniques to maximize information extraction from individual photons and through tailored optical beams with the goal of being able to image at long-ranges and in degraded conditions. - Continue efforts on fundamental implications of classical entanglement on imaging and metrology. - Continue efforts to discover highly sensitive, multi-spectral detector materials and active sensing modalities for imaging through clouds, fog, haze and dust. - Continue efforts to explore novel optical processing architectures to significantly increase signal-processing bandwidth and to enable novel, real-time, distributed sensing applications. - Initiate efforts into direct measurement of current and phase at optical and infrared light frequencies to enable wider flexibility in signal extraction and waveforms.						
Nanoscale Computing Devices and Systems - Continue research on ultra-low power nanoelectronic devices, circuits and systems. - Continue research on spin based electronics, focusing on single atom and single molecule level control. - Continue research combining molecular quantum science and synthetic electronics. - Continue research on experimental routes to topologically-protected quantum computation with non-abelian any on quasiparticles in solid-state devices. - Complete research on atomic precision control of graphene nanostructures using chemical synthesis techniques.						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Complete research on carbon based quantum systems that are compatible with bottom-up chemical synthesis paradigm.</div> <div>- Initiate research on device physics enabling probabilistic computing in stochastic networks.</div> <div>Quantum Information Sciences</div> <div>- Continue research on novel techniques for controlling quantum states to improve performance of information processors, sensors and clocks.</div> <div>Continue research on demonstrations of systems having a quantum advantage in the solution of optimization problems and quantum simulation of complex physical systems.</div> <div>- Continue research on the utilization of photonic and phononic devices for high performance quantum information processing.</div> <div>- Initiate research exploring the distribution of entanglement in a quantum network and applications thereof.</div> <div>Mathematical Data Science</div> <div>- Continue basic research in mathematics, probability, statistics, signal processing, machine learning, data engineering, and information theory.</div> <div>- Continue to develop advanced algorithms for analyzing massive datasets in real time, identify real patterns and avoid false positives.</div> <div>- Continue to develop advanced methods that can integrate and extract common features from large heterogeneous domains.</div> <div>- Continue research on privacy in complex networks.</div> <div>- Initiate development of scalable reinforcement learning.</div> <div>- Initiate research in approximate dynamic programming.</div> <div>Machine Reasoning and Intelligence</div> <div>- Continue developing the science base and computational methods for building versatile intelligent agents, which can function autonomously in uncertain, unstructured, uncontrolled, open-world environments, and can collaborate seamlessly with humans and other agents.</div> <div>- Continue basic research in developing new mathematical methods for principled design of deep learning architectures and analysis of their behavior. This program is expected to develop techniques for predicting performance learning-based systems, to improve their generalization abilities, and to reduce the need for empirical verification.</div>						

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B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none"> - Continue basic research for developing robust computer vision systems, based on human vision, for automated understanding of surveillance imagery, perception for autonomous agents, and managing image/video libraries for after-action analysis and planning. - Initiate basic research in machine self-learning for intelligent agents, inspired by human learning, for understanding real-world environments. <p>Optimization and Discrete Mathematics</p> <ul style="list-style-type: none"> - Continue to identify exploitable mathematical structures within specific decision problems for the purpose of devising superior solution algorithms. - Continue investigation into methods for strategically formulating and solving optimization problems that arise in resource allocation, logistics, and system planning. - Continue investigations into new techniques that utilize convex optimization and duality theory to solve non-convex optimization problems. - Complete investigations on discrete and nonlinear-continuous programs for which input parameters are known with certainty, but for which the acquisition of optimal decision strategies can be computationally intensive. - Complete research on optimizing stochastic programs that, due to incomplete or partial information, have input parameters that are not known with certainty. - Initiate research on integrating machine-learning techniques with algorithms for stochastic and combinatorial optimization. - Initiate research on developing novel first-order methods for solving general classes of problems that include saddle point problems, problems with a large number of constraints, and machine learning problems. - Initiate investigations into applying topological data analysis to combinatorial optimization problems. <p>Applied and Computational Mathematics</p> <ul style="list-style-type: none"> - Continue basic research in developing analytical and computational tools for models of physical phenomena of critical interest to the Navy waves, flows, materials, structures and information processing. - Continue to develop robust, reliable and near-real-time computational models for predicting environmental behavior in atmospheric and oceanic processes. - Continue to develop theoretical and computational tools to predict the onset of extreme events, whether in materials, such as formation of shocks, cracks and other discontinuities. - Continue to develop reduced models to enable speed up of computational models in acoustics, electromagnetics and optics, in regimes of special interest to the Navy. - Continue research to develop mathematically rigorous algorithms for employing variable-precision computations in very large-scale multi-physics problems. 					

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Complex Software Systems and Cybersecurity</p> <ul style="list-style-type: none">- Continue to investigate and develop novel computing concepts that lead toward robust, resilient, and dependable cyber systems.- Continue to explore novel application of ONR's concept of hybrid, formal-statistical machine learning in cyber security and software systems environment.- Continue to explore physics-based approaches to various security aspect of cyber-physical systems, including authentication, vulnerability testing, and exploit resilience.- Continue critical emphasis on improving scalability and capability of bottom-up formal analysis that would enable users to prove security properties about binaries directly.- Continue research on novel methods for attack surface maneuver for cyber physical systems and systems with complex apertures and sophisticated sensing apparatus, to include lightweight decoy synchronization and other resilience techniques. <p>Complete development of tools and environment for programmability of heterogeneous multiple instruction set architecture systems.</p> <ul style="list-style-type: none">- Initiate research on autonomous cyber operations to explore what facets of cyber activities can be done fully autonomously or semi autonomously with human input. <p>Science of Artificial Intelligence</p> <ul style="list-style-type: none">- Continue to explore principled frameworks for integrating domain knowledge and machine learning for fast, robust learning of diverse complex concepts and tasks with light supervision.- Continue to explore artificial intelligence to advance the scientific understanding of collaborative, complex decision-making that is typical of naval command decision making.- Continue to explore formal verification and validation methods for artificial intelligence in the naval domain to enhance trust.- Continue to explore explainable artificial intelligence to enhance human-machine collaboration.- Continue to explore decentralized perception and planning in dynamic environments to develop a unified framework perception and planning for resources distributed across multiple platforms, autonomous systems and agents.- Continue to explore new brain-inspired artificial intelligence algorithms and architecture that provide richer computational capabilities than current deep learning networks, with an emphasis on memory systems and higher vision.- Continue to explore neuromorphic spiking neuron hardware designs based on brain models that are suitable for future edge computing and signal processing in small naval platforms.						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue to explore autonomous problem solving and curiosity driven search for robust performance under unexpected conditions.</div> <div>- Initiate research to identify, characterize and model adversarial AI.</div> <div>- Initiate research exploring theory and algorithms for learning and decision making in multi-agent systems, particularly in adversarial situations.</div> <div>Information Technology</div> <div>- Continue development of improved methods for producing, analyzing, and securing Naval software systems.</div> <div>- Continue to design new concepts for future Naval tactical communication systems and networks.</div> <div>- Continue research in intelligent autonomy and improved interaction with autonomous systems, and improved methods for information analysis, fusion, and presentation.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>Increase due to increased focus on Networks and Communications.</div>						
<div>Title: Materials/Processes</div> <div>Description: Lighter, faster, stronger is a winning combination. Naval materials research produces quieter submarines, fuel-efficient ships/vehicles and systems capable of operating under extreme temperature and chemical environments. New materials will result in warfighting advantages, as well as, systems that ensure environmental compliance, improved system reliability/resilience, stealthier materials, reduced manufacturing/maintenance and lower total ownership costs.</div> <div>The Materials/Processes activity generates fundamental scientific understanding for new, advanced and improved materials, and to accelerate materials-driven concepts essential to Naval superiority. The research is conducted in a cross-cutting and interdisciplinary manner covering Structural Materials, Functional Materials, Manufacturing, Chemistry and Undersea Materials to ensure future Naval power and maritime superiority.</div> <div>Fundamental challenges include understanding atomic-scale to meso-scale phenomena; developing robust, accurate and validated computational modeling and simulation capabilities; and translating this understanding into materials composition, synthesis, processing, properties and performance design principals for engineered devices, components and systems. This activity also includes peer-review basic research to develop innovative solutions and enhance the science and engineering base.</div>		54.618	57.519	59.945	0.000	59.945

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B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Research directions in the Focus Area are selected to generate new, advanced and improved materials that enable innovative new technologies or can close critical technology gaps. Successes provide breakthroughs for higher performing, cost effective and/or timely technologies supporting Navy and Marine Corps acquisitions, operations and sustainment.</p> <p>Accomplishments and plans described below are examples for each effort category.</p> <p>FY 2022 Plans:</p> <p>Structural Materials</p> <p>- Continue foundational research in basic materials science on metals, ceramics and composites advances in 2D and 3D materials imaging across spatial scales; multiphysics/multiscale modeling, model reduction strategies and machine learning techniques. This advances Integrated Computational Materials Engineering methods, accelerating materials and process design methods. Novel synthesis and processing routes are also being developed using new temperature, pressure, electromagnetic, aerosol deposition and additive manufacturing strategies. Progress in these areas will enables new high strength and corrosion resistant steel and compositionally complex alloys. Advanced nanoscale core-shell powders promise high temperature performance for hypersonic system components. New microscale composite architectures are pursued which efficiently dissipate energy to enable lighter weight blast, ballistic and impact protection for individuals and vehicles.</p> <p>Functional Materials</p> <p>- Conduct research on high speed energy efficient information processing by advances in magnetic, electronic and optical materials. Development of nanoscale control of two dimensional materials, interfaces, heterostructures, dopants and defects is used to demonstrate fundamental principles necessary for advanced Naval technologies. Key elements of these efforts are single atom control of multi-atom and quantum systems, fast phase transition materials, novel computational simulation strategies, quantum computing algorithms of material physics, machine learning and artificial intelligence for materials design. Advanced lithographic methods are used to experimentally fabricate and demonstrate novel device concepts and performance. Progress enables advances in low Size-Weight-Power and Cost (SWAP-C) information processing for advanced magnetic, chemical, biological, radiological and explosive sensors, Naval edge computing and decision systems for autonomy, communications and networking, energy harvesting and photovoltaics.</p> <p>Manufacturing</p>								

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO
<p>- Conduct basic manufacturing science research to develop a fundamental understanding of materials and processes necessary for emerging manufacturing technologies relevant to Navy systems. Results will advance Navy opportunities to design and produce validated and verified, low production volume replacement engineered parts for aircraft and ships; new gradient, composite and metamaterial architectures expanding design optimization space; and complex shapes enabling new conformal structural, acoustic and thermal component designs.</p> <p>Efforts are structured around multidisciplinary research on new manufacturing processes, using Integrated Computational Materials Engineering (ICME) approaches and techniques, to advance materials and component production. This includes understanding and modeling key relationships between additive manufacturing alloy chemistry, microstructure, process parameters, part design, high quality properties and certification strategies while minimizing or eliminatoing the need for post processing.</p> <p>Materials and chemistry</p> <p>- Develop the scientific foundations for molecular-level understanding of materials synthesis, processing, and physical properties aimed at propelling, equipping and sustaining the US Navy and Marine Corps with tactical and strategic advantage. Nanoparticle surface chemistry for plasmonic mediated reactions, photocatalysis, hydrogen storage, energetic materials, and fuel additives enables new high power and energy density generation, storage, release and harvesting materials and technologies. These fuel generation, energetic, fuel cell and battery material will enable next generation Navy autonomous undersea and air vehicles. Research on combustion and reacting transport, coupled with advanced mutiphysics computational simulation, will advance fire suppression for damage control as well as liquid and solid-fueled power and energy for hypersonics. Combinatorial and multivariate chemical approaches inform sensor system designs for aviation fuel surety and complex shipboard atmosphere environment monitoring. Advanced quantum computing simulations of quantum systems are modeling aqueous chemistries to allow design of anti-corrosion additives. Understanding fundamental electrochemistry, (tribo)corrosion, and biofouling will guide materials solutions for fleet sustainment through manpower and life-cycle cost reductions.</p> <p>Undersea Warfare</p> <p>- Conduct laboratory and theoretical/numerical work focusing on creation of new techniques for understanding, predicting, and controlling the interactions between acoustic and elastic waves and the processing routes for associated new materials. A key goal is advanced underwater material coupling architectures that achieve a broad range of passive and active acoustic impedances and control. Success will enable new material technologies and methodologies for achieving acoustic stealth. Creation of high performance source transducer materials, such as textured ferroelectric ceramics, should achieve high power receiver performance at reduced</p>					

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>cost and complexity. This would enable high throughput production of high performace tranducer ceramics, providing alternatives to current costly and difficult to produce single crystal technology. The creation of high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications will also be pursued by exploiting nanocrystallization and multilayering to control thermal conductivity. This will enable solid-solid thermal management and new options for submarine and Underwater Unmanned Vehicle (UUV) power generation.</p> <p>FY 2023 Base Plans:</p> <p>Structural Materials</p> <p>- Continue foundational research that provides the underpinnings for robust systems and platforms, exploring and understanding phenomenology of structural properties as functions of with the aim to improve performance and predict and mitigate component degradation, captured in quantitative data and physics-driven models that utilize an Integrated Computational Materials Engineering (ICME) approach and support machine learning. Research domains include Basic Materials Research, Structural Metals, Polymer Composite Materials, Propulsion Materials, Materials for Additive Manufacturing, Sensors & NDE Prognostics, and Alternative Hull Materials & Structures.</p> <p>- Complete efforts in Structural Cellular Materials and Solid Mechanics, as technology areas have matured and attention turns to other emerging research areas.</p> <p>Functional Materials</p> <p>- Continue research to explore opportunities for controlling material composition and atomic structure through characterization and modeling enabling and utilizing an ICME approach to enhance electro-mechanical coupling for next generation Acoustic Transduction Materials; better understand the chemical and mechanical properties of Material Science for Environment Quality; and accelerate research efforts through Computer Aided-Material Design - Functional Materials.</p> <p>Manufacturing</p> <p>- Complete basic manufacturing science research efforts, migrating fundamental work to portfolios of the relative disciplines including Structural Metals and Materials for Additive Manufacturing.</p> <p>Materials and Chemistry</p> <p>Continue the development of the scientific foundations for molecular-level understanding of materials synthesis, processing, and physical properties aimed at propelling, equipping and sustaining the US Navy and Marine Corps with tactical and strategic advantage. These efforts include:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Continue efforts into nanoparticle surface chemistry for plasmonic mediated reactions, photocatalysis, hydrogen storage, energetic materials, and fuel additives which will enable new high power and energy density generation, storage, release and harvesting materials and technologies. These fuel generation, energetic, fuel cell and battery material will enable next generation Navy autonomous undersea and air vehicles.</p> <p>-Continued research efforts on combustion and reacting transport, coupled with advanced mutiphysics computational simulation, will advance fire suppression for damage control as well as liquid and solid-fueled power and energy for hypersonics. Combinatorial and multivariate chemical approaches inform sensor system designs for aviation fuel surety and complex shipboard atmosphere environment monitoring.</p> <p>-Continue advancements into quantum computing simulations of quantum systems which1 model aqueous chemistries to allow design of anti-corrosion additives. Understanding fundamental electrochemistry, (tribo)corrosion, and biofouling will guide materials solutions for fleet sustainment through manpower and life-cycle cost reductions.</p> <p>Undersea Materials</p> <p>- Continue laboratory and theoretical/numerical work focusing on creation of new techniques for understanding, predicting, and controlling the interactions between acoustic and elastic waves and the processing routes for associated new materials; high performance source transducer materials that achieve high powered performance with reduced cost and complexity; and high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications.</p> <p>- Continue research into high performance source transducer materials, such as textured ferroelectric ceramics, that should achieve high power receiver performance at reduced cost and complexity. This would enable high throughput production of high performace tranducer ceramics, providing alternatives to current costly and difficult to produce single crystal technology.</p> <p>- Continue the creation of high efficiency silicon-based thin film thermoelectric modules for undersea warfare applications by exploiting nanocrystallization and multilayering to control thermal conductivity.</p> <p>- Complete research on advanced underwater material coupling architectures that achieve a broad range of passive and active acoustic impedances and control.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to increased focus on Materials Chemistry and Dynamics.</p>						
Title: Medical and Biological Sciences		18.895	15.997	15.675	0.000	15.675

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: The health and performance of Sailors and Marines is a top priority. Extensive research in the medical and biological sciences discover and leverage breakthroughs to improve Naval warfighter performance, so they can fight, win and come home safe. Sailors and Marines operate in the harshest working environments at sea and around the world. Conducting research to gain a better understanding of the biologic challenges of warfighters in their operating environments will ensure optimal performance, prevent injury, and equip the DON to provide the best care for its warfighters.</p> <p>Research areas include: bio-inspired autonomous systems; bioengineering; biophysics; microbial synthetic biology; microelectronics; microbial electrophysiology; microbiome research; bio-inspired multi-spectral camouflage and sensing; sensory neuroscience and physiology; Naval force health protection; undersea medicine; stress responses, health monitoring and modeling research; and health and welfare of the Navy's marine mammals.</p> <p>FY 2022 Plans: Bio-Inspired Autonomous Systems and Soft Robotics - Conduct basic research to explore novel bio-inspired sensing, control, and fluid dynamics of underwater propulsion and control systems to expand capabilities of underwater autonomous and unmanned systems. This research will include: (i) Exploration of experimental sensing capabilities and modeling for bio-sensing to enable sensorimotor control including fish schooling for passive swarm coordination in underwater vehicles; (ii) Exploration of bio-inspired locomotion from amphibious animals to enable technologies for amphibious and cross-domain vehicles; (iii) Investigation of bio-inspired design principles of distributed sensing, actuation, and control in soft biological structures for underwater propulsion and manipulation; and (iv) Design bio-inspired soft robots (e.g. worm-like robots) to characterize and measure geotechnical properties of the ocean floor. The long-term result will be bio-inspired propulsion and control systems to enable high-lift, stealthy propulsion without propellers and achieve high maneuverability for underwater vehicles.</p> <p>Bioengineering and Life Sciences - Conduct basic research that explores manipulation of biologically-based material design, synthesis, and system assembly. The result of this research will be to discover novel methods and approaches to leverage synthetic biology (e.g., bioengineering and bionanotechnology) to enable material characterization, optimized biomimetic/bio-inspired underwater adhesives, fabricating complex, functional materials from living organisms (e.g., bacteria); endow living mammalian cells with computational capabilities (e.g., information storage), and energy harvesting, storage, conversion, and actuation.</p>						

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Naval Biosciences and Synthetic Biology for Naval Applications - Conduct basic research to investigate synthetic biology approaches to design microbes/microbial communities to enhance warfighter resilience (e.g., metabolic regulation, stress response, and preventing musculoskeletal injury), sensory capabilities (e.g., olfactory enhancement), and enabling novel technologies for warfighter tools such as electronic sensing, signaling, rapid environmental monitoring, energy harvesting/storage, and biogenic synthesis and sequestration of electronic materials (including rare-earth metals). The long-term goal of this research is to expand the natural capabilities of living organisms (e.g., microbes) to purpose-specific organisms for environmental sensing and monitoring; energy generation, information processing, and material harvesting (important for supply chain security).						
Warfighter Augmentation - Conduct basic research to investigate novel bio-inspired mechanisms for multi-spectral camouflage including adaptive texture/shape, color adaptation, and near- to mid- infrared concealment. The long-term result of this research will provide novel enabling materials to protect warfighters from detection in the field.						
Sensory Neuroscience and Physiology - Conduct basic research efforts to advance understanding of auditory processing. The long-term goal is to enhance communication, understanding, and mission success in noisy military environments.						
Physiological Monitoring and Modeling - Conduct basic research to discover novel sensing capabilities and biomarkers to improve warfighter performance including real-time sensing and monitoring of individual biological functions and physiological responses to environmental and operational stressors across domains and in extreme environments. The result of this research will be to improve sensing capabilities, enhance current signal monitoring capabilities, enable physiological monitoring to predict individual outcomes; discover methods and approaches in quantum biology to incorporate into physiological monitoring and modeling; and autonomously collect, distribute, and integrate information about human teams (including the individuals and environment). The long-term goal of this research will be to discover the next generation of sensing capabilities to collect, understand, distribute, and integrate real-time information on the biological / physiological / cognitive status of both individuals and teams for command and leadership situational awareness and action.						
Naval Force Health Protection						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO
<p>- Conduct basic research to discover methods for: (i) Modeling and simulation approaches to improve Warfighter protection and injury treatment; (ii) Autonomy for medical care and logistics; (iii) Maritime casualty prevention; and (iv) Wearable technologies and protective equipment for maritime casualty prevention. The long-term goal of this research will be to integrate models of non-invasive sensors, biomarkers, simulations, and biophysical mechanisms to detect injury and identify preventive/mitigating mechanisms for safer protective equipment and vehicles. Investigate nanotechnologies, microelectronics, and autonomy for use in medical care of combat casualties to repair damage at the scale of cells, tissues, and whole body. Understand use of composite materials, additive manufacturing, and microelectronics to enhance warfighter protective equipment by providing increased biomedical sensing of warfighter status and greater operator situational awareness. The long-term goal of this research is to explore to optimize medical treatment, logistics, and casualty evacuation in the tactical environment.</p> <p>Undersea Medicine</p> <p>- Conduct basic research to identify novel technologies to improve performance of naval divers under extreme conditions (e.g, thermal, extended diving operations). The long-term goal of this research will provide understanding of human physiology (and leverage insights from comparative physiology studies of marine mammals) in extreme conditions experienced in the undersea environment; create synthetic biology approaches for thermal protection during dive operations; and identify novel technologies to support underwater breathing apparatus to include utilizing resources naturally present in the ocean for gas management (e.g., oxygen supply and carbon dioxide disposal). Another long-term goal of this research is to understand gas physiology of high partial pressures (e.g., oxygen, carbon dioxide and nitrogen to include metabolic dysfunction) and discover advantageous comparative physiology factors to enhance diver performance, and provide novel pathways and technologies to improve dive operations.</p> <p>Stress Response</p> <p>- Conduct basic research to understand the clinical, neurobiological and genetic factors that predict differences in stress reactivity and investigate how the interaction of chronically stressful environments and changes in light/dark periods affect the circadian system to regulate the central stress response system. The results of this research will provide validated predictive factors of stress reactivity in healthy, young subjects and the effects of photoperiod changes (model of circadian disruption) on the stress axis reactivity. The long-term goal is to explore the biological mechanisms of stress vulnerability, and research stress resilience for prevention and effective treatment of stress-related disorders.</p> <p>Physiological Monitoring and Modeling:</p>					

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B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to research the use of nucleic acid cleavage in creation of detection systems for the Warfighter. This will enable easily adapted nucleic acid detection with orders of magnitude lower sensitivity and specificity.</p> <p>Bio-derived Materials</p> <p>- Continue research on biomolecule embedding and control of cells and membranes will enable advanced biomaterials, bioelectronics and biotic-abiotic system interfaces. This would provide new biomimetic sentinel molecules for Navy chemical and optical sensor/actuator devices and biorobotic systems. The resulting chemical, biological, radiological, and explosive sensors will enable sensitive operating environment surveillance.</p> <p>FY 2023 Base Plans:</p> <p>Bio-Inspired Autonomous Systems and Soft Robotics</p> <p>- Continue research to explore novel bio-inspired sensing, control, and fluid dynamics of underwater propulsion and control systems to expand capabilities of underwater autonomous and unmanned systems. This research will include: (i) Exploration of experimental sensing capabilities and modeling for bio-sensing to enable sensorimotor control including fish schooling for passive swarm coordination in underwater vehicles; (ii) Exploration of bio-inspired locomotion from amphibious animals to enable technologies for amphibious and cross-domain vehicles; (iii) Investigation of bio-inspired design principles of distributed sensing, actuation, and control in soft biological structures for underwater propulsion and manipulation; and (iv) Design bio-inspired soft robots (e.g., worm-like robots) to characterize and measure geotechnical properties of the ocean floor. The long-term result will be bio-inspired propulsion and control systems to enable high-lift, stealthy propulsion without propellers and achieve high maneuverability for underwater vehicles.</p> <p>- Complete investigation of fish lateral line pressure sensing for navigation and obstacle avoidance of underwater vehicles.</p> <p>- Initiate research to explore multi-fin control, propulsion and maneuver with robotic fish prototypes.</p> <p>Bioengineering and Life Sciences</p> <p>- Continue the exploration of computational tools and fabrication methods for producing materials with targeted properties from the molecular level (nanometers) to the macroscopic level (meters) for Naval applications.</p> <p>- Continue investigation of bioinspired and biomimetic adhesives and reversible adhesives that cure in seawater for underwater applications.</p> <p>- Continue the exploration of computational design tools and characterization methods for nanostructures made from DNA, and their application to optical computing, data storage, and cell-free bioconversion systems for bioproduct manufacturing.</p>								

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<div>- Continue experimentation with synthetic biology to establish new biomanufacturing strategies for complex and living materials.<div>- Continue the exploration of water absorption-evaporation cycling in biomaterials to develop hydro- and thermo-responsive textiles and as a power source for maritime sensing surveillance systems.</div></div> <div>Naval Biosciences and Synthetic Biology for Naval Applications (This thrust includes the efforts previously listed under Warfighter Augmentation in the FY22 plan.)<div>- Continue research to investigate: (i.) bio-inspired mechanisms for multi-spectral camouflage (adaptive texture/ shape, color, and near- to mid- infrared concealment), and (ii.) bioengineering bacteria for sensing, materials, and functionalized microbial communities.<div>- Continue researching the construction of bacterially synthesized biomaterials for capturing and enriching rare earth elements to establish a secure source of these critical materials for defense-related applications.<div>- Continue the investigation of novel materials and electroactive bacteria to improve energy generation from bacteria powered fuel cells and for use of components in synthetic biology applications.</div></div></div></div> <div>Auditory Science for the Naval Domain (This thrust was previously part of the Sensory Neuroscience and Physiology FY22 plan. The name was changed to more accurately describe the research.)<div>- Complete studies that led to the discovery of small molecule therapeutics for the potential treatment of auditory system injuries associated with noisy Naval environments.<div>- Initiate studies investigating how biological systems use acoustic camouflage and design bio-inspired acoustic dampening metamaterials.</div></div></div> <div>Physiological Monitoring and Modeling<div>- Continue to research the use of nucleic acid cleavage in creation of detection systems for the Warfighter. This will enable easily adapted nucleic acid detection with orders of magnitude lower sensitivity and specificity.<div>- Complete research on innovative communications capabilities for discreet transmission of individual and team health and geolocation data.<div>- Initiate research to characterize new physiologic signal monitoring capabilities.<div>- Initiate research into innovative technologies for real-time sensing and observation of individual responses to environmental and operational stressors.</div></div></div></div><div>Naval Force Health Protection</div></div>								

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Continue research into methods for modeling and simulation approaches to improve Warfighter protection and injury treatment.</div><div>- Continue to investigate nanotechnologies, microelectronics, artificial intelligence, and autonomy for use in medical care of combat casualties to repair damage at the scale of cells, tissues, and whole body.</div><div>- Continue research to understand use of composite materials, additive manufacturing, and microelectronics to enhance warfighter protective equipment by providing increased biomedical sensing of warfighter status and greater operator situational awareness. The long-term goal of this research is to explore to optimize medical treatment, logistics, and casualty evacuation in the tactical environment.</div><div>- Continue use of fundamental principles of physics to determine material properties of biological tissues.</div></div> <div>Undersea Medicine</div> <div><div>- Continue studies to enhance our understanding of human physiology (and leverage insights from comparative physiology studies of marine mammals) in the undersea environment.</div><div>- Continue work to create synthetic biology approaches for thermal protection during dive operations.</div><div>- Continue research to identify novel technologies to support underwater breathing apparatus to include utilizing resources naturally present in the ocean for gas management (e.g., oxygen supply and carbon dioxide disposal).</div><div>- Complete research that identified the role of specific gas channels (AQP1 and 4) now being explored as potential targets for limiting oxidative stress caused by elevated oxygen exposures encountered in dive operations.</div><div>- Initiate research on respiratory plasticity in relation to metabolic efficiency, immunologic resilience and thermal tolerance with a particular focus on respiratory loads in altered breathing gas states (e.g., hyperoxia, hypercapnia, hypoxia).</div></div> <div>Stress Response</div> <div><div>- Continue to investigate the clinical, neurobiological, and genetic factors that predict differences in stress reactivity for constructing a multi-modal predictor of stress responsiveness, and for identifying targets for intervention.</div><div>- Continue to examine the interaction of a chronically stressful environment and changes in light/dark periods on the function of the stress response system.</div><div>- Continue to explore the feasibility of continuous and unobtrusive stress detection, tracking, and mitigation for a wearable closed-loop system capable of monitoring stress and providing bioelectronic therapy.</div></div> <div>FY 2023 OCO Plans:</div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.						
Title: Ocean Sciences		79.801	83.529	84.272	0.000	84.272
Description: Understanding and predicting oceanographic and acoustical phenomena provides significant warfighting advantages to naval forces. Ocean Sciences research addresses the full spectrum of acoustics and oceanography to enable observation, modeling, and prediction of the maritime environment. Efforts include: studying common operating areas for naval forces in the open oceans, the Arctic, the littorals, and nearshore and river mouths and inlet environments; elucidating the coupling between oceanographic, geophysical and acoustical phenomena relevant to such mission areas such as Anti-Submarine Warfare and Mine Warfare; development of global, regional and local predictive models that fully couple the ocean-atmosphere-wave-ice domains; development and use of autonomous systems and sampling technologies for the collection of environmental observations and continuing support to research vessels of the U.S. Academic Research Fleet to enable at-sea oceanographic science.						
Research within the Ocean Sciences subactivity responds to mission needs of the Navy and Marine Corps as guided by the Oceanographer of the Navy. At-sea research involves ancillary studies to ensure full compliance with environmental requirements.						
FY 2022 Plans: Littoral Geosciences and Optics Areas of research include the highly nonlinear and coupling between atmospheric phenomena and surface gravity and internal waves; the transport of sediment by waves and currents; and the bathymetric evolution of the nearshore and coastal environment. Field, modeling, experimental and remote sensing studies are all used. - Continue modeling and field studies of high spatial and temporal resolution coastal land-air-sea interactions and their role in creating atmospheric electromagnetic ducting. - Continue studies of surface gravity waves, currents, tides and internal wave processes along rocky coastlines. - Continue autonomous, scalable, hydrographic charting and coastal parameter sampling studies with concomitant remote sensing for data-assimilative coastal models. - Continue research using airborne and satellite active and passive microwave sensors, overhead optical sensors, and ship or shore-based radars to observe coastal and nearshore phenomena. - Continue field studies of coastal oceanographic phenomena using sonar-equipped autonomous underwater vehicles in conjunction with ground-based, airborne and satellite remote sensing.						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue research to predict physical, geological, geochemical, geoacoustic and geotechnical properties of the seafloor in shallow-water coastal environments.</p> <p>Physical Oceanography and Prediction Areas of research include ocean circulation, thermodynamics and mixing, and the dynamics of surface gravity waves, nonlinear internal waves and the interaction of waves with sea ice in order to understand the sub-mesoscale physical oceanography parameters from the tropics to the poles. Sub-mesoscale understanding of the ocean is necessary to support the required fidelity and accuracy of ocean feature inputs to Naval warfighting applications.</p> <p>- Continue study of three-dimensional Lagrangian ocean circulation and the prediction of vertical pathways in field experiments in the Mediterranean Sea.</p> <p>- Continue exploration of novel expeditionary ocean instrumentation to support targeted observing.</p> <p>- Continue study of ocean fronts, eddies and turbulence; ocean thermodynamics including mixing and acoustic impacts; and ocean boundary layer processes and surface gravity waves.</p> <p>- Continue study of the rapid evolution of the upper ocean in the high North Atlantic between Iceland and the European continent to understand the physical processes that control vertical and horizontal density structures in the upper ocean.</p> <p>- Continue study of the seasonal variability of processes that control sea surface temperature in the Arabian Sea to understand the relevant space and time scales that enable improved ocean and weather forecasts through the reduction of ocean temperature biases in coupled models.</p> <p>- Complete study of sources and sinks of near-inertial shear and energy in the ocean in the Greenland, Iceland, United Kingdom (GIUK) region.</p> <p>- Initiate studies to explore the cascade of energy in the sub-mesoscale ocean, including the physics and dynamics of ocean features such as current meanders, vortices, and filaments, with a field program in the Western Pacific, to expand the knowledge of the lifecycle of these features and enable improved predictions.</p> <p>Arctic Sciences Areas of research include the complex processes governing the interaction of the arctic atmosphere, ocean, and sea ice, including formation, deformation, and melting. Physical processes in the arctic are inherently different from those in non-polar regions.</p> <p>- Continue studies to characterize the behavior of sea ice, including melt and reformation, ice rheology and motion, and interactions with ocean stratification, surface waves and the atmosphere.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate a joint acoustics and oceanographic experiment to infer full water column and seabed waveguide geoacoustic parameters in a dynamic ocean.</p> <p>Marine Mammals</p> <p>Areas of research include monitoring and detection, integrated ecosystem, and effects of sound on marine mammals.</p> <p>- Continue development and testing of new and existing technologies to detect, classify, localize and potentially track marine mammals.</p> <p>- Continue multidisciplinary ecosystem research including tagging, visual surveys, and passive acoustics to collect baseline measures of marine mammal behaviors and distributions relative to environmental features and marine mammal prey fields.</p> <p>- Continue research on sound reception mechanisms in large whales.</p> <p>- Continue research on the effects of sound include behavioral, physiological and population-level consequences of sound exposure on marine life.</p> <p>- Continue studies to characterize and quantify the cumulative effects of multiple stressors on marine mammal populations.</p> <p>Battlespace Environments</p> <p>- Continue research is to improve basic understanding of physical, seafloor and biological oceanographic processes on space and time scales of naval interest. Emphasis is on improved measurements, laboratory and model based experiments to quantify and understand important oceanographic processes that lead to the development of ocean dynamic/thermodynamic models from global to sub-mesoscale scales, and to couple these oceanographic models with atmospheric, ice, biological, sediment response, and optical models. While today's numerical analysis and prediction systems are more capable of resolving and predicting highly variable phenomena than were the systems of 10-20 years ago, there are still oceanographic processes that are not well understood and must be studied including aspects of ocean circulation (fronts, eddies and turbulence), thermodynamics (mixing and acoustic impacts), waves (including their impact on sea ice and rogue waves), sea ice (including landfast ice) as well as ocean boundary layer processes. Navy and Marine Corps requirements also include: a) an improved use of overhead (airborne and satellite) active and passive microwave sensors, overhead optical sensors, surface-based (ships and ground-based) grazing angle microwave sensor, b) use of remote sensing of bulk properties of Arctic sea-ice over broad two-dimensional areas that previously could</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
be sampled only at spot locations by in-situ sampling, and c) use of newly available higher resolution (sub-mesoscale) oceanographic data.						
FY 2023 Base Plans: Littoral Geosciences and Optics Areas of research include the highly nonlinear coupling between atmospheric phenomena and surface gravity and internal waves; the transport of sediment by waves and currents; and the bathymetric evolution of the nearshore and coastal environment using integrated field observations, modeling, experimental and remote sensing studies. - Continue studies of surface gravity waves, currents, tides and internal wave processes along rocky coastlines. - Continue autonomous, scalable, hydrographic charting and coastal parameter sampling studies with concomitant remote sensing for data-assimilative coastal models. - Continue research using airborne and satellite active and passive microwave sensors, overhead optical sensors, and ship or shore-based radars to observe coastal and nearshore phenomena. - Continue field studies of coastal oceanographic phenomena using sonar-equipped autonomous underwater vehicles in conjunction with ground-based, airborne and satellite remote sensing. - Continue research to predict physical, geological, geochemical, geoacoustic and geotechnical properties of the seafloor in shallow-water coastal environments. - Initiate studies of the dynamics of shallow coastal inlets; specific areas include their formation and maintenance processes by tides, waves, currents, discharge and sediment type and supply.						
Physical Oceanography and Prediction Areas of research include ocean circulation, thermodynamics and mixing, and the dynamics of surface gravity waves, nonlinear internal waves and the interaction of waves with sea ice in order to understand the sub-mesoscale physical oceanography parameters from the tropics to the poles. Sub-mesoscale understanding of the ocean is necessary to support the required fidelity and accuracy of ocean feature inputs to Naval warfighting applications. - Continue study of three-dimensional Lagrangian ocean circulation and the prediction of vertical pathways in field experiments in the Mediterranean Sea. - Continue exploration of novel expeditionary ocean instrumentation to support targeted observing. - Continue study of ocean fronts, eddies and turbulence; ocean thermodynamics including mixing and acoustic impacts; and ocean boundary layer processes and surface gravity waves.						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue study of the rapid evolution of the upper ocean in the high North Atlantic between Iceland and the European continent to understand the physical processes that control vertical and horizontal density structures in the upper ocean.</p> <p>- Continue study of the seasonal variability of processes that control sea surface temperature in the Arabian Sea to understand the relevant space and time scales that enable improved ocean and weather forecasts through the reduction of ocean temperature biases in coupled models.</p> <p>- Complete study of sources and sinks of near-inertial shear and energy in the ocean in the Greenland, Iceland, United Kingdom (GIUK) region.</p> <p>- Initiate studies to explore the cascade of energy in the sub-mesoscale ocean, including the physics and dynamics of ocean features such as current meanders, vortices, and filaments, with a field program in the Western Pacific, to expand the knowledge of the lifecycle of these features and enable improved predictions.</p> <p>Arctic Sciences</p> <p>Areas of research include the complex processes governing the interaction of the arctic atmosphere, ocean, and sea ice, including formation, deformation, and melting. Physical processes in the arctic are inherently different from those in non- polar regions.</p> <p>- Continue studies to characterize the behavior of sea ice, including melt and reformation, ice rheology and motion, and interactions with ocean stratification, surface waves and the atmosphere.</p> <p>- Continue development of Arctic System models and data assimilation techniques for improved prediction of the Arctic region and development of new sensors and unmanned platforms to collect observations of the Arctic environment.</p> <p>- Continue development of algorithms enabling the space-based remote sensing of bulk properties of Arctic sea-ice that previously could be sampled only by localized in-situ methods.</p> <p>- Initiate studies of the circulation of the Arctic Ocean to explore the fate of heat flowing in through the Bering Strait and the impact on the upper ocean density structure of the Beaufort Sea.</p> <p>Ocean Acoustics</p> <p>Ocean Acoustics continues as one of five National Naval Responsibilities (NNR). Research and education supported under this PE contributes to a vigorous science and technology base to ensure continuing U.S. leadership in the critically important discipline of Ocean Acoustics. Areas of research contribute to improved basic understanding of the physical, seafloor and biological parameters that impact acoustic propagation in the ocean. Accurate acoustic predictions are required to keep our undersea assets undetected as well as to enable the detection and tracking of adversary assets.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>environmentally responsible and legal manner. Areas of research include monitoring and detection of marine mammals, integrated ecosystem research, hearing in large whales, and effects of sound on marine mammals.</p> <ul style="list-style-type: none"> - Continue development and testing of new and existing technologies to detect, classify, localize and potentially track marine mammals. - Continue multidisciplinary ecosystem research including tagging, visual surveys, and passive acoustics to collect baseline measures of marine mammal behaviors and distributions relative to environmental features and marine mammal prey fields. - Continue research on sound reception mechanisms in large whales. - Continue research on the effects of sound include behavioral, physiological and population-level consequences of sound exposure on marine life. - Continue studies to characterize and quantify the cumulative effects of multiple stressors on marine mammal populations. - Continue research to develop framework for understanding the ecology of eDNA, including the origin, state, transport, and fate of extraorganismal genetic material. - Initiate studies to design appropriate primers and bioinformatics workflows to effectively and efficiently detect and identify target biological communities and ecosystems, and advance our understanding of the relationships between eDNA and the abundance of marine megafauna. <p>Battlespace Environments</p> <ul style="list-style-type: none"> - Continue research is to improve basic understanding of physical, seafloor and biological oceanographic processes on space and time scales of naval interest. Emphasis is on improved measurements, laboratory and model based experiments to quantify and understand important oceanographic processes that lead to the development of ocean dynamic/thermodynamic models from global to sub-mesoscale scales, and to couple these oceanographic models with atmospheric, ice, biological, sediment response, and optical models. While today's numerical analysis and prediction systems are more capable of resolving and predicting highly variable phenomena than were the systems of 10-20 years ago, there are still oceanographic processes that are not well understood and must be studied including aspects of ocean circulation (fronts, eddies and turbulence), thermodynamics (mixing and acoustic impacts), waves (including their impact on sea ice and rogue waves), sea ice (including landfast ice) as well as ocean boundary layer processes. Navy and Marine Corps requirements also include: a) an improved use of overhead (airborne and satellite) active and passive microwave sensors, overhead optical sensors, surface-based (ships and ground-based) grazing angle microwave sensor, b) use of remote sensing of bulk properties of Arctic sea-ice over broad two-dimensional areas that previously could 					

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
be sampled only at spot locations by in-situ sampling, and c) use of newly available higher resolution (sub-mesoscale) oceanographic data.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to increased focus on Underwater Acoustics and Geophysical Processes.						
Title: Science and Engineering Education, Career Development and Outreach		41.127	44.948	47.405	0.000	47.405
Description: The Science and Engineering Education, Career Development and Outreach activity addresses the critical need to grow and maintain a highly skilled technical naval workforce. These efforts inspire, engage, educate and attract participants to pursue naval careers and build the extramural performer base. DON Science, Technology, Engineering and Math (STEM) education and outreach is designed to increase the number of students and naval civilians with naval-relevant skills and degrees, expand capabilities of the current and future workforce by developing curricula and augmenting education, and augment awareness of Naval opportunities through localized education and outreach initiatives that foster the talent pipeline.						
This activity supports both the Naval Research Enterprise Intern Program (NREIP) for college students and the Science and Engineering Apprenticeship Program (SEAP) for high school students to encourage participants to pursue science and engineering careers. The objective is to further education via mentoring by laboratory personnel and their participation in research, and to make them aware of Department of the Navy (DON) research and technology efforts. This program serves as a recruitment tool for employment within the DON. Participating students at 45 DON laboratories will spend eight to ten weeks during the summer conducting research.						
The separately-managed Department of the Navy's (DON) Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) program oversees the Navy's efforts to engage and support research in our nation's HBCU/MIs and is responsible for developing and managing efforts that strengthen and support the capabilities of HBCU/MIs to participate in basic, applied, and advanced development research programs within the Naval Research Enterprise.						
The ONR Young Investigator Program (YIP) attracts outstanding faculty members to the Department of Navy's basic research program by identifying individuals that show exceptional promise for doing creative research						

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and encourage their teaching and research careers through long term support. Young Investigator awards are for a period of three years. Proposals are solicited annually via a funding opportunity announcement open to tenure-track faculty in science, engineering, and mathematics. YIP awardees are competitively selected based on faculty achievements, technical proposal, benefit to the Navy and Marine Corps, and university endorsement.						
The Naval Research Institution was established through a Memorandum of Understanding between the United States Naval Academy (USNA) and the Office of Naval Research. This effort contributes to the technical education of midshipmen by providing a research experience in STEM and its impact on fleet and forces capabilities.						
This activity also supports the Office of Naval Research Global mission to serve as the enduring Navy and Marine Corps global presence in technical and operational communities, investing in trusted partnerships to discover and connect science and technology leaders for sustained maritime security. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, Department of Defense, other US Government agencies and international partners. The direct impact of this investment is to leverage international basic research during increasingly dynamic global interdependence and improve the ability to solve DON Science & Technology challenges through shared knowledge with partners.						
FY 2022 Plans:						
Conduct Science, Technology, Education and Mathematics (STEM) initiatives to foster and cultivate a diverse, world-class STEM workforce in order to maintain the U.S. Navy and Marine Corps' technological superiority.						
- Continue existing successful efforts, while examining approaches to further scale up these efforts to achieve greater impact across the Department Of the Navy (DON).						
- Continue transparent and accountable coordination of DON STEM efforts aligned with the DON STEM strategy.						
- Continue activities targeting regional efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community.						
- Continue to support programs that provide hands-on and virtual research experiences in STEM fields for United States Naval Academy (USNA) midshipmen and faculty members to enhance the midshipmen's educational environment at the USNA.						
- Initiate the development of highly scalable pilot efforts to expand STEM education and outreach through the development of new virtual and in-person curricula as well as virtual and in-person experiential learning activities.						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate new outreach and communication approaches to significantly broaden and increase awareness of naval STEM opportunities and careers.</p> <p>Naval Enterprise Partnership Teaming with Universities for National Entrepreneurship (NEPTUNE) program:</p> <p>- Continue to sponsor Naval educational institutes (e.g. Naval Postgraduate School) to conduct research that provides Navy Energy Education & Training for students and promotes the use of entrepreneurial practices to accelerate the delivery of technologies to the warfighter.</p> <p>Historically Black Colleges and Universities / Minority Institutions (HBCU/MI):</p> <p>- Continue to provide robust research opportunities, such as faculty fellowships and student internships that address critical Naval S&T challenges through collaborations with Naval scientists, engineers and academic researchers. Through the coordination of symbiotic engagements between Naval researchers, industry partners and minority serving institutions to advance Naval-relevant research, this program cultivates long-term partnerships that leverage knowledge sharing and empower scientific global discovery.</p> <p>- Develop new outreach plans to increase the number of HBCU/MI white paper and grant proposal submissions. Establish a HBCU/MI Post-doctoral program that supports the efforts of increasing the number of HBCU/MI students working within the Navy STEM related fields.</p> <p>- Increase the number of science fairs at HBCU/MI that have partnerships with local schools.</p> <p>Young Investigator Program (YIP):</p> <p>- Continue YIP awards to 25 to 35 assistant professors that show exceptional promise for performing creative research. Topics are competitively selected based on faculty achievements, technical proposal, benefit to the Navy and Marine Corps, and institution support. Ongoing efforts cover a wide range of topics of Naval S&T interest. Recent topics include innovative technical approaches to: next generation wireless technology, symbolic deep learning, safe autonomous navigation, artificial intelligence in weather prediction, underwater artificial gills, scalable Ytterbium tweezer arrays, high-speed liquid-fueled combustion, remote sensing and forecasting in coastal environments, multi-frequency high-power microwave, van der Waals metamaterials, heat transfer in nanomaterials, 3-D accelerated tissue repair, and automated machine intelligence. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges.</p> <p>- Complete Young Investigator Program projects initiated in fiscal year 2020.</p> <p>ONR Global</p>						

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<p>- Continue international outreach efforts to foster collaboration through PhD-level scientists located in Asia, Europe, South America and Australia, providing coverage in these regions by awarding grants in innovative basic research to discover, access and assess revolutionary, high-payoff technologies for future Naval missions and capabilities.</p> <p>FY 2023 Base Plans: Science, Technology, Education and Mathematics (STEM) - Continue existing successful efforts, while examining approaches to further scale up these efforts to achieve greater impact across the DON. - Continue the development of highly scalable pilot efforts to expand STEM education and outreach, with a focus on reaching underrepresented students, through the development of new virtual and in-person curricula as well as virtual and in-person experiential learning activities. - Continue activities targeting regional efforts to augment awareness of naval opportunities and increase diverse workforce opportunity for the naval science and technology community. - Continue to support the Naval Research Institution efforts that provide hands-on and virtual research experiences in STEM fields for United States Naval Academy (USNA) midshipmen and faculty members to enhance the midshipmen's educational environment at the USNA. - Continue NREIP and SEAP opportunities for students to participate in Navy and Marine Corps-relevant research at Naval Warfare Centers and Laboratories by expanding the number of participating sites, mentors, and interns.</p> <p>Historically Black Colleges and Universities / Minority Institutions (HBCU/MI): - Continue to provide innovative research opportunities, such as faculty fellowships and student internships that address critical Naval S&T challenges through collaborations between academic researchers and Naval scientists and engineers. - Continue to advance Naval-relevant research, by cultivating long-term partnerships that leverage knowledge sharing and empower scientific global discovery. - Continue new outreach initiatives to increase the number of HBCU/MI white paper and grant proposal submissions. - Initiate new efforts to increase applications and participants in the HBCU/MI Post-doctoral program that impacts the number of HBCU/MI PhD candidates working within the Navy STEM related fields. - Initiate new efforts to increase the number of science fairs at HBCU/MI that have partnerships with local junior and high schools.</p>						

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Young Investigator Program (YIP): - Continue YIP awards to 25 to 35 assistant professors that have demonstrated exceptional promise for performing creative research. Recent YIP topics include innovative technical approaches to: autonomy, deep learning, optimization, artificial intelligence, wireless communications, energetics, power and energy, propulsion, turbulence, hypersonics, remote sensing, bio-sensors, bionic composites, nanocomposites, ocean sciences, marine mammal health, multi-function materials and additive manufacturing. These and other research topics will benefit today's and the next generation warfighter by improving lethality, survivability, and communications. Additionally, many of these investigators will provide long-term support and knowledge in solving Naval related S&T challenges. - Complete Young Investigator Program topics initiated in previous fiscal years. - Initiate Young Investigator Program topics selected in fiscal year 2023. ONR Global - Continue international outreach efforts to foster collaboration through doctoral-level scientists located in Europe, South America, Canada, Asia and Australia, providing coverage in these regions by awarding grants in innovative basic research to discover, access and assess revolutionary, high-payoff technologies for future Naval missions and capabilities. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to increased investment in HBCU/MI Navy STEM sponsored opportunities and participation.						
Title: Sensors, Electronics and Electronic Warfare (EW) Description: Basic research efforts directed toward increasing knowledge, components and algorithmic advances for electronics, sensing and EW ensuring the Navy can counter current and future threats. These efforts are applicable to sensing and EW on individual Naval platforms, as well as, efforts that aggregate capabilities in a Distributed Maritime Operation. The efforts research focus include: 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		50.845	53.650	55.113	0.000	55.113

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>(RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; and RF electronic warfare.</p> <p>FY 2022 Plans:</p> <p>Electronics</p> <p>Continue to create new knowledge and understanding and explore new concepts, components, techniques and methods, for the design, growth, and characterization of electronic, electromagnetic, quantum phenomenology, and electro-optical materials, fabrication processes, electronic and electro-optic components, including novel electromagnetic concepts and techniques, and plasma phenomena and theory.</p> <ul style="list-style-type: none">- Continue efforts in nitrogen-polar GaN materials and device development.- Continue efforts in superconducting GaN materials and device development.- Continue efforts in plasmonic photomixer devices and circuits.- Continue effort to use generative neural networks to design topology-optimized metasurfaces and apply results to generate dual-level short-wave infrared antireflective coatings.- Continue efforts to develop novel materials for linear, low-power, broadband switches, including phase-change materials such as GeTe, as well as two-dimensional hexagonal boron nitride.- Continue to utilize the unique quantum properties of superconductors and photonics to deliver new devices and integrated circuits, which enable real time, software defined, wide band, and simultaneous signal, receive functionality.- Continue to investigate how to realize increased receiver dynamic range over entire DC to 200 GHz spectrum. Stimulate demonstrations of increasingly complete receive capabilities. These systems will be applicable to all the RF applications while being most important to Surveillance, Electronic Warfare (EW), signal intelligence (SIGINT).- Continue work on squeezed lasers, optical cooling, and new superconducting sensors of magnetic field sources, even if cloaked.- Initiate work on quantum entanglement and measurement as applied to RF signal analysis.- Initiate device reliability studies of nitrogen-polar GaN devices.- Initiate studies on superconducting GaN functional circuits.- Initiate efforts to create new knowledge and understanding for quantum computing algorithms and their use to create new understanding of materials by design, process optimization, and quantum simulation. <p>Quantum Information Sciences</p> <ul style="list-style-type: none">- Continue the development of protocols for sensing and timekeeping devices based on quantum systems, including clocks with improved short and long-term performance and electromagnetic field sensors.							

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<p>- Continue the development of inertial and gravity sensors based on light-atom interferometry.</p> <p>Electromagnetic Warfare</p> <p>Continue research efforts with the overarching objective of establishing the mathematical constructs, techniques, computational procedures, and scientific foundations for analysis/design of signal, image, control, and data generating systems for use in Navy, other DoD, dual-use, or commercial development programs. Each project has defined objectives within the contexts of the Naval Research Enterprise Research and Development Strategic Framework and Marine Corps S&T Strategic Plan.</p> <p>- Continue developing ultrafast, efficient, and accurate time domain (TD) algorithms to predict the ultra-wideband radar cross-section (RCS) of complex naval platforms by solving the long-standing late-time instability problem.</p> <p>- Continue investigating mathematical, statistical and algorithmic issues associated with performing robust and adaptive detection and discrimination of targets when sensed by multiple, resource-constrained, unmanned vehicle sensors operating in a decentralized fashion and in highly cluttered environments.</p> <p>- Continue research to establish basic feasibility of novel emerging non-linearized imaging and feature extraction techniques with respect to existing and/or realistic multi-static sensing geometries, research to utilize and enhance the understanding and applicability of topological techniques to enable improved capabilities for target detection, object identification, and data fusion.</p> <p>- Continue research to enable the imaging of self-illuminating thermal objects occluded by walls by sensing non-specular reflections from rough surfaces such as open doors and around corners, to allow for asymmetric warfare through image recovery in previously denied conditions.</p> <p>- Continue research to develop advanced multi-dimensional Convolutional Neural Network approaches and algorithms to investigate and demonstrate improved means of analyzing high-dimensional data resulting in improved results for classification, segmentation, anomaly/ target detection.</p> <p>Materials and Chemistry</p> <p>- Continue to design novel experiments and robust theoretical models necessary to enable new warfighter capabilities through advanced sensors and electronics.</p> <p>- Complete target identification algorithms utilizing nonlinear dynamics.</p> <p>- Understand and demonstrate the principles and mechanisms of DNA-based molecular-scale machines to amplify detection of biochemical agents.</p> <p>- Complete the fabrication of single atomic layer of materials to create 2-dimensional ferromagnets and semiconductors. The material of choice will be single layer MoS2 for utilization as indirect gap semiconductors.</p> <p>- Complete research on unique single stage accelerator mass spectrometer to evaluate the fine scale detection limits of fusion products and isotopes.</p>						

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<div><div>- Complete research to recognize the protein-surface interactions leading to highly sensitive biosensors.</div><div>- Complete the development of principle theoretical models to understand the principles governing the interactions between surfaces and small molecules. Prior studies in these areas have demonstrated success in designing biological and chemical sensors with parts per trillion sensitivity as well as understanding of electronic mobility of graphene due to the effects of edge and defects.</div><div>- Initiate the design and fabrication of single-monolayer or low-dimensional materials with unique and useful fundamental properties distinct from bulk materials, e.g. ferromagnets and semiconductors, capable of being functionalized for high performing sensors, computer memory elements or electronic components.</div><div>- Initiate the use of precision molecular placement and orientation to design and create bio-inspired materials exploiting quantum phenomena to perform functions such as ultrasensitive photon detectors and energy generation</div><div>- Initiate highly sensitive measurement and modeling techniques to design, detect, diagnose and/or quantify physical, chemical and biological processes and properties affected by trace impurities, subtle composition changes and chemical species with high spatial resolution, sensitivity, and precision.</div></div> <div>Undersea Warfare</div> <div><div>- Continue to conduct laboratory, field, and theoretical/numerical studies to investigate physical phenomena related to acoustic propagation and scattering in oceanic environments such as: prediction of the scattering signature of a structure using noise sources of opportunity; fundamental physical phenomena of wave propagation in ocean environments; approaches to separate an acoustical field from turbulent flow on an acoustic array; new structural acoustics theory for scattering from large, complex undersea objects; and creation of new approaches to monitoring the acoustic signature and structural state of undersea vessels.</div></div> <div>FY 2023 Base Plans:</div> <div>Electronics Technology</div> <div><div>- Continue to create new knowledge and understanding and explore new concepts, components, techniques and methods, for the design, growth, and characterization of electronic, electromagnetic, quantum phenomenology, and electro-optical materials, fabrication processes, electronic and electro-optic components, including novel electromagnetic concepts and techniques, and plasma phenomena and theory.</div><div>- Continue efforts in nitrogen-polar GaN materials and device development.</div><div>- Continue efforts in superconducting GaN materials and device development.</div><div>- Continue efforts in plasmonic photomixer devices and circuits.</div><div>- Continue effort to use generative neural networks to design topology-optimized metasurfaces and apply results to generate dual-level short-wave infrared antireflective coatings.</div></div>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Continue efforts to develop novel materials for linear, low-power, broadband switches, including phase-change materials such as GeTe, as well as two-dimensional hexagonal boron nitride.</div><div>- Continue work on squeezed lasers, optical cooling, and new superconducting sensors of magnetic field sources, even if cloaked.</div><div>- Continue work on quantum entanglement and measurement as applied to RF signal analysis.</div><div>- Continue device reliability studies of nitrogen-polar GaN devices.</div><div>- Continue studies on superconducting GaN functional circuits.</div><div>- Continue efforts to create new knowledge and understanding for quantum computing algorithms and their use to create new understanding of materials by design, process optimization, and quantum simulation.</div><div>- Continue to improve full spectrum, real time, fully adaptive reception of many simultaneous signals-of-interest by exploiting the unique quantum properties of superconductor microelectronics and photonics.</div><div>- Continue to investigate how to realize increased receiver dynamic range over entire DC to 200 GHz spectrum and enhance functional density to produce lighter and smaller receivers.</div><div>- Initiate research in epitaxial synthesis of p-type crystalline metal nitrides.</div><div>- Initiate transport studies of p-type and crystalline metal nitrides.</div><div>- Initiate investigations into p- and n-type crystalline metal nitrides heterostructures.</div><div>- Initiate architectural studies for implementing priority based processing utilizing the combination of wideband reception and machine learning algorithms. Such systems will be applicable to all RF applications while being most important to Surveillance, Electronic Warfare (EW), signal intelligence (SIGINT).</div></div> <div>Quantum Measurement Architectural Devices (formerly Quantum Information Sciences)</div> <div><div>- Continue the development of protocols for sensing and timekeeping devices based on quantum systems, including clocks with improved short and long-term performance and electromagnetic field sensors.</div><div>- Continue the development of inertial and gravity sensors based on light-atom interferometry.</div><div>- Initiate research on the capabilities of non-equilibrium many-body systems for novel metrology.</div></div> <div>Electromagnetic Warfare</div> <div><div>- Continue research efforts with the overarching objective of establishing the mathematical constructs, techniques, computational procedures, and scientific foundations for analysis/design of signal, image, control, and data generating systems.</div><div>- Continue the development of ultrafast, efficient, and accurate time domain (TD) algorithms to predict the ultra-wideband radar cross-section (RCS) of complex naval platforms by solving the long-standing late-time instability problem.</div></div>						

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acoustic array; new structural acoustics theory for scattering from large, complex undersea objects; and creation of new approaches to monitoring the acoustic signature and structural state of undersea vessels. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to increased focus and investment in Electronic Materials and Interfaces.						
Title: Weapons Description: The Weapons activity focuses on a number of fundamental scientific areas aimed at expanding the underlying understanding of disciplines that are broadly useful for a wide range of naval weapon applications, including undersea weaponry; air weaponry; energetic materials and solid rocket propulsion; both laser and high power microwave directed energy systems; counter directed energy phenomena; and hypersonic aerodynamics and materials to address the unique challenges of extreme temperatures and air flow. FY 2022 Plans: Undersea Weapons (USWs) - Conduct basic research to understand science and technology that will contribute to undersea and surface vehicle swarm autonomy, undersea weapons (USWs) and advanced concepts for sea warfare. This research will allow further development of technologies for legacy and next-generation offensive and defensive USWs and payloads capable of engaging threat submarines, surface ships and torpedoes. - Additionally, the Naval Undersea Research graduate-level STEM program will continue to support the development of the Navy lab workforce. Air Weaponry - Basic research will focus on the areas of solid and hybrid rocket propulsion, advanced structural and aperture materials, navigation, aerodynamics, single and multi-missile control, and power management. Specific research in the area of multi-functional material structures include making missile skins with embedded (woven in) antennas, sensors, power sources, computational resources, and energetic materials. These efforts will enable missiles with greatly increased speed, range and lethality to meet future naval warfare needs. Directed Energy and Counter Directed Energy		24.566	27.535	26.324	0.000	26.324

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div><div>- Conduct basic research in high-energy lasers, optical components, infrared technologies and high power microwaves to enable significant leap-ahead capabilities for the survivability and lethality of naval forces. Efforts will explore advanced photonics and optical techniques that vary energy levels in individual photons at energy density levels significantly above those needed for other applications, advanced photonics techniques to maximize extraction of the highest energy levels available from individual photons, and advanced photonics from unique sources otherwise not commercially viable.</div><div>- There will be continued exploration of computational and photonic creation that model next-generation waveform interactions and power conversion designs.</div><div>- Additional basic research will contribute to identifying new nanostructured materials and coatings processing for naval applications and investigate unique interactions of photons with materials and coatings.</div></div><div>Energetic Materials and Rocket Propulsion</div><div><div>- Basic research will investigate advanced energetic materials, which provide reactive, explosive, and propulsive phenomena including high-energy ingredient synthesis, modeling, characterization, and the fundamentals of initiation, decomposition and combustion/shock. This research will include synthetic methodology for new energetic materials and material concepts with superior specific energy / energy density, brisance, and insensitivity for useful warhead fills and solid rocket propellants.</div><div>- Additional research in novel diagnostic methods for improved understanding of formulations and dynamic combustion/shock and related energetic materials dynamic phenomena will be conducted.</div><div>- Finally, further efforts in advanced modeling and simulations on energetic materials, along with new methods and instrumentation for characterization will continue.</div></div><div>Hypersonics</div><div><div>- Basic research will address technologies needed for long-range weapon components that are able to survive high temperature exposure for several minutes and thwart anti-access/ area denial countermeasures.</div><div>- Additional research will be conducted in hypersonic boundary-layers and shock-wave / boundary-layer interactions, prediction of hypersonic weapon flight performance and control, environment-material interactions, exploration of ultra-high temperature materials, and technologies needed for high-speed propulsion.</div></div><div>FY 2023 Base Plans:</div><div>Undersea Weaponry</div><div><div>- Continue research on Undersea Warheads (characterization and modeling of explosive formulations), Advanced Concepts for Sea Warfare and Weapons (unconventional power and energy technology), Cooperative</div></div></div> <td></td> <td></td> <td></td> <td></td> <td></td>						

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Autonomous Swarm Technology and the Naval Undersea Research graduate-level STEM program, which supports the development of the Navy lab workforce.						
Air Weaponry - Continue efforts in the areas of solid and hybrid rocket propulsion, advanced structural and aperture materials, navigation, aerodynamics, single and multi-missile control, and power management. - Continue research on multifunctional material structures include making missile skins with embedded (woven-in) antennas, sensors, power sources, computational resources, and energetic materials. These efforts will enable missiles with greatly increased speed, range and lethality to meet future naval warfare needs. -Initiate research to develop models and tool to provide robust bearings without oil.						
Directed Energy and Counter Directed Energy Directed energy weapons are defined as electromagnetic systems capable of converting chemical and/or electrical energy to radiated energy and focusing it on a target, resulting in damage that degrades, neutralizes, defeats, or destroys an adversarial capability. Directed Energy Weapons efforts include High Energy Lasers that emit photons and High Power Microwaves that release radiofrequency waves. The ability to focus the radiated energy reliably and repeatedly at range, with precision and controllable effects, while producing measured physical damage, is the measure of effectiveness - requiring understanding of the basic sciences in high energy physics, optics, quantum mechanics and material sciences. The U.S. Navy applies the basic research knowledge through follow on applied technology programs for power projection and integrated defense missions.						
Energetic Materials and Rocket Propulsion - Continue research investigating advanced energetic materials, which provide reactive, explosive, and propulsive phenomena including high-energy ingredient synthesis, modeling, characterization, and the fundamentals of initiation, decomposition, combustion and shock. - Continue and expand research in energetic material ingredients and material concepts with superior specific energy / energy density, brisance, and insensitivity for useful warhead fills and tactical propulsion. - Continue and expand research in novel diagnostic method development for improved understanding of energetic material combustion, shock response, and related dynamic phenomena. - Continue and expand efforts in advanced modeling and simulations on energetic materials to further understand and predict energetic material properties, response to stimuli, and performance. - Complete efforts in ingredient development, experimental diagnostics, and modeling that have not shown promise.						

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<div><div>- Initiate research focused on novel synthetic methodology development for carbon/hydrogen/nitrogen/oxygen-based energetic ingredients in addition to new metal based fuel particle design and other inorganic and hybrid energetic material concepts;</div><div>- Initiate research into fundamental understanding of material interfacial physics/chemistry relevant to energetic formulation development and advanced manufacturing.</div></div> <div>Hypersonics<div><div>- Continue research that will address technologies needed for long-range weapon components that are able to survive high temperature exposure for several minutes and thwart anti-access/ area denial countermeasures;</div><div>- Continue investigating the hypersonic boundary-layers and shock-wave / boundary-layer interactions, prediction of hypersonic weapon flight performance and control, environment-material interactions, exploration of ultrahigh temperature materials, and technologies needed for high-speed propulsion.</div></div></div> <div>High Energy Lasers<div><div>- Continue the exploration of the physics of photonic creation, materials interaction, energy release and interactions with optical materials via computational and mathematical modeling methods, including machine learning.</div><div>- Continue research on next-generation photon waveform and mode shaping interactions with materials, including metamaterials, examining high efficiency energy conversion designs within unique nanostructured materials with goal of increasing efficiency from source to release.</div><div>- Continue examination of high energy laser-launched collimated photon interactions with the atmosphere, which are unique in propagation within the maritime domain, examining unique physical and optical interactions related to absorption, reflectance, scatter and turbulence often seen in expeditionary and at-sea conditions;</div><div>- Continue research that will contribute to identifying new nanostructured materials, metamaterials and optical coatings processing for naval applications and investigate unique interactions of high energy photons with materials and coatings;</div></div></div> <div>High Power Microwaves<div><div>- Continue research into solid-state and vacuum electronic based sources and amplifiers, antennas, high voltage storage/switching components and power supplies, novel high power capable materials, radio-frequency coupling and electronic device interaction physics, predictive effects and modeling tools along with novel sensors and instrumentation.</div></div></div> <div>Ultra Short Pulse Laser</div>						

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate research on interaction of intense laser pulses with nanostructured surfaces, the role of disorder in promoting synchronization in technological systems of relevance to the Navy, hybrid quantum devices with the greatest technological impact to photonics and solid-state laser components, and extension of mode-locked laser and optical frequency comb technologies from the traditional near-infrared regime to new spectral regions.</p> <p>- Initiate research on generation of high-average power ultra-broadband radio frequency and mid-infrared radiation in dielectrics and plasmas, effects of atmospheric turbulence on the propagation of laser beams having orbital angular momentum, demonstration of a compact solid-state laser source, demonstration of highly efficient frequency conversion of ultrashort pulse laser sources, and demonstration of ultrahigh peak power compact ultrashort sources in specific spectral ranges via advanced mode locking and chirped pulse amplification techniques.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no significant change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		445.302	472.992	479.583	0.000	479.583
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
Not applicable.						

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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3465: In-House Lab Independent Res	0.000	0.000	11.332	19.533	-	19.533	19.923	20.322	20.729	21.144	Continuing	Continuing

Note

Effective in FY 2022, In-house Laboratory Independent Research (ILIR) funding and associated requirements are realigned from Program Element (PE) 0601152N, Project 0000 to PE 0601153N, Project 3465.

A. Mission Description and Budget Item Justification

The In-house Laboratory Independent Research (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.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: In-House Laboratory Independent Research (ILIR)	0.000	11.332	19.533	0.000	19.533
Description: The In-house Laboratory Independent Research program provides opportunities to strengthen the Naval Science and Engineering workforce through basic research conducted at the Naval Warfare Centers and Laboratories. These research efforts address high risk/high payoff warfighter science and technological needs, as well as attract the next generation of researchers to consider employment within the Department of the Navy. ILIR also provides opportunities for advanced degrees, technical publications, presentations, and patents.					
FY 2022 Plans: Further develop and maintain the Science and Engineering workforce by providing funding to Naval Warfare Centers and Laboratories to foster high risk/ high reward basic research initiatives of Naval interest. Each of the Naval sites will evaluate existing research projects and propose new topics. All efforts will be selected based on warfighter needs, researcher capabilities, and science and technology alignment.					
FY 2023 Base Plans: Continue: Further develop and maintain the Science and Engineering workforce by providing funding to Naval Warfare Centers and Laboratories to foster high risk/ high reward basic research initiatives of Naval interest. Each naval					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 1		R-1 Program Element (Number/Name) PE 0601153N / <i>Defense Research Sciences</i>		Project (Number/Name) 3465 / <i>In-House Lab Independent Res</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>site conducts peer reviews for existing research projects, assess the quality of the research, and determine if projects should continue.</p> <p>Complete:</p> <p>Conclude research topics that initiated in FY 2021. Assess opportunities for technology transition through coordination with various resource sponsors. Transfer successful efforts to research, development, test, and evaluation-sponsored programs.</p> <p>Initiate:</p> <p>The participating warfare centers or laboratories generate new three-year research topics where priority is given to warfighter needs, technology alignment, high quality research, and the recruitment and retention of outstanding scientists and engineers. Topics cover a broad range of naval relevant research areas critical to the support of warfare center and laboratory missions.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The funding increase from FY 2022 to FY 2023 will be used to initiate and expand basic research topics across a broad range of naval relevant science and technology focus areas. The funding is critical to providing adequate support for the successful accomplishment of each topic, measured by the advancement of new knowledge that addresses warfighter needs and challenges. Research topics include key areas such as advanced ship design, multifunction materials, environmental sciences, ocean acoustics and signature reduction, hydrodynamics, aerodynamics, hypersonics, casualty management, mine countermeasures, machine learning and artificial intelligence, data science, navigation and timing, radar and RF propagation, energetics, fuels and combustion, energy storage, additive manufacturing, high temperature alloys, cognitive science, and hypoxia.</p>						
Accomplishments/Planned Programs Subtotals		0.000	11.332	19.533	0.000	19.533
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	26.065	39.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	65.065

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Basic Research FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct 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 effort subject areas include: Autonomous Systems; Artificial Intelligence/Machine Learning; 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).	0.000	25.000
Congressional Add: Defense Research Sciences FY 2021 Accomplishments: Conduct multidisciplinary basic research to enable the U.S. Navy to maintain its technological superiority. FY21 efforts include grants such as "Synthesis Planning and Reaction Discovery for Photochemistry and Chemistry in Novel Environments". This basic research grant produced 9 peer-reviewed publications and support to 6 graduate students and 4 post-doctoral fellows. By employing cutting edge computational methods to identify unusual reaction pathways and retrosynthetic path generation, new ways to discover viable reactions and their use in synthesis planning are taking shape. FY 2022 Plans: N/A	14.480	0.000
Congressional Add: Silicon-Germanium-Tin Alloy Research FY 2021 Accomplishments: Conduct basic research on Silicon-Germanium-Tin Alloy FY 2022 Plans: N/A	4.827	0.000
Congressional Add: Bio-inspired Engineering and Design for Naval Applications FY 2021 Accomplishments: This research project will be on mobility, maneuverability and agility, and will focus on locomotion and mechanics (e.g., fin-based swimming, flapping flight and legged locomotion), modalities of distributed sensing and processing (visual, echolocation, lateral-line and vibrissae "imaging" and cognitive-	2.896	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / <i>Defense Research Sciences</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022
neural processing, neuroscience and machine learning), and distributed actuation (neural activation and muscle mechanics, hard and soft robotics).			
FY 2022 Plans: Conduct basic research on mobility, maneuverability and agility, with focus on locomotion and mechanics (e.g., fin-based swimming, flapping flight and legged locomotion), modalities of distributed sensing and processing (visual, echolocation, lateral-line and vibrissae "imaging" and cognitive-neural processing, neuroscience and machine learning), and distributed actuation (neural activation and muscle mechanics, hard and soft robotics).			
Congressional Add: Predictive Modeling & Simulation for Next Gen Naval Undersea Vessel and Platform		1.931	0.000
FY 2021 Accomplishments: This effort will advance naval warfare capabilities by providing focused research on experimentally validated, multi-physics and multi-fidelity predictive modeling to support undersea smart systems design. Augmented by machine learning capabilities the research will support applications such as digital twin, situational awareness and vessel health monitoring.			
FY 2022 Plans: N/A			
Congressional Add: USV Batteries, Materials, and Additive Manufacturing		1.931	0.000
FY 2021 Accomplishments: The research will focus on developing: (i) multifunctional batteries, which offer lightweight energy storage that could enhance the range and performance of undersea vehicles, including their potential integration with hybrid and regenerative energy sources; (ii) metamaterials with tunable acoustic properties, structural materials with computationally optimized microstructures and advanced coatings for extreme marine environments such as extended exposure to sea water and high strain-rate deformation; (iii) transformative multi-material (multi-metal and multi-polymer) additive manufacturing methods for fabrication of materials and structures with designed microstructures at micro-scale spatial resolution.			
FY 2022 Plans: N/A			
Congressional Add: Generally-capable robotics for naval operations		0.000	4.000
FY 2021 Accomplishments: N/A			
FY 2022 Plans: Conduct basic research focused on generally-capable robotics for naval operations			
Congressional Add: Multifunctional structural batteries		0.000	2.000
FY 2021 Accomplishments: N/A			
FY 2022 Plans: Conduct basic research in multifunctional structural batteries			
Congressional Add: Silicon-germanium-tin alloy research		0.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601153N / <i>Defense Research Sciences</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	
<i>FY 2021 Accomplishments:</i> N/A			
<i>FY 2022 Plans:</i> Conduct basic research on silicon-germanium-tin alloys			
Congressional Adds Subtotals	26.065	39.000	
C. Other Program Funding Summary (\$ in Millions) N/A			
Remarks			
D. Acquisition Strategy N/A			

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	37.925	43.013	22.953	-	22.953	27.166	27.710	28.264	28.829	Continuing	Continuing
0000: Power Proj Applied Research	0.000	17.652	23.013	22.953	-	22.953	27.166	27.710	28.264	28.829	Continuing	Continuing
9999: Congressional Adds	0.000	20.273	20.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	40.273

A. Mission Description and Budget Item Justification

In an Artificial Intelligence (AI) enabled maritime battlespace, the ability to fight at the speed of light will determine the outcome. The effective defense against threats increasingly beyond human speed, will enable U.S. naval forces to outthink, outmaneuver and outfight adversaries. This Program Element (PE) supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on directed energy, high speed weapon propulsion, Electro-Optic/Infrared (EO/IR) sensor technologies, and Naval Precision Strike Operations. The goal of this research is to develop technologies and capabilities that enable Directed Energy (DE) weapons as well as defense against adversary DE systems; the development of vehicle and propulsion technology for high-speed weapons operating from Mach 3 to Mach 8 and beyond; investment in the areas of Electro Optic/Infrared devices and advanced sensors; and technologies that provide the navy of the future the ability to quickly locate, target, and strike critical targets ashore.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		PE 0602114N I Power Proj Applied Research			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	38.701	23.013	0.000	-	0.000
Current President's Budget	37.925	43.013	22.953	-	22.953
Total Adjustments	-0.776	20.000	22.953	-	22.953
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	20.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.291	0.000			
• SBIR/STTR Transfer	-1.068	0.000			
• Rate/Misc Adjustments	0.001	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	22.953	-	22.953
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Miniaturization of Lasers					
Congressional Add: High Power Microwave Systems for Counter-UAS Defense					
Congressional Add: Manufacturing of high temperature hypersonic materials					
Congressional Add: Multi-mission UAV-borne electronic attack					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Funding: No significant change.					
Technical: No significant change.					
Schedule: No significant change					

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h				Project (Number/Name) 0000 / Power Proj Applied Research			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Power Proj Applied Research	0.000	17.652	23.013	22.953	-	22.953	27.166	27.710	28.264	28.829	Continuing	Continuing
A. Mission Description and Budget Item Justification												
In an Artificial Intelligence (AI)enabled maritime battlespace, the ability to fight at the speed of light will determine the outcome. The effective defense against threats increasingly beyond human speed, will enable U.S. naval forces to outthink, outmaneuver and outfight adversaries. This Project supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on directed energy, high speed weapon propulsion, electro-optic/ infrared (EO/IR) sensor technologies, and Naval Precision Strike Operations. The goal of this research is to develop technologies and capabilities that enable Directed Energy (DE) weapons as well as defense against adversary DE systems; the development of vehicle and propulsion technology for high-speed weapons operating from Mach 3 to Mach 8 and beyond; investment in the areas of Electro Optic/Infrared devises and advanced sensors; and technologies that provide the navy of the future the ability to quickly locate, target, and strike critical targets ashore.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Directed Energy								6.864	7.492	7.139	0.000	7.139
Description: The goal of this activity is to develop technologies and capabilities that enable Directed Energy (DE) weapons for naval applications as well as defense against adversary Directed Energy systems.The advanced research focus is primarily for directed energy is in Naval Ship Defense, Naval Air Defense, and Naval Precision Strike Operations. The goal of Directed Energy (DE) research is to develop technologies and capabilities enabling both line of sight and beyond line of sight non-kinetic weapon capabilities, as well as defend against adversary DE systems. This DE Weapons scope includes the associated technologies of optics and material properties, providing Navy future forces the ability to quickly target and strike critical targets, in cost effective means, while minimizing potential collateral damage, as well as the ability to defend against and counter adversarial modes of attack.												
FY 2022 Plans: Conduct exploratory research and develop component technologies that enables higher power, more lethal High Energy Laser (HEL), High Power Microwave (HPM) and Ultra Short Pulse Laser (USPL) weapons. Research efforts include: -Development of novel laser and beam-director architectures -Improved sensor and illuminator technologies -Improved HEL electrical-to-optical efficiency -Improved laser sources with enhanced spectrum control												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h		Project (Number/Name) 0000 / Power Proj Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>-Reduced system jitter and improved precision aim-point maintenance</div> <div>-Improved characterization of atmosphere and associated modeling tools</div> <div>-Improved understanding of blooming and laser/material/target interactions</div> <div>-Development of novel laser sources in Mid Wave Infrared (MWIR) and Long Wave Infrared (LWIR)</div> <div>-Improved understanding of USPL propagation mechanisms and effects</div> <div>Conduct exploratory research in response to development of HEL and HPM threats by potential adversaries.</div> <div>Research efforts include:</div> <div>-Development of Counter-capabilities, including the understanding of HEL Weapons risks to US naval forces</div> <div>-Development of understanding of HPM use in Electromagnetic (EM) Maneuver Warfare and Integrated Defense of US naval forces</div> <div>-Improved understanding of HPM effects and lethality</div> <div>-Improved predictive tools and testing instrumentation</div> <div>Electronics: Develop and apply innovative S&T in plasmas, pulsed power, electromagnetic acceleration, particle beams, high-energy & ultra-short-pulse lasers (USPL), and non-linear optics to support current and future Navy and DoD needs. (</div> <div>- Research efforts include:</div> <div>- Finalize efforts on Adaptive Optics for Nonlinear Atmospheric Propagation of High-Power Laser Pulses.</div> <div>- Continue Multiband Tunable High Power Fiber Laser effort.</div> <div>FY 2023 Base Plans:</div> <div>Conduct exploratory research and develop component technologies that enables higher power, more lethal High Energy Laser (HEL), High Power Microwave (HPM) and Ultra Short Pulse Laser (USPL) weapons.</div> <div>Continuing Efforts</div> <div>- Development of novel laser and beam-director architectures</div> <div>- Improved sensor and illuminator technologies</div> <div>- Improved HEL electrical-to-optical efficiency</div> <div>- Improved laser sources with enhanced spectrum control</div> <div>- Reduced system jitter and improved precision aim-point maintenance</div> <div>- Improved characterization of atmosphere and associated modeling tools</div> <div>- Improved understanding of blooming and laser/material/target interactions</div> <div>- Development of novel laser sources in Mid Wave Infrared (MWIR) and Long Wave Infrared (LWIR)</div> <div>- Development of Counter-capabilities, including the understanding of HEL Weapons risks to US naval forces</div> <div>- Improved understanding of USPL propagation mechanisms and effects</div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h		Project (Number/Name) 0000 / Power Proj Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Development of understanding of HPM use in Electromagnetic (EM) Maneuver Warfare and Integrated Defense of US naval forces</div> <div>- Improved understanding of HPM effects and lethality</div> <div>- Effort to develop and apply innovative S&T in plasmas, pulsed power, electromagnetic acceleration, particle beams, high-energy & ultra-short-pulse lasers (USPL), and non-linear optics to support current and future Navy and DoD needs. Continue to focus on areas of high power fiber laser efforts. (NRL)</div> <div>Initiating Efforts</div> <div>- Engineering USPL sub-component maturation for prototype sub systems</div> <div>- USPL component integration for prototype system of systems (SOS) experimentation</div> <div>- New effort for novel Counter-HEL capability</div> <div>-Preparation for range testing of HPM engagement systems</div> <div>-Performing system level performance analysis and mission level modeling relative to threats.</div> <div>-Applied research to further the State-of-the-Art Advancement for HPM source, antenna, pulsed power, and high voltage power supplies to support prototype development.</div> <div>-Explore HPM source and related component development around open architecture principles, to explore hardware options for achieving effective system CONEMPS</div> <div>-Developing self-contained HPRRF prototype development with integrated sensor and C2 capabilities that will provide a response to UAS swarm attack.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>There is no significant funding change from FY 2022 to FY 2023.</div>						
<div>Title: High Speed Propulsion and Advanced Weapon Technologies</div> <div>Description: This activity is focused on applied research to support the development of vehicle and propulsion technology for high-speed weapons operating from Mach 3 to Mach 8 and beyond. The goal is to develop computational, experimental and flight testing capabilities along with the workforce needed to support the development of hypersonic weapons. Research includes:</div> <div>Objectives:</div> <div>- Prediction and control of hypersonic boundary-layers and shock-wave boundary-layer interactions</div>		8.559	12.787	13.773	0.000	13.773

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Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h	Project (Number/Name) 0000 / Power Proj Applied Research			
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none">- Development of hypersonic ground test facilities, instrumentation and nonintrusive diagnostics- Prediction of interactions between materials and the high-speed flight environment such as flight through weather and oxidation of thermal protection systems- Development of improved modeling tools to predict the aerothermal and aerodynamic performance of hypersonic weapons over a wide range of velocities and altitudes- Development of ultra-high temperature materials, cooling strategies and thermal protection systems that can survive the launch and flight environment- Development high-speed propulsion technologies such as solid fuel ramjets <p>FY 2022 Plans: Current investments relevant to the development of high-speed propulsion technologies such as solid-fuel ramjets to extend the range of projectiles and missiles will continue.</p> <p>High-speed and hypersonic external aerodynamic technologies such as laminar flow control will be investigated to support future developments to enable hypersonic missiles and hypersonic ship- launched projectiles.</p> <p>New research plans include:</p> <ul style="list-style-type: none">- Assessment of advanced high-fidelity modeling and simulation tools for the prediction of boundary layer transition and turbulent heat transfer on relevant weapons geometries.- Development of physics based computational structural analysis tools for prediction of impact damage in weapon structures due to atmospheric encounters under high-speed flow conditions.- Experimental and numerical investigation on the combustion characteristics of solid fuels in supersonic combustors. <p>FY 2023 Base Plans: Conduct applied research for high-speed propulsion technologies such as solid-fuel ramjets/scramjets and dual mode ramjet/scramjet (DMRJ) to extend the range of hypersonic missiles; external aerodynamic technologies such as laminar flow control to enable high-performance hypersonic missiles; and improved modeling tools to predict the aerothermal, aerodynamic and propulsion performance of hypersonic weapons over a wide range of velocities and altitudes.</p> <p>Continuing Efforts</p> <ul style="list-style-type: none">- Experimental and numerical investigation on the combustion characteristics of solid fuels in supersonic combustors						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h		Project (Number/Name) 0000 / Power Proj Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Development of physics based computational structural analysis tools for prediction of impact damage in weapon structures due to atmospheric encounters under high-speed flow conditions.</p> <p>Completing Efforts</p> <p>- Assessment of advanced high-fidelity modeling and simulation tools for the prediction of boundary layer transition on relevant weapon geometries</p> <p>Initiating Efforts</p> <p>- Development and testing of new aeroshell material technology to extend laminar flow</p> <p>- High-fidelity computations, ground test techniques and flow diagnostics to characterize neutral and ionized gas species</p> <p>- Experimental and computational studies to extend the flight envelope of solid fuel ramjets to higher speeds and altitudes and to improve throttle-ability</p> <p>- Applied research for Nuclear Aircraft Carrier (CVN) compliant hypersonic air-breathing weapons to increase performance & operability</p> <p>- Development of reduced orders models for rapid prediction of aerothermal and aerodynamic performance using data driven approaches such as machine learning, high-fidelity simulations and experiments as training data</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 is due to research efforts initiating and increased investment in technology supporting hypersonic weapons.</p>						
<p>Title: Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies</p> <p>Description: This activity describes Navy Science and Technology investments in the areas of Electro Optic/Infrared (EO/IR) devices and advanced sensors and includes investment/performance in the technology areas of EO/IR, Electronic Warfare (EW), Electromagnetic Warfare, and Communications.</p> <p>FY 2022 Plans: Electronics</p>		0.865	0.810	0.605	0.000	0.605

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / Power Proj Applied Research h		Project (Number/Name) 0000 / Power Proj Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
To develop and explore new concepts, components, techniques, and subsystems for the detection of UV, visible, and infrared radiation to support current and future Navy and DoD needs with attention given to quantum-enabled precise time, and magnetic and gravimetric sensing.						
Current plans are to focus efforts on: -Demonstrating a better way to search for advanced seeker optimal adjustable settings by using machine learning tools. -Micro-Gas Chromatography with Stationary-Phase Infrared Spectroscopy; Optimize in column planar IR sensor and GC column configuration; Test with range of representative analytes including complex mixture challenges; Include existing IMS or mass spectrometer technology for direct comparison testing; and Demonstrate in column planar IR sensor GC sensor to Government program managers and industry for transitions and commercialization.						
FY 2023 Base Plans: - Initiate research and develop technologies that will protect surface platforms against imaging infrared seekers. Further efforts into development of inexpensive photodetectors operating at room temperature with higher detectivity than state-of-the-art cooled detectors.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease from FY 2022 to FY 2023 is due to completion of Micro-Gas Chromatography with Stationary-Phase Infrared Spectroscop						
Title: Strike and Littoral Combat Technologies		1.364	1.924	1.436	0.000	1.436
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 2022 Plans: The projects in this area are developing technology and techniques to provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore.						
Current research efforts include:						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602114N / <i>Power Proj Applied Research</i> h		Project (Number/Name) 0000 / <i>Power Proj Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Conclude research on new high-resolution sensing techniques for emerging USN needs in Maritime ISR to allow 3D imaging through cloud cover.</p> <p>- Continue efforts for machine-learning-based resource management for distributed radar system operation. This will support search and track requirements while minimizing emissions to degrade, defeat, and delay counter targeting.</p> <p><i>FY 2023 Base Plans:</i></p> <p>-Continue efforts for machine-learning-based resource management for distributed radar system operation. This will support search and track requirements while minimizing emissions to degrade, defeat, and delay counter targeting.</p> <p>-Initiate projects which aim to develop technology and techniques to provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore.</p> <p><i>FY 2023 OCO Plans:</i></p> <p>N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i></p> <p>The decrease from FY 2022 to FY 2023 is due to completion of 3D imaging though cloud cover sensing research.</p>						
Accomplishments/Planned Programs Subtotals		17.652	23.013	22.953	0.000	22.953
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602114N / <i>Power Proj Applied Research</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	20.273	20.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	40.273

A. Mission Description and Budget Item Justification
Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
Congressional Add: Miniaturization of Lasers	4.827	4.000
FY 2021 Accomplishments: Conducted applied research in miniaturization of lasers.		
FY 2022 Plans: Conduct applied research in miniaturization of lasers.		
Congressional Add: High Power Microwave Systems for Counter-UAS Defense	15.446	0.000
FY 2021 Accomplishments: Demonstrated smart directed-energy-based air-to-air layered defense solutions for the afloat and naval covered assets defensive counter air and electronic attack mission.		
FY 2022 Plans: N/A		
Congressional Add: Manufacturing of high temperature hypersonic materials	0.000	8.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research in manufacturing of high temperature hypersonic materials		
Congressional Add: Multi-mission UAV-borne electronic attack	0.000	8.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research supporting multi-mission UAV-borne electronic attack		
Congressional Adds Subtotals	20.273	20.000

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602123N / <i>Force Protection Applied Res</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	203.609	222.388	133.426	-	133.426	135.956	138.126	140.749	143.424	Continuing	Continuing
0000: <i>Force Protection Applied Res</i>	0.000	119.140	122.888	133.426	-	133.426	135.956	138.126	140.749	143.424	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	84.469	99.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	183.969

A. Mission Description and Budget Item Justification

America is a maritime nation with global responsibilities that require U.S. naval forces be respected around the world and decisive when it matters. The Office of Naval Research (ONR) was established to guide ongoing research to ensure the technical superiority of the U.S. Navy and Marine Corps. This Program Element (PE) addresses applied research 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. The goal is to provide the ability to deter, or avoid engagements, and if necessary, fight and win against adversary naval platforms or weapons. In the event of conflict, naval platforms must be able to resist and control damage while preserving operational capability. Research is focused on providing technologically superior defense of naval assets and delivering warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research in: a) Power, Energy & Propulsion and b) Platform Design and Engineering. This program 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. The program addresses 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. The program supports mission-driven problem solving within the Naval Research and Development Establishment (NR&DE) through agile and rapid prototyping processes, while also promoting implementation of a common, effective innovation process and language.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity		R-1 Program Element (Number/Name)				
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		PE 0602123N I Force Protection Applied Res				
B. Program Change Summary (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		209.008	122.888	0.000	-	0.000
Current President's Budget		203.609	222.388	133.426	-	133.426
Total Adjustments		-5.399	99.500	133.426	-	133.426
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	99.500			
• Congressional Directed Transfers		-	-			
• Reprogrammings		0.435	0.000			
• SBIR/STTR Transfer		-5.835	0.000			
• Rate/Misc Adjustments		0.001	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	133.426	-	133.426
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Power Generation and Storage Research						
Congressional Add: Advanced Energetics Research						
Congressional Add: Talent and technology for Navy power and energy systems						
Congressional Add: Energy resilience efforts						
Congressional Add: Coastal environmental research						
Congressional Add: Data-Model Fusion						
Congressional Add: Direct Air Capture and Blue Carbon Removal Technology						
Congressional Add: Machine Discovery and Learning						
Congressional Add: Additive Manufacturing of Unmanned Maritime Systems						
Congressional Add: Asia Pacific Technology and Education Program						
Congressional Add: Low Cost Silicon Solar Cells						
Congressional Add: Navy Alternative Energy Research						
Congressional Add: Robust Energy Infrastrucure Project						
Congressional Add: relative position of autonomous platforms						
Congressional Add: Bonded metal matric composit repair						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>		R-1 Program Element (Number/Name) PE 0602123N <i>I Force Protection Applied Res</i>	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2021	FY 2022
Congressional Add: <i>Resilient innovative sustainable economies via university partnerships</i>		0.000	7.500
Congressional Add: <i>Titanium metal and wire domestic production demonstration</i>		0.000	15.000
Congressional Add Subtotals for Project: 9999		84.469	99.500
Congressional Add Totals for all Projects		84.469	99.500
Change Summary Explanation Funding: The funding increase from FY 2022 to FY 2023 budget request is due to an increase for efforts associated with Naval Platform Operational Endurance & Climate Resiliency Technologies. Technical: not applicable Schedule: not applicable --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Force Protection Applied Res	0.000	119.140	122.888	133.426	-	133.426	135.956	138.126	140.749	143.424	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. Research is focused on providing technologically superior defense of naval assets and delivering warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research in: a) Power, Energy & Propulsion and b) Platform Design and Engineering. This project develops technologies for reduced observables technology and enhanced capability of naval platforms (surface, subsurface, terrestrial, and air) in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. The project addresses 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.

This project is broken out into five primary areas of study: Aircraft Technology, Fleet Force Protection and Defense Against Undersea Threats, Advanced Energetics, Surface Ship and Submarine Hull Mechanical & Electrical (HM&E), and Naval Research Enterprise.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Aircraft Technology	34.839	36.506	35.485	0.000	35.485
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, operational energy, expeditionary capability, 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 rotor systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles.					
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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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
These efforts address unique attributes to propulsion, power and thermal management 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 Defense Research Sciences.						
FY 2022 Plans: Research related to Sea Based Aviation National Naval Responsibility (SBA NNR) priorities in Aviation, Propulsion, and Structures and Materials.						
Research in Aircraft Science & Technology includes: Continuing efforts in the following: - Advanced analytical methods for achieving guaranteed performance in multibody control systems. - Control law synthesis methods to expand the recovery envelope and reduce touchdown loads. - Advanced modeling and analysis methods for ship/aircraft aerodynamic interface. - Air vehicle flying qualities and control. - High lift aerodynamics and control. - Vertical/Short Take-off and Landing (V/STOL) science & technology. - Automated launch and recovery technology. - Mechanical/environmental failure prediction research. Initiating efforts in the following: - Advanced dynamics and topology of coupled human/machine systems. - Precise relative navigation science & technology. - Integrated development environment for cyber secure avionics. - Infrastructure for rapid development, analysis, and experimentation with advanced flight science and technology across academia, government and industry. - Manned/unmanned teaming technology.						
Basic and applied research in Flight Dynamics & Control will develop theory, analysis and experimental data to better understand and exploit the natural dynamics of both conventional and unconventional air vehicles operating in the marine environment.						
Focus areas in Flight Dynamics & Control include continuing efforts in the following: - Multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Robust and precise control in the presence of highly turbulent flow fields to increase operational capability and reduce structural requirements for ship-based operations;</p> <p>- Algorithms and sensors to enable precise ship-relative navigation in GPS-denied environments;</p> <p>- Control effectors and vehicle configurations to enable platforms with VTOL utility and fixed-wing efficiency.</p> <p>- Collaborative research to improve our knowledge of control system interactions between piloted aircraft and human performance.</p> <p>Applied Aerodynamics research for aircraft and weapons platforms will includes: Continuing efforts in the following:</p> <p>- Advanced computational methods addressing the Navy-unique challenge of a fully coupled aerodynamic interface between ships and aircraft;</p> <p>- Advanced methods for reduced-order modeling of complex flow fields to enable real-time, high-fidelity simulations of ship-based aircraft operations;</p> <p>- Advanced methods for manipulating and more precisely controlling the flow fields around air vehicles operating in the maritime environment.</p> <p>Expanding efforts in the following:</p> <p>- Novel diagnostics and techniques for in situ measurement ship airwake dynamics and its coupling to ship motions (sea states) and environmental flow field;</p> <p>Initiating efforts in the following:</p> <p>- Advanced technologies for improved weapons aerodynamics enabling increased range and maneuverability.</p> <p>- Innovative concepts for compact, highly-integrated inlets for air-breathing weapons.</p> <p>Applied research in aircraft Propulsion, Power and thermal management concepts for high speed, long endurance and responsiveness include: Continuing efforts in the following:</p> <p>- Cooling and thermal management for engines and auxiliary systems;</p> <p>- Diagnostics, prognostics and control for Integrated Power, Propulsion and Thermal Management;</p> <p>- Highly integrated Propulsion inlets, exhausts;</p> <p>- Sand, Salt and Dust Ingestion research: including modeling, separating, deposition, coatings and sensing;</p> <p>- Next Generation Propulsion Enablers includes applied research in propulsion, power and thermal management, advanced casing treatments, advanced compression system technologies and engine robustness in austere sand and salt environments.</p> <p>Expanding efforts in the following:</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Research in Aircraft Science & Technology includes: Continuing Efforts - Advanced analytical methods for achieving guaranteed performance in multibody control systems. - Control law synthesis methods to expand the recovery envelope and reduce touchdown loads. - Advanced modeling and analysis methods for ship/aircraft aerodynamic interface. - Air vehicle flying qualities and control. - High lift aerodynamics and control. - Vertical/Short Take-off and Landing (V/STOL) science & technology. - Automated launch and recovery technology. - Mechanical/environmental failure prediction research. - Advanced dynamics and topology of coupled human/machine systems. - Precise relative navigation science & technology. - Integrated development environment for cyber secure avionics. - Infrastructure for rapid development, analysis, and experimentation with advanced flight science and technology across academia, government and industry. - Manned/unmanned teaming technology. Applied research in Flight Dynamics & Control will develop theory, analysis and experimental data to better understand and exploit the natural dynamics of both conventional and unconventional air vehicles operating in the marine environment. Efforts include: Continuing Efforts - Multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state. - Robust and precise control in the presence of highly turbulent flow fields to increase operational capability and reduce structural requirements for ship-based operations; - Algorithms and sensors to enable precise ship-relative navigation in GPS-denied environments; - Control effectors and vehicle configurations to enable platforms with VTOL utility and fixed-wing efficiency. - Collaborative research to improve our knowledge of control system interactions between piloted aircraft and human performance.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Applied Aerodynamics research for aircraft and weapons platforms will include: Continuing Efforts - Advanced computational methods addressing the Navy-unique challenge of a fully coupled aerodynamic interface between ships and aircraft; - Advanced methods for reduced-order modeling of complex flow fields to enable real-time, high-fidelity simulations of ship-based aircraft operations. - Advanced methods for manipulating and more precisely controlling the flow fields around air vehicles operating in the maritime environment. - Novel diagnostics and techniques for in situ measurement ship airwake dynamics and its coupling to ship motions (sea states) and environmental flow field. - Advanced technologies for improved weapons aerodynamics enabling increased range and maneuverability. - Innovative concepts for compact, highly-integrated inlets for air-breathing weapons. Initiating Efforts - Innovative concepts for launch and recovery of unmanned aerial systems. - Understanding aerodynamics of novel air vehicle configurations, including the effects of multi-rotor systems and operational environments. Applied research in aircraft Propulsion, Power and thermal management concepts for high speed, long endurance and responsiveness include: Continuing Efforts - Cooling and thermal management for engines and auxiliary systems. - Diagnostics, prognostics and control for Integrated Power, Propulsion and Thermal Management. - Highly integrated Propulsion inlets, exhausts. - Sand, Salt and Dust Ingestion research: including modeling, separating, deposition, coatings and sensing.; - Next Generation Propulsion Enablers includes applied research in propulsion, power and thermal management, advanced casing treatments, advanced compression system technologies and engine robustness in austere sand and salt environments. - Enabling the use of 'hot' fuels as a heat sink and provide additional energy. - Highly loaded efficient Turbomachinery with improved operability. - Advanced materials and coatings for austere environments.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Hybrid propulsion system component technologies for small to mid-size VTOL capable UAS.</p> <p>Research related to Autonomy includes the following efforts:</p> <p>Continuing Efforts</p> <ul style="list-style-type: none">- High confidence/Safe Autonomous single and multi-vehicle control in naval environments and human interaction with advanced autonomy such decentralized heterogeneous naval systems and interactive machine learning.- New theory-based methods and processes for rapid and safe adoption of new autonomy capabilities including Verification and Validation, safety, risk management, human systems integration, and robustness within complex naval, adversarial environments.- Safe perception based autonomous control in complex naval environments with limited communications and on autonomy to support combined unmanned and manned air systems/units. <p>Structures and Materials Research includes:</p> <p>Continuing Efforts</p> <ul style="list-style-type: none">- Structural remediation: development of materials and processes for extending and restoring operational life.- Hybrid nano-Composites - extend basic research investments in aligned carbon nano-tubes to develop damage tolerant composite structures for composites airframes.- Lightweight flight and transparent armor- Transparent armor with improved performance than those currently fielded.- Lightweight multifunctional structures <p>Completing Efforts</p> <ul style="list-style-type: none">- Composites Characterization: development of composites characterization and validation methods for current and next generation composites for rapid certification and sustainment.- Galvanic compatibility tool development for assessing galvanic capability of metals in operational environment. <p>Initiating Efforts</p> <ul style="list-style-type: none">- Structural Power Research- Thermoplastic composites								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Out of Autoclave and Out of Oven Composites Manufacturing.</div> <div>- Automated Composites Manufacturing</div> <div>- AI/ML applications for reducing composites defects</div> <div>-High Fidelity/ Unitized/ Optimized Structures for Aircraft and Weapons.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>The funding decrease from FY 2022 to FY 2023 is due to completing efforts in Structures and Materials Research.</div>						
<div>Title: Fleet Force Protection and Defense Against Undersea Threats</div> <div>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 (surface, subsurface 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.</div> <div>FY 2022 Plans:</div> <div>Electromagnetic Warfare:</div> <div>- Complete research conducted by one project in this area that provided an increase in the performance of airborne imaging radars by developing a 3D imaging capability for maritime applications.</div> <div>Materials and Chemistry:</div> <div>- Continue designing and developing inexpensive, miniaturized, low power electrochemical sensors for use in autonomous and distributed sensor networks in order to provide stand-off detection of explosive hazards in expeditionary missions; developing real time, standoff, moving target, laser based detection for explosives and hazardous chemicals in marine environment; developing chemical vapor sensing strategy for application</div>		8.747	7.767	9.280	0.000	9.280

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
in marine environment; and developing ultra-high strength sintered ceramics for significant improvements in personnel protection and platform survivability. - Initiate development of high bandwidth modularized airborne ground penetrating radar array and related components as well as integrated near-real-time ground tracking and detection algorithm. - Initiate research and development of modular compact sensors and automated algorithms to rapidly assess, analyze, and report damage to infrastructure for repair following an attack or natural disaster particularly damage to runways, roads, piers, utilities, and buildings. - Complete efforts focused on the use of metal oxide nanoparticle functionalization of graphene conductometric devices to detect sulfur compounds in vapor and liquid phase aviation.						
Undersea Warfare: - Continue developing acoustics technology and associated signal processing to detect and track small-unmanned aerial vehicles for force and infrastructure protection; developing a pressure tolerant, inexpensive hydrogen storage based on hydrogenated graphene to increase undersea storage capacity; and developing technologies for active control of acoustic scattering to increase stealth and survivability of unmanned undersea vehicles. - Initiate efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned systems/units.						
FY 2023 Base Plans: Materials and Chemistry: - Continue designing and developing inexpensive, miniaturized, low power electrochemical sensors for use in autonomous and distributed sensor networks in order to provide real-time, stand-off detection of explosive hazards in expeditionary missions; developing real time, standoff, moving target, laser based detection for explosives and hazardous chemicals in littoral environment; and developing chemical vapor sensing strategy for application in littoral environment. - Continue the development of high bandwidth modularized airborne ground penetrating radar array and related components as well as integrated near-real-time ground tracking and detection algorithm. - Continue research and development of modular compact sensors and automated algorithms to rapidly assess, analyze, and report damage to infrastructure for repair following an attack or natural disaster particularly damage to runways, roads, piers, utilities, and buildings. - Initiate work on a low-cost, high performance, broadband infrared optics solution utilizing new materials.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Undersea Warfare: - Continue developing acoustics technology and associated signal processing to detect and track small-unmanned aerial vehicles for force and infrastructure protection; developing a pressure tolerant, inexpensive hydrogen storage based on hydrogenated graphene to increase undersea storage capacity; and developing technologies for active control of acoustic scattering to increase stealth and survivability of unmanned undersea vehicles. - Continue efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned systems/units. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to an increased emphasis on Optical Materials & Components as well as Seabed Infrastructure & Protection. Increased emphasis will be used to develop lighter, stronger, cheaper optical materials and components with improved performance to address the Navy / Marine Corps needs for personnel protection and platform survivability and situational awareness.							
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 2022 Plans: - Continue applied research related to Advanced Energetic materials with a focus on higher tactical weapon performance including longer range, reduced time-to-target, and enhancing overall lethality in addition to efforts to develop insensitive explosives, propellants, and munitions without compromising performance. - Continue research focused on development and evaluation of advanced explosive, propellant, and reactive composite ingredients and energetic formulations, in addition to various dynamic diagnostic experimental and multi-scale theoretical efforts for development of next generation higher performing weapon systems.			5.225	5.475	5.321	0.000	5.321

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Expand research focused on ingredient chemistry and chemical processing technologies. This work includes: (i) synthesis, scale up, and evaluation of new energetic (i.e. explosives, oxidizers, fuels) and other formulation-enabling ingredients (i.e. polymer binders, plasticizers), (ii) incorporation of molecular design and particle morphology technology into synthetic scale-up and process development, and (iii) exploration and adaptation of innovative mixing, formulation, and other novel manufacturing processes for agile progression of enhanced energetic formulations. New compliant commodity ingredients, and new scale-up and formulation processes will be transitioned to the industrial base as appropriate.</p> <p>- Expand research in development and application of experimental 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 and propulsion applications. This work includes dynamic experimentation in support of design, evaluation and progression of enhanced lethality warhead concepts with focus on smaller form-factor without sacrificing effect on target; and advanced solid rocket motor, air-breathing, gun and other novel tactical propulsion concepts for extended range and reduced time-to-target.</p> <p>- Expand research in development and application of modeling, simulation, and computation to predict dynamic response and effects of energetic processes such as ignition, combustion/deflagration, shock, fragmentation, and detonation in order to predict weapon performance, lethality, and lifecycle for air, surface, and underwater weapon applications. Specific focus areas include applied theory and model development for understanding complex lethality mechanisms and properly assessing target damage for emerging warhead concepts and materials (i.e. high-density reactive materials) in addition to modeling efforts that support progression and transition of advanced tactical propulsion (i.e. ram-jets, high performance solid rocket motor).</p> <p>FY 2023 Base Plans: Overall, continue applied advanced energetic materials research efforts focused on longer range, reduced time-to-target, enhanced lethality/target effects, and cost savings pertaining to kinetic weapons without sacrificing insensitive munitions requirements.</p> <p>Continuing Efforts: -Applied research focused on development, scale up, and evaluation of novel explosive, propellant, and reactive composite ingredients and energetic formulations, in addition to dynamic diagnostic experimental and multi-scale theoretical efforts for development of next generation higher performing weapon systems.</p> <p>- Expanding research focused on ingredient chemistry and chemical processing technologies. This work includes: synthesis, scale up, and evaluation of new energetic (i.e. explosives, oxidizers, fuels) and other formulation-enabling ingredients (i.e. polymer binders, plasticizers), and exploration and adaptation of innovative</p>						

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>mixing, formulation, and other novel manufacturing processes for agile progression of enhanced energetic formulations.</p> <p>- Expanding research in development and application of experimental 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 and propulsion applications. This work includes: explosive blast, reactive materials, and propulsion relevant combustion science, shock-wave/energetic formulation studies, advanced tactical propulsion concepts, and ingredient specific structure/property studies.</p> <p>- Expanding research in development and application of modeling, simulation, and computation to predict dynamic response and effects of energetic processes such as ignition, combustion/deflagration, shock, fragmentation, and detonation in order to predict weapon performance, lethality, and lifecycle for air, surface, and underwater weapon applications.</p> <p>Completing Efforts:</p> <p>- Discontinuing minor efforts in ingredient development, experimental diagnostics, and modeling that do not show promise.</p> <p>Initiating Efforts:</p> <p>- Research focused on new ingredients and processing technologies including incorporation of molecular design and particle morphology technology into synthetic scale-up and process development. New compliant commodity ingredients, and new scale-up and formulation processes will be transitioned to the industrial base as appropriate.</p> <p>- Novel dynamic experimentation in support of design, evaluation and progression of enhanced lethality warhead concepts with focus on smaller form-factor without sacrificing effect on target; and advanced solid rocket motor, air-breathing, gun and other novel tactical propulsion concepts for extended range and reduced time-to-target.</p> <p>- Applied theory and model development for understanding complex lethality mechanisms and properly assessing target damage for emerging warhead concepts and materials (i.e. high-density reactive materials) in addition to modeling efforts that support progression and transition of advanced tactical propulsion (i.e. ram-jets, high performance solid rocket motor, detonation engines).</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base
There is no significant change from FY 2022 to FY 2023.					FY 2023 OCO
					FY 2023 Total
Title: Surface Ship and Submarine Hull Mechanical and Electrical (HM&E) Description: Technology programs focused on providing technologically superior warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research and advanced technology development of programs in: a) Power, Energy & Propulsion and b) Platform Design and Engineering. This element also includes the National Naval Responsibility in Naval Engineering (NNR-NE). Specific research themes are: Power, Energy and Propulsion Technology: Efforts address electrical and auxiliary system and component technology to dramatically improve naval capabilities by providing energy and power resiliency through applied research into energy and power density, control, operating efficiency, operational endurance, recoverability from casualties, and design tools. A major investment focus is providing the power, energy, and thermal management required for directed energy weapons and advanced sensor systems on current and future surface combatants. Significant investments are also focused on improving the energy performance of unmanned systems for the next generation surface fleet, subsea and seabed warfare, and expeditionary forces wherein the limited availability of power and energy are critical. Platform Design and Engineering Technology: This research area seeks to further the applied physics and mathematics necessary to improve the hydrodynamics, platform structures, platform resiliency/survivability, autonomy, and enabling digital technologies needed to improve naval warfighting capabilities as they relate to platforms/capabilities for use in expeditionary, surface and subsurface warfare. - Hydrodynamics: Critical design for naval platform hydrodynamics that is focused on the applied sciences, computation, laboratory experiments, and at-sea experimentation to develop the understanding and prediction capabilities for all hydrodynamic phenomena associated with naval sea-going platforms including, surface ships, submarines, unmanned vessels and manned small craft. Key research goals are to fully understand the physics of hydrodynamics of wakes, ship dynamics/control, propulsors and their effects on vessel performance and associated energy dissipation into the environment to provide science-based metrics for the evaluation of new design concepts to improve efficiency, signatures, and overall capabilities. - Platform Structures: Focused on all timescales of varying reliability of naval structures. Key applied research is focused on the analysis and prediction for a ship structural system with uncertainty quantification and propagation based on real world usage.		65.900	68.499	74.149	0.000
					74.149

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Unmanned Vehicles (UxV): Autonomy for UxVs and related mission functions aligned with Naval S&T strategic focus on autonomy and unmanned vehicles in support of surface, submarine, subsea/seabed naval warfare.</p> <p>- Sea Platform Resiliency: Aligned with survivability S&T strategic focus area, research investigates susceptibility, survivability, and recoverability of all naval platforms. Work in susceptibility of naval platforms concentrates on signature reduction across the acoustic and non-acoustic spectrums. .Applied research on survivability seeks to improve the ability of naval platforms to survive under stressing combat conditions, before, during, and after being affected by adversarial actions from kinetic and/or non-kinetic effectors. Research in recoverability of naval platforms seeks to better understand the complex nature of modern damage control measures necessary to enable platforms to recover to capability states necessary to avoid mission kill.</p> <p>- Digital Engineering: Naval engineering and platform design efforts to increase the speed to field and capability resiliency in the engineering process across platform lifecycles through the enablement of virtual design/monitor/usage models to be better informed through improved modeling and data science. Concentration of effort is placed on digitally linking all aspects of a platform lifecycle from ideation to destruction with identifiable metrics of military utility enabling fuller solution trade-space exploration.</p> <p>FY 2022 Plans: Power, Energy and Propulsion Technology:</p> <p>- Expand advanced energy systems research, which is focused on the analysis and optimization of resilient electrical grids and microgrids in the Pacific and across DON critical mission areas. Results from previous research will be used to evaluate and increase the energy resiliency of critically infrastructures on DON installations. Efforts include enhancing collaborations across academia, industry and DON beneficiaries.</p> <p>- Expand new and existing surface ship and submarine program efforts aimed at supporting electrical system reliability, as well as advanced power distribution and control to support both new and existing surface ship and submarine programs. This will be utilizing the Electric Ship Research and Development Consortium (ESRDC) to develop modeling and simulation tools, system analysis tools and models to provide critical design and operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, and to reduce risk of technology insertion. These efforts also address the national shortage of naval electrical power engineers.</p> <p>- Continue Next Generation Integrated Power System (NGIPS) and Distribution/Control of Power Advanced Power Systems efforts focused on power and energy requirements for directed energy weapons and advance</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
sensor systems on current and future surface combatants, as well as for unmanned naval platforms, including thermal modeling.						
- Initiate research efforts associated with High Temperature Superconducting Cables for flexible ship degaussing system design and sustainable deployment for new and existing surface ship and submarine programs.						
Platform Design and Engineering Technology:						
- Continue applied research related to critical S&T that supports platform design and advanced capability efforts related to propulsor, surface, and subsurface hydrodynamics; platform performance, and platform structural reliability. Specific efforts include the following: utilize advanced analytics (machine learning and artificial intelligence), incorporate environmental effects on platform performance, research related to advancing unmanned sea surface vessel technologies and capabilities; naval engineering and platform design efforts to support set-based design for the Next Generation Attack Submarine SSN(X), and efforts to mitigate technology and susceptibility risk for the COLUMBIA class submarine program and the Future Surface Combatant Force.						
- Continue applied research related to critical S&T to investigate efforts related to signature reduction; structural and machinery acoustics; machinery autonomy; and platform survivability (detectability and susceptibility); and acoustic and non-acoustic signatures. Specific efforts include the following: utilize advanced analytics (machine learning and artificial intelligence), integrate environmental effects on platform performance and detectability, naval engineering and platform design to support the Next Generation Attack Submarine SSN(X), and mitigating technology and susceptibility risk for the COLUMBIA class submarine program and the Future Surface Combatant Force.						
- Continue/expand research efforts focused on the science and physics based signal detection technologies that, individually or as a system, can impact the security of the SSBN and submarines in general. Efforts looking at both passive and active detection technologies with near term (0-5 years), mid-term (5-10 years) and far term (10-20 years) implications, as well as improving the understanding of the generation, radiation, propagation, scatter, and detection of a variety of signal types (acoustic, chemical, optical, electromagnetic, hydrodynamic and radiological) associated with a submarine's operation.						
- Continue research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. This includes multi-disciplinary research into the science of autonomy						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
focuses on four interrelated areas: scalable and robust distributed collaboration among autonomous systems; human/unmanned system collaboration; autonomous perception and intelligent decision-making; and intelligent architectures for autonomous systems.							
- Continue research to develop and test autonomy for Unmanned Undersea Vehicle (UUV) missions including understanding of counter-UUV autonomy options; implementations and testing; autonomy development involving a shared world model and sensor feedback; and extensive in-water testing.							
Spectrum Superiority:							
- Continue research efforts for passive and active long-range high-resolution detection and imaging for increased survivability and situational awareness even in degraded/contested environments.							
- Continue/expand research efforts to demonstrate portable sensor technology and machine learning based algorithms capable of identifying and recognizing emitters based off of unique RF characteristics in a complex EM environment.							
- Initiate research efforts exploring simultaneous full-spectrum (RF and optical) effects to enable full operations and signature control across the entire electromagnetic spectrum.							
Electronics:							
- Continue research to develop and explore new high voltage, high efficiency wide bandgap and ultra-wide bandgap power switches for electric propulsion and electric weapons. Current plans are to focus efforts on: Pioneering Vertical GaN High Power Switches; and Ultra-Wide Bandgap Gallium Oxide Power Device Transformative Integrated GaN Power Technology Platform.							
Materials and Chemistry:							
- Complete efforts associated with the design and demonstration of a rechargeable Zn-air battery with pulse-power capability that incorporates a Zn sponge anode and trifunctional air cathodes.							
Undersea Warfare:							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue research to reduce the time and cost for Submarine hull inspections by creating technologies for non-destructive evaluation (NDE) of submerged elastic surfaces coated with highly absorptive layers.</p> <p>FY 2023 Base Plans: Power, Energy and Propulsion Technology:</p> <p>- Continue research efforts associated with High Temperature Superconducting Cables for flexible ship degaussing system design and sustainable deployment for new and existing surface ship and submarine programs.</p> <p>- Complete advanced energy systems research, which is focused on the analysis and optimization of resilient electrical grids and microgrids in the Pacific and across DON critical mission areas. Results from previous research will be used to evaluate and increase the energy resiliency of critically infrastructures on DON installations. Efforts include enhancing collaborations across academia, industry and DON beneficiaries.</p> <p>- Complete research associated with Advanced Power Systems, Combat Power Systems and Energy Resiliency to expand surface ship and submarine program efforts aimed at supporting electrical system reliability, as well as advanced power distribution and control to support both new and existing surface ship and submarine programs. This will be utilizing the Electric Ship Research and Development Consortium (ESRDC) to develop modeling and simulation tools, system analysis tools and models to provide critical design and operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, and to reduce risk of technology insertion. These efforts also address the national shortage of naval electrical power engineers.</p> <p>- Complete HM&E initiatives associated with Next Generation Integrated Power System (NGIPS) and Distribution/Control of Power Advanced Power Systems efforts focused on power and energy requirements for directed energy weapons and advance sensor systems on current and future surface combatants, as well as for unmanned naval platforms, including thermal modeling.</p> <p>- Initiate and focus prior research efforts on the Naval Enterprise Partnership Teaming with Universities for National Entrepreneurship (NEPTUNE) program. The effort is derived from previous efforts in the areas of advanced energy systems research, which was focused on enhancing collaborations across academia, industry and DON beneficiaries. The NEPTUNE program is focused on conducting research that provides Navy Energy Education & Training for students.</p> <p>- Initiate applied superconductivity research in support of future Naval HM&E and mission systems.</p> <p>- Initiate applied research in Thermal Management.</p> <p>- Initiate applied research in Medium Voltage Direct Current (MVDC) electrical architectures.</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate research efforts in support of climate resiliency and clean energy to include applied research on low Global Warming Potential (GWP) refrigerants & environmentally friendly refrigeration cycles, electromechanical machinery applied research to reduce energy demand and improve component and power system energy conversion efficiencies, local generation of sustainable and zero-carbon fuels, DDG(X) advanced propulsion and to expand existing fuel efficiencies in the DDG-51 fleet, and design tools for uncrewed platform power architecture design, performance, and performance prediction</p> <p>Platform Design and Engineering Technology:</p> <p>- Complete research to develop and test autonomy for Unmanned Undersea Vehicle (UUV) missions including understanding of counter-UUV autonomy options; implementations and testing; autonomy development involving a shared world model and sensor feedback; and extensive in-water testing.</p> <p>- Complete applied research related to critical S&T that supports platform design and advanced capability efforts related to propulsor, surface, and subsurface hydrodynamics; platform performance, and platform structural reliability.</p> <p>- Complete applied research related to critical S&T to investigate efforts related to signature reduction; structural and machinery acoustics; machinery autonomy; and platform survivability (detectability and susceptibility); and acoustic and non-acoustic signatures.</p> <p>- Complete research efforts focused on the science and physics based signal detection technologies that, individually or as a system, can impact the security of the SSBN and submarines in general.</p> <p>- Complete research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. This includes multi-disciplinary research into the science of autonomy focuses on four interrelated areas: scalable and robust distributed collaboration among autonomous systems; human/unmanned system collaboration; autonomous perception and intelligent decision-making; and intelligent architectures for autonomous systems.</p> <p>- Initiate and focus research efforts in the following areas: USV and UUV Applied Research, Vessel Dynamics with Propulsors, Submarine Wakes, Structural Reliability, EM Signature Reduction, Topside Signature Reduction, Machinery Autonomy, Platform Survivability, Structural Acoustic Signature Control, Top-Side Signature Development, Machine Learning, Digital Twins, Data Analytics Rapid Experimentation, and Submarine Security S&T-Susceptibility. These efforts are derived from previous efforts in the area of Platform Design and Engineering.</p> <p>- Initiate and focus research efforts focused on digital engineering, the digital framework, and the digital thread, particularly regarding design tools, in order to increase the reliability and resiliency across the lifecycle for</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>surface and undersea platforms, both manned and unmanned. These efforts are derived from previous efforts in the area of Platform Design and Engineering.</p> <p>- Initiate and focus research efforts on the Tactical Submarine Evolution Plan, Integrated Permanent Magnet Motors, Submarine Future Technologies and Future Surface Ship and Unmanned Technologies that support their capability evolution plans. These efforts are derived from previous efforts in the area of Platform Design and Engineering.</p> <p>Spectrum Superiority:</p> <p>- Continue research efforts for passive and active long-range high-resolution detection and imaging for increased survivability and situational awareness even in degraded/contested environments.</p> <p>- Continue research efforts to demonstrate portable sensor technology and machine learning based algorithms capable of identifying and recognizing emitters based off of unique RF characteristics in a complex EM environment.</p> <p>- Continue research efforts exploring simultaneous full-spectrum (RF and optical) effects to enable full operations and signature control across the entire electromagnetic spectrum and conduct laboratory-based sub-system demonstrations of component technologies.</p> <p>- Initiate research efforts into coherent combination of optical, infrared, and mm-wave imagers for increased resolution and longer-range detection.</p> <p>- Initiate development of microelectronics system on a transient glass substrate for controlled destruction, which will allow sensitive software application use in hostile operations.</p> <p>- Initiate development of machine learning techniques for automated signal identification in order for own-forces to understand and adjust electromagnetic spectrum signature.</p> <p>Electronics:</p> <p>- Continue research to develop and explore new high voltage, high efficiency wide bandgap and ultra-wide bandgap power switches for electric propulsion and electric weapons. Current plans are to focus efforts on: Pioneering Vertical GaN High Power Switches; Ultra-Wide Bandgap Gallium Oxide Power Device Transformative Integrated GaN Power Technology Platform; and High-Voltage Ultra-Fast SiC Semiconductor Closing Switches.</p> <p>Materials and Chemistry:</p> <p>- Initiate research into the use of prototype ammonium borosulfate electrolyte fuel cells to increase power output in current commercial solid acid fuel cells.</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Undersea Warfare: - Complete research to reduce the time and cost for Submarine hull inspections by creating technologies for non-destructive evaluation (NDE) of submerged elastic surfaces coated with highly absorptive layers. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to an increase for efforts associated with Naval Platform Operational Endurance & Climate Resiliency Technologies.							
Title: Naval Research Enterprise Description: The Naval Research Enterprise (NRE) supports mission-driven problem solving within the Naval Research and Development Establishment (NR&DE) through agile, rapid prototyping processes, while also promoting implementation of a common, effective innovation process and language. Adopting a common innovation process stimulates effective NR&DE-wide collaborations and facilitates NR&DE-wide sharing and implementation of best practices to accelerate the delivery of innovative capabilities to the warfighter. Activities are based on three foundational principles: (1) utilize innovative technical and business pathways that accelerate technology acquisition and deployment to the warfighter and pilot potential efforts as a result of this investigation; (2) leverage the commercial market and attract private investments to accelerate and reduce the cost for defense acquisition and deployment of technologies that provide capabilities to the warfighter; and (3) employ innovative best-practices in contracting that accelerate awards and provide flexibility and speed in technology and acquisition. The Independent Applied Research (IAR) Program focuses 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 Naval Research and Development Framework 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: (1) developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems; (2) promoting the hiring and development of talented new scientists and engineers (S&E) with the insurance of proper mentoring with senior personnel; and (3) encouraging collaboration with universities, private industry, and other Navy and			4.429	4.641	9.191	0.000	9.191

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>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- payoff research and also allow young S&Es to manage Navy relevant research projects.</p> <p>FY 2022 Plans:</p> <p>- Continue development of innovative prototypes at Warfare Centers, Naval Laboratories, Naval Accelerator (NavalX) Tech Bridges and related DON organizations solving key warfighter problems that are identified through the Hacking for Defense (H4D) innovation process pipeline.</p> <p>- Continue/expand efforts that will be carried out under the Naval Innovations Process Adoption (NIPA) program to emphasize the implementation of a common process and language to promote collaborations and facilitate the use of best practices to accelerate the delivery of capabilities to the warfighter.</p> <p>- Initiate NIPA Challenges that solicit and expand the Department of the Navy (DON) industrial base, especially small businesses, to solve warfighter problems. The Challenges will employ the NavalX Tech Bridge network to reach the widest possible industrial base and to promote collaborations across the Naval R&D community.</p> <p>FY 2023 Base Plans:</p> <p>Naval Innovation Process Adoption (NIPA):</p> <p>- Continue/expand development of innovative prototypes at Warfare Centers, Naval Laboratories, NavalX Tech Bridges and related DON organizations solving key warfighter problems that are identified through the H4D innovation process pipeline. - Continue/expand efforts that will be carried out under the NIPA program to emphasize the implementation of a common process and language to promote collaborations and facilitate the use of best practices to accelerate the delivery of capabilities to the warfighter.</p> <p>- Continue NIPA Challenges that solicit and expand the DON industrial base, especially small businesses, to solve warfighter problems. The Challenges will employ the NavalX Tech Bridge network to reach the widest possible industrial base and to promote collaborations across the Naval R&D community. - Expand Naval sustainment efforts across Warfare Centers through cross-community NIPA/H4D Challenges and Small Business Innovative Research (SBIR) topics.</p> <p>- Support the Gordian Knot Center for National Security Innovation at Stanford University.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Independent Applied Research (IAR):</p> <p>Initiate the following efforts:</p> <ul style="list-style-type: none"> - Naval warfare centers and laboratories generate new two- to three-year research topics where priority is given to warfighter needs, technology alignment, high quality research, and the recruitment and retention of outstanding scientists and engineers. Topics cover a broad range of naval relevant research areas critical to supporting the missions of the warfare centers and laboratories. - Utilize peer review process to select and evaluate IAR topics and develop a diverse S&T research portfolio. - Establish mid-year and annual progress review meetings to ensure topic objectives are being accomplished and projected outcomes are being achieved. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to funds being added for the Independent Applied Research (IAR) program.</p>					
Accomplishments/Planned Programs Subtotals	119.140	122.888	133.426	0.000	133.426
C. Other Program Funding Summary (\$ in Millions) N/A					
Remarks					
D. Acquisition Strategy N/A					

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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	84.469	99.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	183.969

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Power Generation and Storage Research	4.827	0.000
FY 2021 Accomplishments: Conducted and expanded on-going competitively awarded efforts that improved Li-ion battery safety and increased micro-grid resiliency and efficiency		
FY 2022 Plans: N/A		
Congressional Add: Advanced Energetics Research	4.827	3.000
FY 2021 Accomplishments: Continued research towards the advanced demonstration of energetic materials in a variety of weapon system applications to include: high performance solid rocket and air breathing propulsion, reactive materials demonstrations and effects in advanced lethality and effectiveness models, advanced warhead concepts to include novel reactive shaped charge configurations, hybrid reactive material warhead demonstrations, and the development and demonstration of any necessary modeling and simulation capabilities for quantification of damage effects on adversary weapon systems, and other potential energetic technologies.		
FY 2022 Plans: Continue research towards the advanced demonstration of energetic materials in a variety of weapon system applications to include: high performance solid rocket and air breathing propulsion, reactive materials demonstrations and effects in advanced lethality and effectiveness models, advanced warhead concepts to include novel reactive shaped charge configurations, hybrid reactive material warhead demonstrations, and the development and demonstration of any necessary modeling and simulation capabilities for quantification of damage effects on adversary weapon systems, and other potential energetic technologies.		
Congressional Add: Talent and technology for Navy power and energy systems	10.136	10.500

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B. Accomplishments/Planned Programs (\$ in Millions)		
		FY 2021
		FY 2022
FY 2021 Accomplishments: Developed autonomous command and control of ship power and energy systems, leveraging digital twin technology that protects the ship's power and energy grid. In addition, designed and built a digital twin testbed for physical experimentation with power and energy controls technologies.		
FY 2022 Plans: Continue efforts to develop autonomous command and control of ship power and energy systems, leveraging digital twin technology that protects the ship's power and energy grid. In addition, designed and built a digital twin testbed for physical experimentation with power and energy controls technologies.		
Congressional Add: Energy resilience efforts		0.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research supporting energy resilience efforts		
Congressional Add: Coastal environmental research		4.827
FY 2021 Accomplishments: Provided a complete, portable, and field-tested ocean electro-magnetic observatory capable of global deployment to observe the fluid dynamics and magnetic signature of the ocean in coastal environments. Installed, calibrated, and collected data for the Navy's Electro-Magnetic Observatory prototype.		
FY 2022 Plans: Continue efforts to provided a complete, portable, and field-tested ocean electro-magnetic observatory capable of global deployment to observe the fluid dynamics and magnetic signature of the ocean in coastal environments. Installed, calibrated, and collected data for the Navy's Electro-Magnetic Observatory prototype.		
Congressional Add: Data-Model Fusion		2.896
FY 2021 Accomplishments: This project, "Data Model Fusion for Naval Engineering", under the Force Protection line, provided substantial science and technology work in the area of digital-twins, big data, and autonomy for the US Navy. Working under separate but parallel contracts, MDG and U of M propose to extend initial exploration of data-model fusion from FY20, focusing on methods to combine data-rich and data-sparse problems to provide robust system-level performance prognosis for autonomous platforms. They performed a series of fundamental research activities and table-top scale demonstrators at U of M, and real-world applications and demonstrations coordinated by MDG.		
FY 2022 Plans: N/A		
Congressional Add: Direct Air Capture and Blue Carbon Removal Technology		7.240
		10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022
<p>FY 2021 Accomplishments: This funding supported direct air capture and blue carbon technology development. Advancements in these technologies and their integration with next generation fuel producing and material producing technologies will enhance DON & DoD fuel energy security.</p> <p>FY 2022 Plans: This funding will support direct air capture and blue carbon technology development. Advancements in these technologies and their integration with next generation fuel producing and material producing technologies will enhance DON & DoD fuel energy security.</p>		
<p>Congressional Add: Machine Discovery and Learning</p> <p>FY 2021 Accomplishments: Continued to develop emergent artificial intelligence (AI) and machine learning (ML) methods for discovery of energetic systems. Demonstrate use of these new methods to discover and transition defense-critical applications, in particular, significant improvements to undersea weapons of particular interest to the Naval Surface Warfare Center, Indian Head Explosive Ordnance Disposal Technology Division (NSWC IHEODTD), and the Navy, with the goal of significant and dramatic reductions in undersea weapon system size, cost and development time. The deliverable will be a methodology that can be used to discover new energetic materials and, ultimately, new energetics-based systems.</p> <p>FY 2022 Plans: N/A</p>	1.931	0.000
<p>Congressional Add: Additive Manufacturing of Unmanned Maritime Systems</p> <p>FY 2021 Accomplishments: This work developed advanced composite structures for an unmanned surface vessel (USV) using additive manufacturing techniques. The final USV enabled is expected to provide higher performance, lower weight, lower cost and faster manufacturing times than achievable with conventional technologies. This contract will deliver the USV design, hull manufacturing process demonstrations, full scale hull sections and a sub-scale complete hull.</p> <p>FY 2022 Plans: This work will develop advanced composite structures for an unmanned surface vessel (USV) using additive manufacturing techniques. The final USV enabled is expected to provide higher performance, lower weight, lower cost and faster manufacturing times than achievable with conventional technologies. This contract will deliver the USV design, hull manufacturing process demonstrations, full scale hull sections and a sub-scale complete hull.</p>	9.654	6.000
<p>Congressional Add: Asia Pacific Technology and Education Program</p>	4.827	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021 Accomplishments: Sponsor applied research supporting the Asia Pacific Technology and Education Program.		
FY 2022 Plans: N/A		
Congressional Add: Low Cost Silicon Solar Cells	2.413	0.000
FY 2021 Accomplishments: Low Cost Silicon Solar Cells: North Dakota State University will work on new ways to chemically alter the cyclohexylsilane (CHS) ring, to yield facile processing routes to novel silicon devices (films, rods, quantum dots and associated devices such as thin film transistors and solar cells) and to enhance semiconductor properties with molecularly incorporated dopants.		
FY 2022 Plans: N/A		
Congressional Add: Navy Alternative Energy Research	24.134	27.500
FY 2021 Accomplishments: Conducted applied research supporting Navy Alternative Energy technologies.		
FY 2022 Plans: Conduct applied research supporting Navy Alternative Energy technologies.		
Congressional Add: Robust Energy Infrastructure Project	6.757	0.000
FY 2021 Accomplishments: Conducted applied research in support of the Robust Energy Infrastructure Project.		
FY 2022 Plans: N/A		
Congressional Add: relative position of autonomous platforms	0.000	3.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research in relative position of autonomous platforms		
Congressional Add: Bonded metal matrix composite repair	0.000	5.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research in bonded metal matrix composite repair		
Congressional Add: Resilient innovative sustainable economies via university partnerships	0.000	7.500

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602123N / <i>Force Protection Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct applied research for resilient innovative sustainable economies via university partnerships		
<i>Congressional Add:</i> Titanium metal and wire domestic production demonstration	0.000	15.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct applied research supporting titanium metal and wire domestic production demonstration		
Congressional Adds Subtotals	84.469	99.500

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
Not applicable.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602131M / <i>Marine Corps Lndg Force Tech</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	53.711	64.112	53.467	-	53.467	59.208	64.575	66.618	67.950	Continuing	Continuing
2958: <i>Cyberspace Activities</i>	0.000	5.021	5.050	5.100	-	5.100	5.100	5.202	5.306	5.412	Continuing	Continuing
3001: <i>Marine Corps Landing Force Tech</i>	0.000	43.863	46.062	48.367	-	48.367	54.108	59.373	61.312	62.538	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	4.827	13.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.827

A. Mission Description and Budget Item Justification

The U.S. Navy/Marine Corps team is the most potent naval fighting force in the world. Fundamental to their success are the technologies necessary for effective distributed maritime operations. The Office of Naval Research (ONR) combines knowledge of the naval mission with researchers to select and explore solutions critical to expeditionary warfighting needs.

This Program Element (PE) addresses requirements outlined in the Marine Corps Operating Concept, which calls for Expeditionary Forces to conduct maneuver warfare in challenging, contested maritime environments characterized by complex terrain, technology proliferation, information and electronic warfare. Additionally, an emergent operation stressor is the contested urban environment which exemplifies the characterizations listed above. The urban environment is one of the most complex terrains with physical compartmentalization and canalization, additional physical dimensions (subterranean and multi-story structures), crowded conditions and associated threat obscuration, communications challenges, informational and human aspects, and proliferation of observation and fires technologies. This environment requires capabilities addressing all the activities within this PE and while it provides many challenges, unique opportunities are also presented and can further shape technology approaches.

These future challenges and portents demand robust technologies for the Marine Corps, but the technology options are constrained. They must have a lightweight deployable character, and the ability to operate in austere conditions with little fixed infrastructure or support while retaining the agility and lethality of an integrated maneuver force. Technology must provide full spectrum capability against robust and complex peer and near-peer adversaries while meeting Size, Weight, Power, Post limitations, and information availability within Distributed, Intermittent and Limited environments.

The approach within this PE encompasses ideas that support both revolutionary and evolutionary capabilities, and in this way considers and balances both "push" and "pull" aspects of technology projects.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 2: Applied Research		R-1 Program Element (Number/Name) PE 0602131M / Marine Corps Lndg Force Tech				
B. Program Change Summary (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		55.403	51.112	0.000	-	0.000
Current President's Budget		53.711	64.112	53.467	-	53.467
Total Adjustments		-1.692	13.000	53.467	-	53.467
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	13.000			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-1.692	0.000			
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	53.467	-	53.467
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Marine Corps Asset Life-Cycle Management						
Congressional Add: Unmanned Logistical Solutions						
Congressional Add: 5G biometric installation access control demonstration						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Funding: No significant change.						
Technical: No significant change.						
Schedule: No significant change.						

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602131M / Marine Corps Lndg Force Tech				Project (Number/Name) 2958 / Cyberspace Activities			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2958: Cyberspace Activities	0.000	5.021	5.050	5.100	-	5.100	5.100	5.202	5.306	5.412	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Project activity provides freedom of maneuver and influence in the cyber-electronic warfare domain while simultaneously denying the same to the adversary and protecting critical command systems. Technologies are being developed using a multi-disciplinary approach that combines Radio Frequency electronics, digital signal processing, computer engineering, software engineering, machine learning and data science to support Naval Expeditionary warfighters operating with size, weight and power constrained equipment in Disrupted, Intermittent, Limited environments. Areas of applied research include distributed precision time, predictive software defined radio architectures, coordinated Cyber and Spectrum maneuver to mitigate detection and exploitation, tactical Cyber visualization, discovering and mapping networks in dense urban environments, contextual awareness and blind channel characterization.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Expeditionary Cyber Description: This activity provides freedom of maneuver and influence in the cyber-electronic warfare domain while simultaneously denying the same to the adversary and protecting critical command systems. Technologies are being developed using a multi-disciplinary approach that combines Radio Frequency electronics, digital signal processing, computer engineering, software engineering, machine learning and data science to support Naval Expeditionary warfighters operating with size, weight and power constrained equipment in Disrupted, Intermittent, Limited environments. Areas of applied research include distributed precision time, predictive software defined radio architectures, coordinated Cyber and Spectrum maneuver to mitigate detection and exploitation, tactical Cyber visualization, discovering and mapping networks in dense urban environments, contextual awareness and blind channel characterization. FY 2022 Plans: - Continue algorithm and tool development for Cyber-EW capabilities for tactical engagement. - Continue development of sense-making algorithms through machine learning for the cyber physical layer and algorithms to assist in supply chain validation that are designed for small form-factor tools. - Continue cyber threat identification (cyber health assessments) including vulnerability research of ubiquitous embedded systems focusing on devices commonly carried by Marines. - Continue development of new portable tools to capture software configuration management to include malware on forward deployed systems.	5.021	5.050	5.100	0.000	5.100

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602131M / <i>Marine Corps Lndg Force Tech</i>		Project (Number/Name) 2958 / <i>Cyberspace Activities</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate research into the development low space, weight and power (SWAP) cyber secure technologies that when integrated into a single platform will enable dismounted Marines to conduct EW/Cyber missions in a highly responsive, dynamically reprogrammable and modular standards based configuration.</p> <p>FY 2023 Base Plans:</p> <ul style="list-style-type: none"> - Continue algorithm and tool development for Cyber-EW (Electronic Warfare) capabilities for tactical engagement. - Continue development of sense-making algorithms through machine learning for the cyber physical layer and algorithms to assist in supply chain validation that are designed for small form-factor tools. - Continue cyber threat identification (cyber health assessments) including vulnerability research of ubiquitous embedded systems focusing on devices commonly carried by Marines. - Continue development of new portable tools to capture software configuration management to include malware on forward deployed systems. - Continue research into the development of low space, weight and power (SWAP) cyber secure technologies that when integrated into a single platform will enable dismounted Marines to conduct EW/Cyber missions in a highly responsive, dynamically reprogrammable and modular standards based configuration. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		5.021	5.050	5.100	0.000	5.100
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3001: Marine Corps Landing Force Tech	0.000	43.863	46.062	48.367	-	48.367	54.108	59.373	61.312	62.538	Continuing	Continuing
A. Mission Description and Budget Item Justification												
This project funds applied research; technology assessment, road mapping, and concept development; and less technologically mature projects within the Future Naval Capability (FNC) process as means to inform, enhance, enable, and invent future concepts and capabilities with new Science and Technology (S&T). This project is organized into ten activities, the core of which is represented by the eight Expeditionary Warfighting Capability Areas.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Command, Control, Communications, and Computers (C4)								5.118	6.139	7.200	0.000	7.200
Description: This activity investigates robust, resilient, and secure networked communications pathways and capability that support an expeditionary force's distributed and disaggregated operations. Research supports both networked and local computation for communications that exploits the expeditionary forces close physical proximity to threats while mitigating shortfalls commiserate within Distributed, Intermittent and Limited environments. Expeditionary forces must operate in the cyber domain and in addition to defending communications networks, vehicles, and weapons systems, are reliant on electronic controllers for basic operations and as such are susceptible to cyber attacks.												
Technologies addressed within this activity include secure, robust, self-forming, mobile communications networks; distributed computing to support information dissemination to all echelons; improved capabilities in over-the-horizon, beyond line-of-sight, and restricted environment communications and sensors; and software and data processing to support formation of an appropriate common picture. Other efforts include power management, low detectability, conforming to Size, Weight, Power, Cost constraints, and interoperability within the joint environment.												
FY 2022 Plans: -Research areas have expanded to include novel portable materials for rapid deployment of back-up Command, Control, Communications and Computers (C4) assets, and distributed system technology enablers for operating in denied /contested electromagnetic (EM) environments. -Continued focus on operations in the challenging warfighter EM spectrum environment by making investments in the multifunction electronic warfare domains. Mission requirements include lightweight, man or squad												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>portable, deployable systems for expeditionary forces. Investigations include increasing bandwidth and dynamic range in portable systems.</p> <p>-Electromagnetic signature management, machine learning, countermeasures and interoperability technologies will progress to manage control and exploitation of the electromagnetic spectrum. Focus includes developing underlying technologies to enable multifunction operations at multiple-domain cryptography and security levels. Research is closely coordinated with the Intelligence, Surveillance, and Reconnaissance and Expeditionary Cyber research to address the multifunction requirement of future systems.</p> <p>FY 2023 Base Plans:</p> <p>- Continue developing portable technologies using advanced algorithms and machine learning to manage, control and exploit the electromagnetic spectrum.</p> <p>- Continue investigations to increase bandwidth and dynamic range of portable systems to increase real-time situational awareness and enable assured spectrum operations in a congested and contested Electromagnetic environment.</p> <p>- Continue development of electromagnetic signature management, countermeasures, and interoperability technologies utilizing machine learning in order to manage the control and exploitation of the electromagnetic spectrum.</p> <p>- Initiate efforts to explore combined Electromagnetic Warfare (EW)/Cyber resilient communications and effects.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>The funding increase from FY 2022 to FY 2023 is due to an alignment to Naval priorities and a targeted investment in signature management, multi-domain sensors and robust communications networks necessary to close high priority capability gaps. These efforts meet the demands of the National Defense Strategy and directly support Navy and Marine Corps operating concepts Distributed Maritime Operations (DMO), Expeditionary Advanced Base Operations (EABO), Littoral Operations in a Contested Environment (LOCE) and Force Design 2030.</p>						
<p>Title: Firepower</p> <p>Description: The activity investigates a large variety of weapons technologies to enhance fires capabilities of Fleet Marine Forces as part of joint maritime campaigns to counter emerging threats and create new opportunities for the joint force to secure operational advantage. Research efforts increase range, lethality, and capacity, while maintaining mobility and tempo to operate inside actively contested maritime domains, to</p>		2.897	3.168	3.400	0.000	3.400

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
achieve overmatch fires capabilities when operating within the landward portions of the littorals, and to provide weapons system capabilities able to persist when operating within the adversary's intelligence, surveillance, collection, and weapons ranges. Focus on low size, weight, power, and cost of weapons components and weapon systems, having low manpower and cognitive burdens to operate, with low logistics burdens, stresses technical solutions. Weapons system technologies being developed include fire control, launch and propulsion, precision guidance, navigation, and control, seekers, fuzing, and lethality.						
FY 2022 Plans: - Continue end-to-end navigation technology developments suitable for shaping trajectories of extended range, precision guided munitions in satellite- and network-denied environments. - Continue research into real-time, multi-spectral target detection and identification technologies for expanded applications to weapons optics, aviation targeting and navigation sensors, unmanned aircraft systems, missile seekers, and naval platforms, to improve anomaly and object detection during degraded visibility and long-range day and night situations, and to improve decision-aid algorithms. - Complete research to develop thin film coatings that will change how munitions interact with electromagnetic waves. - Complete development of novel materials and processes to improve energetic output of explosives.						
FY 2023 Base Plans: -Continue end-to-end navigation technology developments suitable for shaping trajectories of extended range, precision guided munitions in satellite- and network-denied environments. -Continue research into real-time, multi-spectral target detection and identification technologies for expanded applications to weapons optics, aviation targeting and navigation sensors, unmanned aircraft systems, missile seekers, and naval platforms, to improve anomaly and object detection during degraded visibility and long-range day and night situations, and to improve decision-aid algorithms.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Title: Force Protection		6.369	6.660	6.750	0.000	6.750
Description: This activity investigates new ways and means to protect forces and materiel across all operational settings, from contested sea-land surface interfaces to complex urban environments. The portfolio protects						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
against adversaries' challenges such as guided-rockets and missiles, mobile coastal artillery, threat Electronic Warfare, and counter Intelligence, Surveillance and Reconnaissance. Mines and obstacles both in the water and ashore also complicate amphibious landings. The activity invests in vehicle survivability aspects that are exacerbated due to Size, Weight, Power, Cost constraints inherent to Marine Corps operation and the harsh nature of the amphibious environment.						
Technologies addressed include lightweight armor for ballistic and underbody blast protection, advanced sensors for counter tactical surveillance, active protection, and signature management. This activity also considers technology for payloads, packages and sensors that are needed by amphibious vehicles (both manned and unmanned) including mine counter measures; explosive hazard defeat systems; and obstacle and threat detection systems as well as technologies for improved protection for individuals against blast, ballistic and blunt impact threats.						
FY 2022 Plans:						
- Research will complete on computer vision/machine learning approaches specific to real-time, onboard processing of target of interest of known pedigree. Efforts will continue on CV/ML approaches for detection and classification of obscured and camouflaged threats.						
- Research will continue in enabling technologies for countering unmanned aerial vehicles. This addresses both an increase in number and sophistication of threat systems to include kinetic and/or controlled interceptors with a specific focus on countering UAV swarms and scalable/low-cost approaches.						
- Create multi-agent hardware and software components capable of autonomous operation in complex, contested, and congested environments. The objective is to create autonomous systems that can operate without relying on of radio communications and Global Navigation Satellite System (GNSS).						
FY 2023 Base Plans:						
- Continue computer vision/machine learning (CV/ML) approaches for detection and classification of obscured and camouflaged threats.						
- Create multi-agent hardware and software components capable of autonomous operation in complex, contested, and congested environments, leading to autonomous systems that can operate without reliance on radio communications or Global Navigation Satellite System (GNSS).						
-Continue Research in enabling technologies for countering unmanned aerial vehicles. This addresses both an increase in number and sophistication of threat systems to include kinetic and/or controlled interceptors with a specific focus on countering UAV swarms and scalable/low-cost approaches.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue effort to create multi-agent hardware and software components capable of autonomous operation in complex, contested, and congested environments. The objective is to create autonomous systems that can operate without relying on of radio communications and Global Navigation Satellite System (GNSS).</p> <p>- Initiate a follow-on and focused research effort into high-power directed energy weapon systems for increased efficiency and scalable power, when used by ground platforms/assets against adversarial ground and air threats.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Human Performance, Training and Education</p> <p>Description: This activity investigates two technology investment areas: warrior resilience, and decision-making and expertise development. Warrior resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Decision making and expertise development accelerates and improves the advancement in retention of skills in decision making, situation awareness, including individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields.</p> <p>FY 2022 Plans: Conduct applied research on algorithm development using advanced analytics techniques to generate predictions and recommend actions to improve physical readiness and performance. -Conduct applied research on generalized approaches for adaptive training and assessment that minimizes the need for content and curriculum development. -Continue applied research in training and decision tools to provide information to the warfighter at the point of friction to enhance individual performance, and mitigate negative aspects of combat and reduce negative consequences of stressors to improve readiness and resilience. -Continue applied research into implementation of state-of-the-art and science of learning based training techniques to improve the development of small unit decision-making expertise through effective training, leveraging persistent computing technologies. Expand and extend small unit leader training and education continuum to increase learning outcomes for the warfighter.</p>		3.573	3.366	3.400	0.000	3.400

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Transition applied research into the ability of the warfighter to process information and speed good decision-making by implementing novel data collection and visualization techniques into Marine Corps specific applications.</p> <p>FY 2023 Base Plans:</p> <p>- Continue research on algorithm development using advanced analytics techniques to generate predictions and recommend actions to improve physical readiness and performance.</p> <p>- Continue research on generalized approaches for adaptive training and assessment that minimizes the need for content and curriculum development, and improves learning outcomes and engagement.</p> <p>- Continue research in training and decision tools to provide information to the warfighter at the point of friction to enhance individual performance, mitigate negative aspects of combat, and reduce negative consequences of stressors (e.g., sleep) to improve readiness and resilience.</p> <p>- Continue research into implementation of state-of-the-art and science-of-learning based training techniques to improve the development of small unit decision-making expertise.</p> <p>- Expand and extend small unit leader training and education continuum to increase learning outcomes for the warfighter.</p> <p>- Complete applied research into the ability of the warfighter to process information and speed good decision-making by implementing novel data collection and visualization techniques into Marine Corps specific applications.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Intelligence, Surveillance, And Reconnaissance (ISR)</p> <p>Description: This activity investigates enhanced situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes biometric monitoring for expeditionary operations, operational Course Of Action (COA) development, and autonomous surveillance in support of distributed operations.</p> <p>FY 2022 Plans:</p>		5.408	5.545	5.700	0.000	5.700

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Create new artificial intelligence (AI) algorithms to inform and support command decision making by inferring adversarial intent, plans, and tactics.</div><div>- Create new artificial intelligence (AI) algorithms to automate the parsing of naval communications to create a common operating picture.</div><div>- Generate new family of Neural Network algorithms to identify and counter adversarial deception.</div><div>- Create learning-enabled artificial intelligence (AI) algorithms to provide reactive and adaptive tactical and strategic planning to support logistic and mission level operations.</div><div>- Create new artificial intelligence (AI) algorithms capable of developing tactical plans. The approach is to utilize existing games and military simulations to derive winning strategies.</div><div>-Initiate applied research for dynamic metadata that enable question and answering techniques.</div><div>- Continue development of algorithms to understand and recognize patterns in common intelligence and tactical pictures, useful for decision support tools.</div><div>- Continue use of Artificial Intelligence (AI) and machine learning to automate mission planning and mission re-planning.</div><div>- Develop end-to-end deep reinforced learning and demonstrate warfare at machine speed that can be applied to a very large force of manned and unmanned platforms.</div><div>- Conduct applied research on strong artificial intelligence decision support systems that avoid bad decisions even when presented with very noisy data.</div><div>- Continue research in analytic algorithms and visualizations (e.g., smart graphs, network shaping metrics, actionable visualizations, and network fractures).</div></div>							
FY 2023 Base Plans:							
<div><div>- Continue effort to create new artificial intelligence (AI) algorithms to inform and support command decision making by inferring adversarial intent, plans, and tactics from sensor data.</div><div>- Continue effort to create new artificial intelligence (AI) algorithms to automate the parsing of naval communications to create a common operating picture for naval tactical operators.</div><div>- Continue research to generate a new family of neural network algorithms to identify and counter adversarial deception.</div><div>- Continue effort to create learning-enabled artificial intelligence (AI) algorithms to provide reactive and adaptive tactical and strategic planning for supporting logistic and mission level operations.</div><div>- Continue development of new artificial intelligence (AI) algorithms capable of developing tactical plans, utilizing existing games and military simulations to derive winning strategies.</div><div>- Continue applied research for dynamic metadata that enable question and answering techniques.</div></div>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none">- Continue development of algorithms to understand and recognize patterns in common intelligence and tactical pictures, useful for decision support tools.- Continue effort for use of Artificial Intelligence (AI) and machine learning to automate mission planning and mission re-planning.- Continue to develop end-to-end deep reinforced learning and demonstrate warfare at machine speed that can be applied to a very large force of manned and unmanned platforms.- Continue applied research on strong artificial intelligence decision support systems that avoid bad decisions even when presented with very noisy data.- Continue research in analytic algorithms and visualizations (e.g., smart graphs, network shaping metrics, actionable visualizations, and network fractures).- Initiate research to help warfighters best employ deception systems, detect when adversaries engage their own systems, and design systems architecture to enable experimentation within virtual or live environments. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: USMC FNC Technology Candidates</p> <p>Description: This R-2 Activity addresses the applied research associated with the Marine Corps' participation in the Department of the Navy's (DoN) Future Naval Capabilities (FNC) Program. The objective of the work in this Program Element (PE) is to develop and mature technologies needed by the Marine Corps to initiate FNCs in PE 0603640M Marine Corps Advanced Technology Development (ATD) that can be commenced at higher Technology Readiness Levels (TRLs). Investments in this activity are coordinated with similar and non-duplicative efforts in PE 0602750N Future Naval Capabilities Applied Research, where the Navy's participation in the FNC Program is funded. The FNC Program is structured to accelerate the transition of new technologies to the Fleet and Force. Each effort is assessed for its technology maturity and transition commitment. Funding for FNCs, which have Technology Readiness Levels (TRLs) of 4/5 to 6 and also have transition funding commitments from acquisition Programs of Record, are resourced in PE 0603640M Marine Corps Advanced Technology Development. Funding for technology candidates at lower TRLs (3 to 4) are resourced in this PE 0602131M, Marine Corps Landing Force Technology. ONR works closely with the Resource Sponsors and acquisition stakeholders to develop high priority technological capabilities needed by the operational forces.</p>		4.630	4.841	4.987	0.000	4.987

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>FNC Budget Activity (BA) 2 investments develop candidate FNC technologies in an agile fashion by exploiting technology advances that respond rapidly to naval needs. This approach facilitates an optimum response when developing and maturing the technology options that can be developed further in PE 0603640M Marine Corps Advanced Technology Development (ATD).</p> <p>The FNC Program favors a high level of collaboration. PE R-2 activities are mostly organized by the Office of Naval Research (ONR) Departments, which are tasked to collaborate with the acquisition stakeholders and their resource sponsors.</p> <p>A complete accounting of the technology candidates being developed and a full disposition of each technology development effort funded in this PE is provided annually to the Congressional oversight committees.</p> <p>FY 2022 Plans: This activity will continue to focus on developing promising technologies emerging from the FNC Applied Research program that have been matured to a Technology Readiness Level of 4 to 5. Development efforts include, but are not limited to, technologies that:</p> <ul style="list-style-type: none">- Enable greater signature management of the Marine Air-Ground Task Force (MAGTF).- Support a multi-domain sensing of the electronic spectrum, Command and Control integration and automated collaboration of warfighting functions.- Enhance mobility, propulsion, autonomy, weapons, materials, logistics, vehicle architectures, and Electronic Warfare (to include cyber) protection for a light armored vehicle fleet.- Support improved warfighter training, performance, feedback and enhanced learning in live, virtual and constructive environments, and enhance warfighter health and endurance.- Optimize the balance between hard and flexible software development for future dynamic engagements in contested environments with adversaries.- Produce new repair techniques to include the use of solid-state technologies such as cold-spray and additive friction stir welding for structural repairs. <p>FY 2023 Base Plans:</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue research in the area of Signature Management.</div> <div>- Continue research supporting multi-domain sensing of the electronic spectrum.</div> <div>- Continue the Command and Control Thrust with applied research in the area of integration and automated collaboration as a function of command and control.</div> <div>Initiate:</div> <div>- Initiate research to provide a secure tactical computing infrastructure allowing applications to be dynamically deployed to support mission tasking requirements.</div> <div>- Initiate feasibility studies and prototype development to test new Logistics techniques and capabilities that support expeditionary ground operations.</div> <div>- Initiate research in the area of on-site energy generation, storage and power management in support of Expeditionary Advanced Base Operations (EABO).</div> <div>- Research in Fleet Vehicles, Warfighter Training, Flexible Software Development and New Repair Techniques were completed in this PE in FY22 and are being continued in FY23 in the Expeditionary Maneuver Warfare (EMW) and Combating Terrorism Activity of PE 0602750N.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>There is no significant funding change from FY 2022 to FY 2023.</div>						
<div>Title: Logistics</div> <div>Description: This activity investigates the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. 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. This includes efficient and responsive force sustainment, planning and directing logistics operations, logistics demand reduction, fleet maintenance, and expeditionary energy. Expeditionary Energy enhances combat capability of expeditionary warfighters by increasing the efficiency and effectiveness of energy production, storage, distribution and use. Beyond traditional energy efforts, this portfolio also looks at other issues, including energy-efficient behaviors and hybridization of energy sources. These pillars are thoroughly integrated and perpetually related in execution.</div> <div>FY 2022 Plans:</div>		6.014	6.336	6.400	0.000	6.400

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue research to predict vehicle health and prognostics of remaining useful life for military ground vehicles and equipment in support of logistics planning, execution and combat support.</p> <p>- Advance enhancement of combat capability by increasing energy production, storage, and distribution including curbing energy consumption of the individual Marine and other tactical assets Activities continue to involve applied research into new, rugged, low cost, and high specific power solar cell technologies, including investigation into the stability of the solar cells. Investigate developing more energy efficient componentry as part of the Marine warfighter loadout.</p> <p>FY 2023 Base Plans:</p> <p>- Continue research to predict vehicle health and prognostics of remaining useful life for military ground vehicles and equipment in support of logistics planning, execution and combat support.</p> <p>- advance enhancement of combat capability by increasing energy production, storage, and distribution including curbing energy consumption of the individual Marine and other tactical assets.</p> <p>- Continue activities to involve applied research into new, rugged, low cost, and high specific power solar cell technologies, including investigation into the stability of the solar cells. Investigate developing more energy efficient componentry as part of the Marine warfighter loadout.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Maneuver</p> <p>Description: This activity investigates new ways and means to land forces and material through contested sea-land surface interfaces to then conduct maneuver warfare. In order to enable future Amphibious Operations, research efforts will support autonomous operations across the sea-surf-ground environment, improved fuel efficiency and speed of amphibious vehicles, amphibious vehicle technologies, water performance, and amphibious payloads to change the dynamics of a surface amphibious assault. This includes the emergence of manned-unmanned teaming and autonomous vehicle collaboration.</p> <p>The technologies included in this work address areas of mobility, materials, propulsion, signature reduction, modularity, and unmanned systems.</p> <p>FY 2022 Plans:</p>		8.469	8.587	8.246	0.000	8.246

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Research will focus on intelligent mobility technologies to enable greater capability in harsh off road and littoral environments, with efforts including predictive and adaptive mobility testing and demonstration</p> <p>- Progress research to gain a better understanding of the ground interface through terrain characterization and researching enhanced platform effectors that allow the system to adapt to varying terrain approaching in real time, increasing operational tempo</p> <p>- Continue research for amphibious vehicle autonomy through development of components for low-cost robotic autonomy kits (e.g. Sensing & Perception, Planning & Control, Localization, World Modeling and Integration)</p> <p>- Develop sensors and autonomous behaviors to enable combat ground and amphibious vehicles to perform landing zone reconnaissance, create feint and decoys, deploy mine countermeasures, and provide direct/indirect fires for future deployment in contested landing environment through integration of payloads developed under other activities</p> <p>FY 2023 Base Plans:</p> <p>- Continue research that will focus on intelligent mobility technologies to enable greater capability in harsh off road and littoral environments, with efforts including predictive and adaptive mobility testing and demonstration.</p> <p>- Continue progress research to gain a better understanding of the vehicle-ground interface through terrain characterization and researching enhanced platform effectors that allow the system to adapt to varying terrain in near-real time, increasing operational tempo.</p> <p>- Continue research for amphibious vehicle autonomy through development of components for low-cost robotic autonomy kits (e.g. Sensing & Perception, Planning & Control, Localization, World Modeling and Integration)</p> <p>- Continue effort to develop sensors and autonomous behaviors to enable combat ground and amphibious vehicles to perform landing zone reconnaissance, create feint and decoys, deploy mine countermeasures, and provide direct/indirect fires for future deployment in contested landing environment through integration of payloads developed under other activities.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant funding change from FY 2022 to FY 2023.</p>							
<p>Title: Future Concepts, Technology Assessment, And Roadmapping</p> <p>Description: This activity supports the planning and integration of technology development efforts across the entire Program Element (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.</p>			1.385	1.420	2.284	0.000	2.284

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
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 2022 Plans: - Continue to assess technologies and technology concepts that have potential alignment to the Marine Corps Operating Concept (MOC) as well as ability to support both Expeditionary Advanced Basing and Distributed Maritime Operation concepts - Extend development of technology roadmaps, concepts, and holistic systems of systems approaches that fulfill the needs identified in in these concepts - Conduct warfighter workshops and wargaming to understand highest potential for these technologies in order to shape investment priorities. - Create methods and tools for studying the effectiveness of autonomous systems operating in adversarial environments. The effort will allow naval personnel to explore and develop novel human-machine teaming concepts under simulated combat conditions.						
FY 2023 Base Plans: Continue: - Continue to assess technologies and technology concepts that have potential alignment to the Marine Corps Operating Concept (MOC) as well as ability to support both Expeditionary Advanced Basing and Distributed Maritime Operation concepts. - Continue effort to create methods and tools for studying the effectiveness of autonomous systems operating in adversarial environments. The effort will allow naval personnel to explore and develop novel human-machine teaming concepts under simulated combat conditions. - Continue warfighter workshops and wargaming to understand highest potential for these technologies in order to shape investment priorities. - Continue and extend development of technology roadmaps, concepts, and holistic systems of systems approaches that fulfill the needs identified in in these concepts.						
FY 2023 OCO Plans:						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602131M / <i>Marine Corps Lndg Force Tech</i>		Project (Number/Name) 3001 / <i>Marine Corps Landing Force Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The funding increase from FY 2022 to FY 2023 is due to USMC research efforts to assess immediate capability gaps required to compete with near-peer competitors and support Distributed Maritime Operations (DMO), Expeditionary Advanced Base Operations (EABO), Littoral Operations in a Contested Environment (LOCE) and Force Design 2030.						
Accomplishments/Planned Programs Subtotals		43.863	46.062	48.367	0.000	48.367
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602131M / <i>Marine Corps Lndg Force Tech</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	4.827	13.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.827
<p>A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.</p>												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Marine Corps Asset Life-Cycle Management								0.000	1.500			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct applied research supporting Marine Corps Asset Life-Cycle Management												
Congressional Add: Unmanned Logistical Solutions								4.827	7.500			
FY 2021 Accomplishments: The project will develop a littoral sensor perception system to provide our littoral USVs with reliable perception of their littoral environment including other vessels and targets along with bathymetry, wave, surf and current conditions.												
FY 2022 Plans: The project will develop a littoral sensor perception system to provide our littoral USVs with reliable perception of their littoral environment including other vessels and targets along with bathymetry, wave, surf and current conditions.												
Congressional Add: 5G biometric installation access control demonstration								0.000	4.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct applied research supporting 5G biometric installation access control demonstration												
Congressional Adds Subtotals								4.827	13.000			
<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p>												
<p>D. Acquisition Strategy N/A</p>												

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602235N / Common Picture Applied Research							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	42.219	51.477	51.911	-	51.911	54.616	55.709	56.823	57.960	Continuing	Continuing
0000: Common Picture Applied Research	0.000	42.219	51.477	51.911	-	51.911	54.616	55.709	56.823	57.960	Continuing	Continuing

A. Mission Description and Budget Item Justification

Activities and efforts in this program examine concepts and technologies that enable the transformation to Distributed Maritime Operations (DMO). 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 Science and Technology (S&T) investments.

Today's Sailors and Marines are enabled by Naval S&T. Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		PE 0602235N I Common Picture Applied Research			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	43.495	51.477	0.000	-	0.000
Current President's Budget	42.219	51.477	51.911	-	51.911
Total Adjustments	-1.276	0.000	51.911	-	51.911
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.276	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	51.911	-	51.911
Change Summary Explanation					
Funding: No significant change					
Technical: No significant change					
Schedule: No significant change					

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Common Picture Applied Research	0.000	42.219	51.477	51.911	-	51.911	54.616	55.709	56.823	57.960	Continuing	Continuing

A. Mission Description and Budget Item Justification

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 Science and Technology S&T investments.

The activities described in this Program Element (PE) address future Navy and Marine Corps capabilities needed to maintain maritime superiority and ensure national security. They are based on input from Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Office of the Chief of Naval Operations, and Headquarters Marine Corps) and are designed to exploit breakthroughs in science and technology in order to deliver maximum warfighting benefit to our sailors and marines. These efforts are aligned with shared priorities throughout the whole of RDT&E in order to quickly advance new capabilities from discovery to deployment across the warfighting domains.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>Title: Communication and Networks</div><div>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 Radio Frequency (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 RF challenged environments.</div><div>The current specific objectives are:</div></div>	5.952	6.294	6.345	0.000	6.345

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Radios and Apertures:</p> <ul style="list-style-type: none">- 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 Beyond Line Of Sight (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 Radio Frequency (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. <p>Tactical Networking and Network Control/Management:</p> <ul style="list-style-type: none">- 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. <p>FY 2022 Plans:</p> <p>Communication and Networks:</p> <ul style="list-style-type: none">- Continue research on communications with low probability of detection.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Title: Applied Information Sciences for Decision Making		29.059	37.088	37.883	0.000	37.883
Description: The goal of this activity is to develop enablers for decision making and mission execution in order 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, recognizing activities, 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 Communication, Command and Control (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. Applied research in artificial intelligence focuses on the unique challenges of the Naval domain by providing intelligent decision aids while operating in the complex spatio-temporal environments of distributed Naval forces.						
FY 2022 Plans: Quantum Information Sciences: - Complete quantum communication research as it applies to practical approaches to secure key generation that include technologically limited eavesdropper assumptions. - Complete research into interconversion of optical and microwave quantum states for memory and information processing tasks. - Continue research into the application of on-chip optical processing with distributed quantum states of light for suppressing noise for measurement and communication devices. - Initiate research into efficient protocols to implement quantum information processing with atoms and photons.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate research into quantum approaches to solve hard decision problems with naval relevance that may outperform classical techniques.</p> <p>Computational Methods for Decision Making:</p> <ul style="list-style-type: none">- Complete methods for recognition of activities in urban and semi-urban areas from surveillance video based on weakly supervised deep learning techniques.- Complete methods based on probabilistic (and-or) graphs for modeling events and activities toward automated understanding of data acquired by Naval information systems.- Complete methods based on computer vision, deep learning, and reasoning for detection, tracking, and reacquisition of small vessels in (intermittent) aerial surveillance imagery for interdiction of sea-borne smuggling.- Complete efforts of combining priming queues and learning agendas to optimize memory retrieval, resulting in decreased computational effort and a lower memory footprint for missions in the 2-15 year lifetimes. (NRL Input)- Complete efforts to create explainable deep networks within the context of automated surveillance and demonstrating how this approach can be used to locate and explain why something is a potential threat. (NRL Input)- Continue development of methods for robust recognition of activities in surveillance videos based on the integration of plan recognition and short-duration action recognition.- Continue development of methods for large-scale coordination and aggregation of individual preferences.- Continue development of methods for adaptive training on individual and group levels.- Continue development of methods for continuous learning and expertise assessment.- Continue development of mathematical models, theory, and solution methods for most effectively allocating scarce resources (funds, information, personnel, equipment) within competitive environments.- Continue development of methods for Unmanned Aerial Vehicle (UAV)-based video surveillance along roads and rivers that are partially occluded by tree canopies using a marsupial system consisting of a large UAV capable of long-duration flight and several small quadcopters.- Continue analysis of information flow and dynamics of influence in large networks.- Continue development of tools for structured and distributed deliberation and decision-making.- Continue development of secure and privacy-preserving tools for information sharing.- Continue development of visual sense making capabilities for distributed Navy teams to successfully run operations in increasingly contested, diverse, multi-expertise, and highly data driven decisional contexts.- Continue a research emphasis on defender-attacker-defender problems that seek strategies for obtaining resilient operational systems under the threat of attack.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
techniques that can be employed throughout Navy networks that address nation state adversary activities. (NRL Input) Data Analytics: - Continue development of methods for large-scale assessment and evaluation of distributed information. (formerly in Computational Methods for Decision Making) - Initiate/complete Agile Enclave capability transitioning to Consolidated Afloat Networks and Enterprise Services (CANES) Program of Record. The Agile Enclave capability will be deployed to all Navy ships and submarines as an additional enclave to enable effective operations in a Command and Control Denied, Degraded, Environment (C2D2E). - Initiate applied research in optimizing coordination, efficient exchange of information and integration of large amounts of data in real time among distributed operations centers. - Initiate development of an architecture that supports distributed/resilient Maritime Operations Center operations that supports multi-level system with zero trust enforcement. - Initiate development of disseminating data in a prioritized way and under zero-trust conditions between a shore-based multi-level system cloud environment and an on-premise cloud multi-level system at the tactical edge. Science of Artificial Intelligence: - Continue development of principled computational frameworks for integrating domain knowledge and machine learning for fast robust learning of diverse, complex concepts and tasks with light supervision. Domain knowledge includes physical models, as well as rules, relations and semantic descriptions. - Continue efforts exploring a unified framework for perception and planning for resources distributed across multiple platforms (agents, platforms, autonomous systems or vehicle swarms) to exploit the massive, diverse data obtained, while subject to communication limitations. - Continue work on new brain-inspired artificial intelligence algorithms and architectures that provide richer computational capabilities than current deep learning networks and model compact neuromorphic hardware suitable for edge computing and signal processing in Naval platforms. - Initiate research on Artificial Intelligence (AI) for enhanced collaborative complex decision-making, and human-machine dialogue. - Initiate research on embedding AI in robotic systems to enable human-machine collaboration and robot training.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue exploratory research on graphene based vacuum electronics.</p> <p>- Initiate research on electronic effects of "Moire" textures induced by broken symmetry between 2D atomic layers, for example in twisted bilayer graphene capable of assuming a sequence of correlated phases.</p> <p>Cyber Defense:</p> <p>- Complete thrusts into automated cryptographic design exploration.</p> <p>- Continue to conduct applied research toward dependable and resilient cyber systems, leveraging results from basic research program, and developing and evaluating technical approaches for future naval capabilities. The program investigates technologies addressing root causes of cyber vulnerability and enhancing efficiency, robustness and cyber resiliency for all classes of computing systems in naval enterprise systems.</p> <p>- Continue thrust in cyber decoys and disinformation, exploring how to automatically analyze the artifacts from cyber adversary campaigns for noise generation that could degrade and disrupt those campaigns.</p> <p>- Continue design and development of tools and techniques for understanding and improving security of cyber-physical systems, which are a critical area of focus for assuring mission success of naval platforms. The systematic extension of techniques in cyber fault tolerance are informing new resilience architectures for sensor processing systems, which continues to inform future planned follow-on efforts.</p> <p>- Continue efforts to improve the security of lookup and the security of entrance for Internet sites developing subdomain onion addresses for self-authenticating subdomains of registered domains that will work with ordinary browsers and will appear as alt names in Transport Layer Security (TLS) certificates.</p> <p>- Continue development of tools and techniques to model and understand adversary motivation and intent that scale beyond traditional artifact analysis in order to achieve robust, hardened and scalable cyber defense techniques that can be employed throughout Navy networks that address nation state adversary activities.</p> <p>- Initiate design of approaches to apply techniques from signal processing and machine learning to ingestion of granular system events in context of memory structure for advanced understanding of system state that would be more effective at discovering activity of stealthy adversaries.</p> <p>Data Analytics:</p> <p>- Continue development of methods for large-scale assessment and evaluation of distributed information.</p> <p>- Continue applied research in optimizing coordination, efficient exchange of information and integration of large amounts of data in real time among distributed operations centers.</p> <p>- Continue development of an architecture that supports distributed/resilient Maritime Operations Center operations that supports data in multi-level system with zero trust enforcement.</p>						

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Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602235N / <i>Common Picture Applied Research</i>	Project (Number/Name) 0000 / <i>Common Picture Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue development of disseminating data in a prioritized way and under zero-trust conditions between a shore-based multi-level system cloud environment and an on-premise cloud multi-level system at the tactical edge.</p> <p>- Initiate development of advanced data analytics to enable automated and orchestrated threat detection consistent with the DISA Zero Trust Reference Architecture to refine and extend Agile Enclave to provide secure data access in challenging warfighting environments.</p> <p>Science of Artificial Intelligence:</p> <p>- Continue applied research on principled computational frameworks for integrating domain knowledge and machine learning for fast robust learning of diverse, complex concepts and tasks with minimal supervision to analyze the sparse, noise and unlabeled data of the Naval domain.</p> <p>- Continue the application of new brain-inspired artificial intelligence algorithms and architectures for the development of compact neuromorphic hardware suitable for edge computing and signal processing in Naval platforms.</p> <p>- Continue the use Artificial Intelligence (AI) for enhanced collaborative complex decision-making and human-machine dialogue to increase the speed and quality of operational decisions.</p> <p>- Continue research on embedding AI in robotic systems to enable human-machine collaboration and robot training for hazardous missions.</p> <p>- Continue to integrate physical models with machine learning to enable predictive maintenance for autonomous Naval platforms and enable long duration autonomous missions.</p> <p>- Continue to conduct AI-based analysis of data from wearable sensors and task performance measures to monitor and optimize human performance.</p> <p>- Continue research on the ability to enable a humanoid robot to adapt skills learned in one environment or context, to new situations. Cues of the current context, including the environmental state or goals of the robot or its teammates, will modulate the execution of existing robotic skills, such as adjusting the robot's speed.</p> <p>- Initiate applied research to design embedded neuromorphic processors into intelligent autonomous systems to permit onboard analysis of target data to enable single-pass mine countermeasures missions.</p> <p>- Initiate applied research to validate AI algorithms to provide distributed perception in networks of interacting autonomous agents in the presence of varying levels of reliability and trust at both network and individual agent.</p> <p>- Initiate applied research on AI tools for multi-level optimization of shipyard maintenance scheduling to accelerate on time delivery of ships out of maintenance and improve ship availability and fleet readiness.</p> <p>- Initiate research techniques for training AI to perform tasks from human behavior and natural language instruction.</p>					

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Electromagnetic Warfare: - Continue the development and demonstration of a novel Electronic Attack (EA) capability. It will accomplish this by enhancement of a suite of Radio Frequency (RF) signature-related technologies. The result will provide a new capability to counter advanced threats. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Title: Multi-Source Integration and Combat Identification 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. FY 2022 Plans: Electromagnetic Warfare: - Complete efforts into discovering features of ship signatures vulnerable to certain threat detections and determine how to mitigate these. - Continue research into the use of models to determine the enhanced radar cross section of HVV and provide improved prediction and interpretation from HVV flights for early detection/identification and performance evaluation of these vehicles. - Continue research into efficient broadband two-dimensional high frequency transmit arrays for Over-The-Horizon (OTH) Radar. This will enable two dimensional transmit beam steering, adaptive transmit side lobe control and reduced prime power requirements for long range detection of objects in the environment. FY 2023 Base Plans: Electromagnetic Warfare:		1.665	1.870	1.774	0.000	1.774

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete research into the use of models to determine the enhanced radar cross section of Hyper Velocity Vehicles (HVV) and provide improved prediction and interpretation from HVV flights for early detection/identification and performance evaluation of these vehicles.</p> <p>- Complete efforts into efficient broadband two-dimensional high frequency transmit arrays for Over-The-Horizon (OTH) Radar. This will enable two dimensional transmit beam steering, adaptive transmit side lobe control and reduced prime power requirements for long range detection of objects in the environment.</p> <p>- Initiate development of sensors and sensor networks to locate and track any target of interest in the Maritime Domain.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Tactical Space Exploitation</p> <p>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.</p> <p>To perform early-applied discovery Research and Development (R&D) to ensure Navy-Marine Corps access to critical space-associated capabilities on the ground, at sea, and in a contested space environment; research thrusts include spacecraft R&D in five strategic cross-cutting areas that lead to the fielding of systems which perform functions critically important to operations. These areas are: (1) Advanced Space Platform Technologies, such as development of new and prototype space systems that are tailored to specific threats, including technologies which reduce cost, mass, power and/ or extend on-orbit lifetimes, and sub-systems that advance propulsion and control capabilities towards precision maneuvering while minimizing fuel; (2) Next-generation Payloads and Sensors, including space robotic capabilities to address on-orbit inspection, servicing, repair, assembly, and mission life extension; (3) Connectivity for disadvantaged users that is rugged, high-bandwidth and space based; (4) Space Weather, and (5) Space Situational Awareness.</p> <p>FY 2022 Plans:</p>		5.543	6.225	5.909	0.000	5.909

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Space Research and Spacecraft Technology: - Complete the development and validation of models of cathode breakdown and plasma formation to demonstrate reliable, repeatable cathode ignition using plasma heating, which will benefit the Navy by enabling instant ignition within seconds for responsive, low-power operation aboard highly mobile small satellites. - Complete the development of a Global Positioning System (GPS)-denied satellite autonomous navigation system that can operate for years with no input from operators or external systems and still perform a useful mission; and the development of a simulation tool capable of predicting the change in the aerodynamic performance of hypersonic vehicles after impact with atmospheric cloud formations over a range of mission scenarios and weather conditions. - Complete effort towards the successful completion of a robotic assembly task using a formally stable haptic feedback scheme in the presence of communication latency that allows an operator to feel how the robot is moving, rather than rely only on camera views or simulations. FY 2023 Base Plans: Space Research and Spacecraft Technology: - Initiate early-applied discovery Research and Development (R&D) to ensure Navy-Marine Corps access to critical space-associated capabilities on the ground, at sea, and in a contested space environment. Research thrusts include space related R&D in three strategic cross-cutting areas that lead to the fielding of systems which perform functions critically important to Naval operations and addressing Navy/Marine Corps current and future needs and requirements. These areas are: 1) Advanced space technologies, such as development of new prototype and exploratory space systems that are relevant to maritime navigation, maritime domain awareness, and distributed maritime operations (DMO), including technologies which reduce cost, mass, power. 2) Next-generation payloads and sensors, including space-based environmental monitoring instruments and on-orbit autonomous calibration and/or data processing addressing the DON's Electromagnetic Environment (EME) needs. 3) Connectivity for disadvantaged maritime and littoral users that is rugged, high-bandwidth and space based. - Initiate efforts for the development and demonstration of new measurement and data assimilation capabilities to predict phenomena that influence Over-the-Horizon Radar (OTHR) and communication, which will advance OTHR related capabilities and communication avenues.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate research efforts for the development of robust and reliable hypersonic air breathing platforms. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Accomplishments/Planned Programs Subtotals		42.219	51.477	51.911	0.000	51.911
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research					PE 0602236N I Warfighter Sustainment Applied Res							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	112.119	117.738	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing
0000: Warfighter Sustainment Applied Res	0.000	64.333	69.488	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing
9999: Congressional Adds	0.000	47.786	48.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	96.036

A. Mission Description and Budget Item Justification

U.S. Sailors and Marines underpin all missions. Advances in Artificial Intelligence (AI) enabled decision aides, autonomy, human-machine training, augmented performance, command and control and protective equipment will ensure their advantage in a complex, maritime environment. This Program Element (PE) conducts applied research to address Warfighter protection and performance concerns, including efforts that focus on advanced Naval materials, biocentric technologies, decision support, intelligent and autonomous systems, human performance optimization, training and education technologies, social and cultural science, and biomedical technologies. This PE also supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of Naval basic and applied research, and advanced technology development investments to ensure Naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602236N I <i>Warfighter Sustainment Applied Res</i>
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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	116.051	70.547	0.000	-	0.000
Current President's Budget	112.119	117.738	70.957	-	70.957
Total Adjustments	-3.932	47.191	70.957	-	70.957
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-1.059			
• Congressional Rescissions	-	-			
• Congressional Adds	-	48.250			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.393	0.000			
• SBIR/STTR Transfer	-3.541	0.000			
• Rate/Misc Adjustments	0.002	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	70.957	-	70.957

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

Project: 9999: *Congressional Adds*

Congressional Add: *Lightweight anti-corrosion nanotechnology coating enhancement*

Congressional Add: *Polymer coatings for reduced ice and fouling adhesion*

Congressional Add: *force Health Protection and Application*

Congressional Add: *Health and Safety Research of Underground Fuel Storage Facilities*

Congressional Add: *Human Performance and injury Rehabilitation Assessment tool*

Congressional Add: *Humanoid Robotics in Unstructured Environments*

Congressional Add: *Engineered Systems to Preserve and Restore Hearing After Deleterious Stimulation*

Congressional Add: *Hypersonics Material Acceleration*

Congressional Add: *Laser Peening Technology for Submarine and Carrier Shafts*

Congressional Add: *Physics Based Neutralization of Threats to Human Tissues and Organs*

Congressional Add: *Social Networks and Computational Social Science*

Congressional Add: *Warfighter as a System Human Digital Twin Research*

Congressional Add: *Advanced nanocomposite coatings*

Congressional Add: *Anticorrosion nanotechnology*

Congressional Add: *Development of chromate-free corrosion inhibitor coatings for marine application*

FY 2021	FY 2022
4.827	0.000
4.827	5.000
4.827	0.000
4.827	5.000
2.413	0.000
4.827	0.000
4.827	0.000
3.861	5.000
2.896	0.000
4.827	5.000
1.931	0.000
2.896	0.000
0.000	6.000
0.000	7.500
0.000	1.750

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>		R-1 Program Element (Number/Name) PE 0602236N / <i>Warfighter Sustainment Applied Res</i>	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2021	FY 2022
Congressional Add: <i>Engineered systems to preserve and restore hearing</i>		0.000	5.000
Congressional Add: <i>Human digital twin</i>		0.000	3.000
Congressional Add: <i>High mobility ground robots to assist dismounted infantry in urban operations</i>		0.000	5.000
Congressional Add Subtotals for Project: 9999		47.786	48.250
Congressional Add Totals for all Projects		47.786	48.250
<u>Change Summary Explanation</u>			
Funding: No significant change.			
Technical: No significant change.			
Schedule: No significant change			

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Warfighter Sustainment Applied Res	0.000	64.333	69.488	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing
A. Mission Description and Budget Item Justification U.S. Sailors and Marines underpin all missions. Advances in AI-enabled decision aides, autonomy, human-machine training, augmented performance, command and control and protective equipment will ensure their advantage in a complex, maritime environment. This Program conducts applied research to address Warfighter protection and performance concerns, including efforts that focus on advanced Naval materials, biocentric technologies, decision support, intelligent and autonomous systems, human performance optimization, training and education technologies, social and cultural science, and biomedical technologies. This PE also supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Advanced Naval Materials Description: Advanced Naval Materials efforts support several Science and Technology (S&T) Focus Areas, in particular Platform Design & Survivability, and perform research across a broad spectrum of technical areas including: structural materials to increase platform performance and survivability at reduced weight and cost; advanced, high-performance materials for energy systems; corrosion mitigation strategies; high-temperature propulsion systems; and enhanced sonar transducers. FY 2022 Plans: Materials: - Conduct research to build Agile Manufacturing - Integrated Computational Materials Engineering (ICME) toolkit infrastructure. - Conduct ongoing research efforts to improve affordability and reliability of piezoelectric transduction materials. - Conduct research to develop advanced structural alloys and composites, joining and repair technologies. - Conduct research to pursue commercially viable processing for nano-engineered materials, including ceramics, metals, and materials systems. - Continue development of new, advanced, environmentally benign Anti-Fouling (AF)/Anti-Corrosive (AC) coating systems for Navy platforms. Sustainment & Logistics:								15.948	17.889	17.679	0.000	17.679

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Conduct applied research to investigate corrosion control modeling, high performance longer-life corrosion resistant coatings, compositionally complex alloys, and corrosion resistant additive manufactured components.</p> <p>Manufacturing:</p> <p>- Develop manufacturing technology to help accelerate capability to the fleet in areas such as high-energy laser (HEL) weapons, advanced electronic warfare, electronics technology for navigation and electronic controls for unmanned vehicles.</p> <p>- Continue efforts focused on demonstrating the deposition of quality carbon phosphonitride materials for liquid-based additive manufacturing techniques tailored for use in true 3-D direct write processes. Efforts will enable this technology to produce inexpensive, high quality parts; and demonstrating that next generation TBCs can be optimized to meet 20-year survivability requirements for use in a marine diesel environment to support an increase in operating temperatures from 500 to 800 degrees Celsius.</p> <p>Materials and Chemistry:</p> <p>-Continue Ongoing efforts include designing new microfluidic system for direct write additive manufacturing to significantly improve the existing techniques.</p> <p>- Continue efforts to determine thermal barrier coating (TBC) degradation mechanisms and susceptibility and apply that understanding to optimize TBCs for marine use and enable long service-life applications in severe environments.</p> <p>FY 2023 Base Plans:</p> <p>Materials:</p> <p>- Continue research on Agile Manufacturing - Integrated Computational Materials Engineering (ICME) toolkit infrastructure to establish and fully utilize a naval laboratory based capability to develop and predict performance of materials and components in an agile and accelerated manor to speed technology delivery and reduce qualification costs.</p> <p>- Continue ongoing research efforts to improve affordability and reliability of piezoelectric transduction materials. The focus will be on Acoustic Transduction Materials Technology to reduce SWaP and improve sensitivity of sensors and SONAR.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue research to develop advanced structural alloys and composites, joining and repair technologies.</div> <div>- Continue research to pursue commercially viable processing for nano-engineered materials, including ceramics, metals, and materials systems. The focus will be on Nanostructured Materials Processing aimed at improved resilience of naval systems and platforms and capabilities for producing novel, high performance components;</div> <div>- Complete development of new, advanced, environmentally benign Anti-Fouling (AF)/Anti-Corrosive (AC) coating systems for Navy platforms.</div> <div>- Advance materials, processes and capabilities. Current efforts are focused on development of a high thermal conductivity later for high power electronic device application to improve performance.</div> <div>Sustainment & Logistics:</div> <div>- Continue applied research to investigate corrosion control technologies through investigation of corrosion inhibitor performance for coatings and corrosion mechanisms of compositionally complex alloys (CCA) and additive manufactured materials.</div> <div>Naval Power Systems:</div> <div>- Continue to advance applied research efforts to support development of naval materials in support of naval power systems.</div> <div>Platform Design and Engineering:</div> <div>- Continue to advance applied research efforts to support development of naval materials in support of naval platforms.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>There is no significant change from FY 2022 to FY 2023.</div>						
Title: Biocentric Technologies		10.089	8.395	9.328	0.000	9.328
Description: Applied research to develop knowledge and technologies for future Naval capabilities. Research areas include: bioinspired and biomimetic materials; synthetic biology for environmental surveillance and materiel production; bioenergy harvesting and electronics; warfighter augmentation and resilience; and marine mammal health. This research provides secure and agile options to enhance performance, increase novel power						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and energy solutions to safely extend operational duration, and improve stealth, maneuverability, and mission capability of platforms and autonomous systems.							
FY 2022 Plans: Bio-Inspired Autonomous Systems: <ul style="list-style-type: none">- Conduct applied research on bio-inspired underwater vehicle propulsion and control.- Mature advanced search behaviors for autonomous vehicles.- Integrate sonar and image processing into a bio-inspired unmanned vehicle to evaluate obstacle detection and avoidance in congested spaces and neutralization maneuvers.- Applied research on bio-inspired cross-domain vehicles for amphibious and sea/air transitions. Human Interaction with Autonomous Systems and Human-Machine Teaming: <ul style="list-style-type: none">- Conduct applied research to develop agile humanoid and quadruped robot teammates. This includes incorporation of computer vision, acoustic localization, reasoning and human communication.- Applied research on training mission-capable robots to perform complex manipulation skills essential for shipboard and urban operations.- Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants. Biocentric Technology: <ul style="list-style-type: none">- Conduct studies of prebiotic food additives/probiotics for effects on microbiome and performance enhancement in human subjects, including divers and combat swimmers.- Develop gut microbiome-based tools to predict individual response to prebiotics for stress resilience.- Develop strategies to incorporate programmable microbial sensors for environmental monitoring into relevant Naval platforms (e.g., for non-acoustic anti-submarine warfare (ASW) or handheld devices for divers).- Initiate efforts to scale up production of biogenic mineral nanomaterials. Important for securing supply chain for electronic materials and microelectronic device fabrication.- Research effects of sample source and rapid dilution on marine environmental DNA sequencing for monitoring undersea environments.- Applied research to focus on deployment of benthic microbial fuel cells in deep water marine environments and testing the ability to power new devices (e.g., distributed mine systems, position-navigation-timekeeping transponders for unmanned underwater vehicles (UUVs)).							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Bioengineering and Life Sciences:</p> <ul style="list-style-type: none">- Conduct applied research to develop a sandcastle worm inspired adhesive effective in seawater with an on-demand curing mechanism.- Conduct applied research to determine the role of lung membrane integrity in marine mammal respiratory diseases; establish therapeutics to prevent kidney stone formation in dolphins; facilitate surveillance of marine mammal viral pathogens in marine waters and indigenous mussels/oysters/clams; and implement dolphin vocalizations as a tool for diagnosing their well-being.- Establish highly efficient proton exchange membrane fuel cells. <p>Warfighter Augmentation & Resilience:</p> <ul style="list-style-type: none">- Conduct applied research in bio-inspired light polarization sensors and machine learning methods for predicting underwater geolocation and developing technology for underwater image dehazing.- Develop technologies to monitor and protect diver from environmental stressors such as temperature, pressure, and limited visibility and resources.- Identify predictors of critical health and safety threats to divers through advanced physiological monitoring and algorithm development.- Support development of manned-unmanned teaming platforms to aide a diver in enhanced situational awareness and to expand diving windows of opportunity by eliminating current limitations such as restricted access (cold, depth, space), visibility, and gas supply. <p>Materials and Chemistry:</p> <ul style="list-style-type: none">- Continue the develop a semi-automated assay system that will enable our transition partners, the Naval Medical Research Center and Naval Medical Research Unit laboratories, to rapidly identify antibiotic resistance genes in bacterial pathogens of importance to the U.S. military. The science, technology and resulting system will contribute directly to warfighter health, performance and survivability. <p>FY 2023 Base Plans:</p> <p>Bio-Inspired Autonomous Systems:</p> <p>Continue:</p> <ul style="list-style-type: none">- Conduct applied research on bio-inspired underwater vehicle propulsion and control.- Mature advanced search behaviors for autonomous vehicles.- Applied research on bio-inspired cross-domain vehicles for amphibious and sea/air transitions.							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Complete:</p> <p>- Exploration of bio-inspired sonar integrated onto autonomous underwater vehicles for obstacle avoidance in congested waters.</p> <p>Initiate:</p> <p>- Integrate advanced flexible batteries into artificial muscle-based prototype underwater vehicle for field testing of speed and duration.</p> <p>Human Interaction with Autonomous Systems: (This thrust has been realigned to the Human Factors and Organizational Design Activity of this PE. The research has a human-machine teaming focus, which aligns better with the objectives of the Human Factors and Organizational Design Activity.)</p> <p>Naval Biosciences and Synthetic Biology for Naval Applications: (This thrust was previously part of the Biocentric Technology FY22 Plan. The name was changed to more accurately describe the research.)</p> <p>Continue:</p> <p>- Develop strategies to incorporate programmable microbial sensors for environmental monitoring into relevant Naval platforms.</p> <p>- Applied research focusing on deployment of self-burying, benthic microbial fuel cells at various depths to power new devices (e.g., a semi-submersible autonomous underwater vehicle (AUV)).</p> <p>Complete:</p> <p>- Conduct studies of prebiotic food additives/probiotics for effects on microbiome and performance enhancement in human subjects, including divers and combat swimmers.</p> <p>- Develop gut microbiome-based tools to predict individual response to prebiotics for stress resilience.</p> <p>- Efforts to scale up production of biogenic mineral nanomaterials.</p> <p>Initiate:</p> <p>- Applied research in bio/bio-inspired materials for multi-spectral camouflage.</p> <p>- Applied research in bioengineering systems for the bioproduction/biodegradation of military relevant materials.</p> <p>Bioengineering and Life Sciences:</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Continue: - Conduct applied research to determine the role of lung membrane integrity in marine mammal respiratory diseases; establish therapeutics to prevent kidney stone formation in dolphins; facilitate surveillance of marine mammal viral pathogens in marine waters and indigenous mussels/oysters/clams, and implement dolphin vocalizations as a tool for diagnosing their well-being. Complete: - Development of a sandcastle worm inspired adhesive effective in seawater and transition it to a Future Naval Capability Program focused on seawater curing adhesive technologies for pier side replacement, or repair, of tiles on outer submarine hulls. - Applied research establishing highly efficient proton exchange membrane fuel cells for transportation applications, which improved their overall performance through catalyst and support engineering. Initiate: N/A Warfighter Augmentation and Resilience: Continue: - Conduct applied research in bio-inspired light polarization sensors and machine learning methods for predicting underwater geolocation and developing technology for underwater image dehazing. - Develop technologies to monitor and protect diver from environmental stressors by maturing and validating models that capture a human diver's heat loss and the ability of various wetsuit designs to provide thermal protection. - Support development of manned-unmanned teaming platforms to aide a diver in enhanced situational awareness and to expand diving windows of opportunity by eliminating current limitations such as restricted access (cold, depth, and enclosed spaces), visibility, and gas supply. Complete: - Research on feasibility of sensor development for oxygen toxicity. This resulted from the ongoing FY22 and FY23 plan to continue identifying predictors of critical health and safety threats to divers through advanced physiological monitoring and algorithm development. Initiate:								

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Create new oxygen-generating and carbon dioxide-disposing diving mask that would replace existing rebreathers.</p> <p>- Applied gas channel research in the context of respiratory fitness and/or potential mitigation strategies for targeted gas management.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to an increased investment in microbial fuel cell research to power platforms and devices (e.g., a semi-submersible autonomous underwater vehicle (AUV) and networked sensors to monitor undersea environments).</p>							
<p>Title: Human Factors and Organizational Design</p> <p>Description: Operational and tactical level decision-making requires making time-critical decisions with imperfect information. This activity seeks to understand how warfighters make decisions despite uncertainty, and research practical strategies for managing information for Naval warfighter decision-making. These applied research efforts will improve mixed social-technical systems design, system interface designs and human-level decision support in Naval contexts. Research areas include the development of techniques to enhance warfighter performance in managing complex, strategic tasks, human-human, human-machine teaming, and decision-making and execution in human and human-machine hybrid teams. These objectives support improvement of managing complex warfighting problems.</p> <p>FY 2022 Plans: Cognitive Science for Human-Machine Teaming and Computational Neuroscience: - Incorporate realistic neural systems into autonomous systems for more robust on-board perception and intelligence. - Conduct applied research on system interface designs and human-machine interaction methodologies that enable or enhance Naval Warfighter performance and human-machine teaming. This includes psychoacoustics and audio-visual scene interpretation implemented in computational models that serve as the front end for cognitive architectures. - Construct new perceptual models for intelligent autonomous systems.</p>			5.555	5.948	6.018	0.000	6.018

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Conduct applied research to develop agile humanoid robot teammates with enhancements including: (i) Embedding computer vision with visual-spatial reasoning; (ii) Auditory systems to enable human communication; and (iii) Neuromorphic (brain-like) processors.</p> <p>- Conduct applied research to train mission-capable robots to perform complex manipulation tasks, integrated with self-learning.</p> <p>- Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants.</p> <p>Social Networks and Computational Social Science:</p> <p>- Conduct applied research in information environment assessment, civil-military communications (public affairs), information operations and strategic communication.</p> <p>- Develop improved course of action guidance and capabilities to detect and defuse: disinformation, social hysteria and group polarization campaigns.</p> <p>- Improve efforts to study effective methods for training military personnel operating in the information environment to discover, monitor, and counter adversarial maneuvers in digital and social media.</p> <p>Command Decision Making:</p> <p>- Explore how to explain recommendations and characterize uncertainty for recommendations derived from Machine Learning (ML) algorithms.</p> <p>- Initiate applied research for a knowledge/skill brokering system that can detect individual knowledge weaknesses / gaps related to task performance and deliver tailored training tutorials as job aids.</p> <p>- Conduct applied research to assist with authoritative and peer-to-peer curation of community generated multi-media content and fusion with authoritative sources.</p> <p>- Conduct research on team composition and social decision-making in order to design Naval decision tools that have reduced risk of human decision biases (e.g. implicit bias, preconceived notions, and social pressure).</p> <p>- Conduct Human System Integration research activities in areas of human factors engineering and physical design layout (habitability, safety, personnel survivability) of naval platforms in order to understand best possible conditions for effective decision-making Naval settings.</p> <p>FY 2023 Base Plans:</p> <p>Cognitive Science for Human-Machine Teaming and Computational Neuroscience:</p> <p>Continue:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Incorporate realistic neural systems into autonomous systems for more robust on-board perception and intelligence.</p> <p>- Conduct applied research on system interface designs and human-machine interaction methodologies that enable or enhance Naval Warfighter performance and human-machine teaming. This includes psychoacoustics and audio-visual scene interpretation implemented in computational models that serve as the front end for cognitive architectures.</p> <p>- Conduct applied research to develop agile humanoid robot teammates with enhancements including: (i) Embedding computer vision with visual-spatial reasoning; (ii) Auditory systems to enable human communication; and (iii) Neuromorphic (brain-like) processors.</p> <p>- Conduct applied research to train mission-capable robots to perform complex manipulation tasks, integrated with self-learning.</p> <p>Complete:</p> <p>- Construct new perceptual models for intelligent autonomous systems.</p> <p>Initiate:</p> <p>- Integrate vision and language for learning and communication in human-agent systems.</p> <p>Social Networks and Computational Social Science:</p> <p>Continue:</p> <p>- Conduct applied research in information environment assessment, civil-military communications, humanitarian assistance / disaster relief, information operations and strategic communication.</p> <p>- Conduct research to support improved course of action guidance and capabilities to detect and defuse disinformation, social hysteria, and group polarization campaigns.</p> <p>- Refine studies to develop effective tactics, techniques and procedures for military personnel operating in the information environment to discover, monitor and counter adversarial maneuvers in digital and social media.</p> <p>Complete:</p> <p>- Course of action guidance to detect and defuse disinformation, social hysteria and group polarization campaigns.</p> <p>Initiate:</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Applied research to explore socio-technical techniques and social decision making to affect stance, perception, identity and behavior of target audiences.</p> <p>Command Decision Making: Continue:</p> <p>- Research to automate and display recommendations and characterize uncertainty, derived from Machine Learning (ML) algorithms.</p> <p>Complete:</p> <p>- Applied research for a knowledge/skill brokering system that can detect individual knowledge weaknesses / gaps related to task performance and deliver tailored training tutorials as job aids.</p> <p>- Conduct applied research to assist with curation of community generated multi-media content and fusion with authoritative sources.</p> <p>Initiate:</p> <p>- Research automation algorithms for managing Man-Machine teaming & Scalability of Control to large numbers of autonomous entities (robots / swarms).</p> <p>- Applied research for a Collaborative Artificial Intelligence (Collaborative AI) decision support tool that allows AI to learn from human command and control tasks.</p> <p>Human Interaction with Autonomous Systems: (This thrust has been realigned from the Biocentric Technologies to the Human Factors and Organizational Design Activity of this PE. This research has a human-machine teaming focus, which aligns better with the objectives of the Human Factors and Organizational Design Activity.)</p> <p>Continue:</p> <p>- Conduct applied research to develop agile humanoid and quadruped robot teammates. This includes incorporation of computer vision, acoustic localization, reasoning and human communication.</p> <p>- Applied research on training mission-capable robots to perform complex manipulation skills essential for shipboard and urban operations.</p> <p>- Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants. This effort was previously described under Cognitive Science for Human-Machine Teaming and Computational Neuroscience, but aligns more closely to the objectives of Human Interaction with Autonomous Systems.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Initiate: - Incorporate cognitive architectures and visual reasoning on robotic teammates to enable enhanced cooperative behaviors.						
Naval Team Performance and Design: (This thrust was previously part of the Command Decision Making FY22 plan.) Continue: - Conduct research on team composition and social decision-making in order to design Naval decision tools that have reduced risk of human decision biases (e.g., implicit bias, preconceived notions, and social pressure). - Conduct Human System Integration research activities in areas of human factors engineering and physical design layout (habitability, safety, personnel survivability) of naval platforms in order to understand best possible conditions for effective decision-making Naval settings.						
Complete: N/A						
Initiate: - Conduct research on team composition, human factors, and decision making in order to design naval decision tools and processes that have reduced risk of human decision biases and heuristics as well as human performance errors related to combat/operational stress.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.						
Title: Human Research Protection Program (HRPP)		2.652	2.766	2.798	0.000	2.798
Description: The Federal Policy for the Protection of Human Subjects is codified in the Department of Defense (DoD) as part 219 of title 32, Code of Federal Regulations (also known and hereinafter referred to as the "Common Rule"). DoD Instruction 3216.02 establishes policy and assigns responsibilities for the protection of human subjects in DoD-supported programs to implement the Common Rule and requires Heads of DoD Components to establish and oversee DoD Component policies and procedures that ensure compliance with federal and DoD requirements. The Secretary of the Navy Instruction (SECNAVINST) 3900.39E CH-1 identifies						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
the Chief of Naval Research as providing support and expertise for human research protection in research conducted or supported by the Navy and Marine Corps Systems Commands and institutions, operational forces, training Commands, and Department of the Navy (DON)-supported research involving human subjects performed by non-DoD institutions. The Human Research Protection Program (HRPP) protects the rights, safety, and welfare of human subjects in research conducted or sponsored by the Navy and Marine Corps by: 1) ensuring that research involving human subjects complies with federal regulations, DoD Directives, DON Instructions, and Marine Corps Orders governing research protection requirements; and 2) providing education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, management, or support of DON human subjects research (HSR).							
FY 2022 Plans: - Develop Research Protection Community of Excellence; establish 5 new HRPPs; finalize SECNAVINST 3900.39F; Program Management of the DON Research Protections Information Technology Management System for management and compliance oversight of ongoing human research protections activities; provide training for updated DoDI 3216.02, provide education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, support or management of DON HSR; provide subject matter expertise and guidance on all DON-supported research involving human subjects.							
FY 2023 Base Plans: Continue: - Establish five new human research protection programs (HRPP). - Program Management of the DON Research Protections Information Technology Management System for management and compliance oversight of ongoing human research protections activities. - Continue providing education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, support or management of DON human subjects research. - Provide subject matter expertise and guidance on all DON-supported research involving human subjects.							
Complete: - Complete revisions of all DON-authored modules hosted on the Collaborative Institutional Training Initiative (CITI) Program. - Complete finalization of draft SECNAVINST 3900.39F and submit for coordination. The revised SECNAVINST 3900.39F will implement recent updates to the revised Common Rule and DoD Instruction 3216.02, thereby ensuring compliance across the navy and Marine Corps research enterprise.							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Initiate: - Develop the Research Protection Community of Excellence to share best practices across the DON research protection enterprise. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.							
Title: Medical and Human Performance Technologies Description: This Activity will be described in two categories to better explain the program areas related to medical and human performance research. The objective of this activity is to sustain, extend, enhance, and repair warfighter endurance, resiliency and readiness while operating in multi-domain and expeditionary environments. Efforts categorized as Human Performance Technologies focus on research before injury. Efforts categorized as Medical Technologies focus on research after injury. The human performance portion of this applied research activity focuses on: improving performance of divers and submarine crews; developing biological markers of stress response; protecting warfighter performance and preventing injuries during exposure to high levels of acoustic or electromagnetic energy; and wearable physiological sensors to support safety and survivability of Naval forces during training and in operational environments. Results from this research will also be translated into operational safety guidelines. The medical portion of this applied research activity focuses on: protecting warfighters from operational health threats; developing diagnostic and treatment capabilities for use in operational environments; and prototyping new capabilities to recover injured warfighters. This research will improve the Fleet's ability to save lives, especially during prolonged field care. FY 2022 Plans: Medical Technologies: - Explore novel technologies including: (i) Nanotechnologies, microelectronics and autonomous materials and systems for improved casualty care; (ii) Non-invasive sensors in casualty prevention and treatment; and (iii) Novel designs of protective equipment for maritime casualty prevention.			5.582	8.691	8.790	0.000	8.790

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div><div>- Conduct applied research to improve casualty care with autonomous or 'smart' materials and systems during distributed maritime operations ashore and afloat. Mature application and treatment methods for novel anti-infectives for improved wound care.</div><div>- Use modeling, microelectronics and novel composite materials for biomedical sensing and therapeutic care in wearable designs, such as protective equipment to ensure optimal performance, prevent harm and equip the DON to provide the best care for its warfighters.</div></div><div>Human Performance Technologies:<div><div>- Conduct applied research to develop noise exposure and mitigation strategies, including improving and evaluating personal protective equipment, communication technologies, noise exposure estimations, and sound localization.</div><div>- Applied research to determine biomedical effects and diagnostics of electromagnetic energy exposures.</div><div>- Applied research to develop countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and supplement metabolic diver energy requirements to advance safe and optimized performance.</div><div>- Applied research to develop human physiologic and biologic sensors for real-time monitoring of performance status in training and operational environments.</div><div>- Continue to mature efforts by field testing of technological solutions in multi-domain environments for ruggedizing technological solutions in multi-domain environments.</div><div>- Integrate applied efforts with autonomous air and sea-based platforms for monitoring solutions in forward deployed operators.</div><div>- Applied research in the development of technology enabling the Fleet's ability to save lives, especially during prolonged field care. Efforts will focus on human physiologic and biologic sensors for real-time monitoring of performance status in training and operational environments. - Develop advanced algorithms using existing "big" medical data collected from humans (all continuous vitals data, drugs given, etc.) for autonomous triage of personnel in mass casualty scenarios. These capabilities will enable field medics to immediately treat and triage patients, increasing survival rates from historically non-survivable injuries and environments.</div><div>- Continue applied research efforts to reduce high performance tactical aircraft jet noise through the evaluation of Noise Reduction Concepts, for human protection.</div><div>- Develop lab scale capability to investigate jet noise at afterburner conditions.</div><div>- Explore active control approaches through advanced analytics and simulations.</div></div></div></div>						
FY 2023 Base Plans:						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Medical Technologies:</p> <p>Continue:</p> <ul style="list-style-type: none">- Explore use of novel technologies including: nanotechnologies, microelectronics, artificial intelligence, non-invasive sensors, multifunctional materials and systems and protective equipment for improved warfighter survivability.- Mature application and treatment methods for novel anti-infectives for improved wound care.- Use modeling, microelectronics and novel composite materials for biomedical sensing and therapeutic care to prototype equipment (e.g., helmet system) to protect, sense, respond, and enhance human performance.- Conduct applied research to improve casualty care using autonomy and 'smart' systems with a focus on autonomous recovery of impaired/injured personnel during operations ashore and afloat. <p>Complete: N/A</p> <p>Initiate:</p> <ul style="list-style-type: none">- Translate physics-based principles to prototypes for measuring material properties of biological tissues. <p>Human Performance Technologies:</p> <p>Continue:</p> <ul style="list-style-type: none">- Conduct applied research to develop noise exposure and mitigation strategies, including communication technologies, sound localization, and noise mitigation strategies.- Applied research to determine biomedical effects of electromagnetic energy exposures.- Applied research to identify and validate countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and maintain a healthy metabolic balance for diver energy requirements to advance safe and optimized performance.- Applied research to develop novel biological sensors that autonomously monitor warfighter performance and physiology (e.g., analytes, blood pressure, heart rate, arterial saturation) in real-time.- Applied research to reduce high performance tactical jet noise through the evaluation of Noise Reduction Concepts.- Develop lab scale capability for the purpose of investigating jet noise at afterburner conditions.- Applied research to investigate approaches to excite natural instability wave of the jet flow. <p>Complete:</p>							

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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				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- The following effort resulted from the FY22 plan to continue applied research to develop countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and supplement metabolic diver energy requirements to advance safe and optimized performance. The completed portion of this effort includes research on the ketogenic diet and supplementation transitioned to advanced development.</p> <p>- Research to develop diagnostic tools for identification of auditory injuries.</p> <p>- Transition successful novel biological and physiological sensor prototypes for performance and task-based outcomes to advanced development.</p> <p>Initiate:</p> <p>- Research on the feasibility of new underwater ultrasound devices to generate individualized and deterministic decompression profiles.</p> <p>- Applied research for the feasibility of providing spatial auditory information to enhance understanding of visual events occurring in operational settings.</p> <p>- Research to validate stress reactivity predictors in a military population to support the development of a performance prediction tool.</p> <p>- Explore large data sets of human biology and physiology to enhance algorithms underlying human performance sensor technologies.</p> <p>- Research studies on using the afterburner to reduce noise during take-off.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>							
<p>Title: The Office of Naval Research Global</p> <p>Description: Supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners.</p> <p>Science Advisors (SA) This effort ensures that the operational Naval fleet/force help shape the DON investment in science and technology (S&T), develops teaming relationships to rapidly prototype, experiment, demonstrate and transition</p>			19.777	20.833	21.321	0.000	21.321

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>technology, supports development of technology-based capability options for Naval forces, and enables warfighting innovations based on technical and conceptual possibilities. The SA Program also informs capability-based war games using current and future technology to identify future capability strengths and shortfalls that assist in shaping the DON investment strategy. The ONR Global SA Program enables continuous communication and collaboration between the warfighters, the Naval Research & Development Enterprise, and strategic development commands.</p> <p>International science</p> <p>The ONR Global mission is also accomplished through PhD-level scientists located in Asia, Europe and South America, providing coverage in these regions as well as Africa, Australia/New Zealand and the Middle East. ONR Global scientists actively search the globe for emerging scientific research and promising technologies, collaborating with international organizations and researchers through liaison visits and grants in innovative applied research. The direct impact of this investment is to leverage international research during increasingly dynamic global interdependence and improve the ability to solve DON S&T challenges through shared knowledge and technologies with partners. In addition, 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.</p> <p>International engagement</p> <p>ONR Global also supports international engagement with partner nations through the development and maintenance of bilateral and multilateral relationships, international agreements, and other activities that promote RDT&E collaboration and interoperability.</p> <p>FY 2022 Plans:</p> <p>- Support all Science Advisor program efforts across Fleet and Forces Commands; objectively assess placement of current Science Advisors and requests for additional support in terms of impact to the Fleet and S&T return on investment. The increase will allow the flexibility of hiring approximately 1 additional science advisor.</p> <p>- Support PhD-level scientists, in multiple overseas offices (Asia, Europe, South America and Australia, Africa and the Middle East) by continuing to engage with international scientists and engineers through liaison visits to research institutions and continue actively fostering international collaboration by awarding research grants. The increase will allow the flexibility of hiring approximately 1 additional PhD-level scientist.</p>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Support international engagement with ten partner nations, three multi-lateral groups, and support to the Northern Atlantic Treaty Organization (NATO), in order to increase collective Naval capability, capacity, and interoperability.</p> <p>FY 2023 Base Plans: Continue to:</p> <p>- Support all Science Advisor program efforts across Fleet and Forces Commands; objectively assess placement of current Science Advisors and requests for additional support in terms of impact to the Fleet and S&T return on investment.</p> <p>- Support PhD-level scientists, in multiple overseas deployed locations (Asia, Europe, South America, and Australia) by continuing to engage with international scientists and engineers through liaison visits to research institutions and continue actively fostering international collaboration by awarding research grants. Maintain and report on global technical awareness.</p> <p>- Support international engagement with ten partner nations, three multi-lateral groups, and support to the Northern Atlantic Treaty Organization (NATO), in order to increase collective Naval capability, capacity, and interoperability.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>						
<p>Title: Training Technologies</p> <p>Description: Applied research to enhance the ability to develop Naval forces from time of recruitment through separation from the military capable of competing and succeeding against novel threats and using novel, rapidly-fielded, technologies. This includes use of modern approaches for evaluation of knowledge, skills, and aptitude in school houses, field training, and point-of-need. Improved effectiveness is achieved by applying psychometric theory, data science, cognitive science, operations research, modeling and simulation, and computer sciences to the development, delivery, evaluation, and execution of training and education. Emphasis is on approaches that are robust at scale and can be implemented in a resource-constrained environment.</p> <p>FY 2022 Plans:</p>		4.730	4.966	5.023	0.000	5.023

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Technologies for Naval Training:</p> <ul style="list-style-type: none">- Mature immersive environments to train unit commanders in decision-making, tactics, and strategies.- Expand new methods and techniques for enhancing problem solving ability of autonomous, artificial intelligence agents.- Continue to develop methods and techniques to identify individual differences to optimize training.- Continue to mature game technology to build innovative job-performance and decision-aids.- Conduct applied research on learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new technologies and threats. This effort will focus on delivery of interventions to representative populations and evaluation of intervention. <p>Advanced Integrated Maritime Mission Modeling:</p> <ul style="list-style-type: none">- Continue work on Live-Virtual-Constructive simulation-based training technologies for Anti-submarine Warfare to include a greater range of simulated target types, behaviors, and scenarios.- Create training technologies to enhance the ability of shipboard operators, supervisors and crypto-technicians to rapidly detect cyber incursions into their radar, GPS, radio, and remote imaging systems, and to efficiently mitigate the effects of these incursions on combat effectiveness. <p>FY 2023 Base Plans:</p> <p>Technologies for Naval Training:</p> <p>Continue:</p> <ul style="list-style-type: none">- Mature immersive environments (multi-player game) to train unit commanders in decision making, tactics, and strategies.- Expand new methods and techniques for enhancing problem solving ability of autonomous, artificial intelligence agents.- Develop methods and techniques to identify individual differences to optimize training.- Continue to mature game technology to build innovative job-performance and decision-aids using augmented reality.- Conduct applied research on learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new technologies and threats. <p>Complete:</p> <p>The following efforts resulted from the investment described in the FY21 and FY22 plans for this program:</p> <ul style="list-style-type: none">- Research on the design of an electronic tutor to be transitioned to a Navy nuclear power technical school.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Research to design a tool for Navy recruiting.</div><div>- Efforts to map knowledge and skills required to fight and win in future conflicts with unmanned ground robotic systems.</div></div> <div>Initiate:</div> <div><div>- Apply new methods for tailored training that exploits artificial intelligence agents.</div><div>- Develop new techniques for obtaining and sharing of knowledge to improve individual and team performance in Naval applications.</div><div>- Mature digital intelligent tutor technologies (e.g., reading tutor) by enhancing tutors ability to characterize and diagnose students errors and provide appropriate real-time remediation.</div><div>- Incorporate Naval social/cultural norms into senior leadership models to inform training.</div><div>- Effort to develop immersive environments (multi-player game) to train unit commanders in decision making, tactics, and strategies.</div></div> <div>Advanced Integrated Maritime Mission Modeling:</div> <div>Continue:</div> <div><div>- Expand work on Live-Virtual-Constructive simulation-based training technologies for Anti-submarine Warfare to include a greater range of simulated target types, behaviors, and scenarios.</div><div>- Create training technologies to mitigate the effects of denied / degraded environments as well as cyber incursions on combat effectiveness.</div></div> <div>Complete:</div> <div><div>- The following effort resulted from the FY22 plan to create training technologies to enhance the ability of shipboard operators, supervisors and crypto-technicians to rapidly detect cyber incursions into their radar, GPS, radio, and remote imaging systems, and to efficiently mitigate the effects of these incursions on combat effectiveness. The completed portion of this effort includes training tools to detect cyber incursions in radar, Global Positioning System (GPS), radio, and remote imaging systems for shipboard operators, supervisors and crypto-technicians.</div></div> <div>Initiate:</div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Leverage work on Live, Virtual, and Constructive simulation-based training technologies for coordinated United States Marine Corps and United States Navy Strike Warfare in Naval Expeditionary Advanced Based Operations (EABO).</p> <p>- Investigate the application of Adaptive Training methodologies into both shore and ship-based training curricula for Anti-Submarine Warfare.</p> <p>Learning to Integrate and Adapt to New Naval Technologies and Threats</p> <p>Initiate:</p> <p>- Applied research for learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new Naval technologies and threats. Focus is on the delivery of interventions to representative populations and evaluation of such interventions. Emphasis is on tailored and scalable strategies.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		64.333	69.488	70.957	0.000	70.957
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602236N / Warfighter Sustainment Applied Res				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	47.786	48.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	96.036

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Lightweight anti-corrosion nanotechnology coating enhancement FY 2021 Accomplishments: Identified and executed several large-scale, cross-domain pilots to determine potential cost savings and improved fleet-wide readiness via the adoption of functional coatings and surface treatments. Supported various pilot demonstrations aimed at improving performance, protect the base metal and reduce corrosion in various DOD systems including storage tanks, aircraft skin, heat exchangers, undersea vehicles and ship hulls. FY 2022 Plans: N/A	4.827	0.000
Congressional Add: Polymer coatings for reduced ice and fouling adhesion FY 2021 Accomplishments: Analyzed solids shedding mechanisms resulting in an improvement to ice release capabilities of Navy topside coatings and the biofouling release capabilities of Navy below the water line antifouling coatings. FY 2022 Plans: Analyze solids shedding mechanisms resulting in an improvement to ice release capabilities of Navy topside coatings and the biofouling release capabilities of Navy below the water line antifouling coatings.	4.827	5.000
Congressional Add: force Health Protection and Application FY 2021 Accomplishments: Conducted research on what occurs inside the brain after experiencing a blast event. The research will leverage partnerships with academia and the national laboratories to acquire a better understanding of the human cellular response and the interface between humans and their protective equipment during blast impulses. These research efforts may lead to predicting injury following a blast event using future wearable sensor systems and may inform the design of advanced protective equipment to reduce blast injuries. FY 2022 Plans: N/A	4.827	0.000
Congressional Add: Health and Safety Research of Underground Fuel Storage Facilities FY 2021 Accomplishments: Developed plans and evaluated technologies to improve the health and safety of the underground Red Hill Fuel Storage Facility in Hawaii, and other underground fuel storage tanks in the Asia-	4.827	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602236N / Warfighter Sustainment Applied Res	Project (Number/Name) 9999 / Congressional Adds
B. Accomplishments/Planned Programs (\$ in Millions)		
Pacific AOR. Performed research for fuel tank inspect and repair protocols; advanced microscope analysis of tank corrosion products; concrete tank degradation inspection and retrofit; and advanced nanomaterials coating.		
FY 2022 Plans: Develop plans and evaluate technologies to improve the health and safety of the underground Red Hill Fuel Storage Facility in Hawaii, and other underground fuel storage tanks in the Asia-Pacific AOR. Perform research for fuel tank inspect and repair protocols; advanced microscope analysis of tank corrosion products; concrete tank degradation inspection and retrofit; and advanced nanomaterials coating.		
Congressional Add: Human Performance and injury Rehabilitation Assessment tool	2.413	0.000
FY 2021 Accomplishments: Conducted applied research in Human Performance and Injury Rehabilitation Assessment tool.		
FY 2022 Plans: N/A		
Congressional Add: Humanoid Robotics in Unstructured Environments	4.827	0.000
FY 2021 Accomplishments: Investigated issues in robotic learning of manipulation skills, natural language interaction with robots, robotic tasks relevant for shipboard maintenance, robot navigation and human-robot collaboration. Research was conducted in humanoid robotics in complex unstructured environments.		
FY 2022 Plans: N/A		
Congressional Add: Engineered Systems to Preserve and Restore Hearing After Deleterious Stimulation	4.827	0.000
FY 2021 Accomplishments: Exposure and extended exposure to high levels of noise can cause hearing damage, which severely impacts operational performance and can lead to permanent hearing loss. While advances are being made in developing therapeutics for auditory injury and delivering them to the inner ear to restore hearing, drug placement remains a major challenge to realizing optimal and consistent outcomes. The primary objective of this effort is to develop a noise-level enabled drug dosing and delivery system that would prevent cochlear damage. Such a system would respond in real-time to prevent noise-induced hearing loss and protect the warfighter from subsequent ear trauma.		
FY 2022 Plans: N/A		
Congressional Add: Hypersonics Material Acceleration	3.861	5.000
FY 2021 Accomplishments: This funding is anticipated to use the membership and resources of the LIFT Institute to increase the manufacturing base for the US hypersonics industrial base. The work focused on additive processing of large 3D structures, joining of dissimilar metals, establishment of powder supply chain for		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602236N / <i>Warfighter Sustainment Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
refractory metal alloys, and ICME tools leading to the development of new materials and processes, as well as characterization of existing materials and prediction of properties for future materials. FY 2022 Plans: This funding is anticipated to use the membership and resources of the LIFT Institute to increase the manufacturing base for the US hypersonics industrial base. The work will focus on additive processing of large 3D structures, joining of dissimilar metals, establishment of powder supply chain for refractory metal alloys, and ICME tools leading to the development of new materials and processes, as well as characterization of existing materials and prediction of properties for future materials.		
Congressional Add: Laser Peening Technology for Submarine and Carrier Shafts FY 2021 Accomplishments: Complete development and activities qualifying to certify laser peening of ship propulsion shafts. This proposed work will follow on an existing program that is addressing shaft operational risk issues and evaluating the efficacy of the laser peening process to reduce risk when applied to propulsion shafts. FY 2022 Plans: N/A	2.896	0.000
Congressional Add: Physics Based Neutralization of Threats to Human Tissues and Organs FY 2021 Accomplishments: Conducted research into a multiscale, physics-based approach to for use in preventing and mitigating both mild traumatic brain injuries (mTBIs) and blast-induced traumatic brain injuries (bTBIs). Preventing and mitigating bTBI and mTBI requires advancing the understanding of injury at a cellular level, as the exact force magnitudes and directions that initiate TBI at the cellular scale are still unknown. Knowledge of neuronal TBI thresholds is a critical and currently missing component of developing improved protective equipment, as well as equipment that addresses the full range of injury. FY 2022 Plans: Conduct research into a multiscale, physics-based approach to for use in preventing and mitigating both mild traumatic brain injuries (mTBIs) and blast-induced traumatic brain injuries (bTBIs). Preventing and mitigating bTBI and mTBI requires advancing the understanding of injury at a cellular level, as the exact force magnitudes and directions that initiate TBI at the cellular scale are still unknown. Knowledge of neuronal TBI thresholds is a critical and currently missing component of developing improved protective equipment, as well as equipment that addresses the full range of injury.	4.827	5.000
Congressional Add: Social Networks and Computational Social Science FY 2021 Accomplishments: Developed new metrics for social media analysis of social cyber-threats to military missions, to include threat characterization, behavior and tactics modeling, coordination structures, action dynamics, narrative evolution and studies of polarization and, multiplatform mapping, and platform	1.931	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602236N / <i>Warfighter Sustainment Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>
B. Accomplishments/Planned Programs (\$ in Millions)		
vulnerabilities and bias. Anticipated deliverables include published papers, book chapters, and presentation, technical demonstrations, and a capstone project to validate results via a technical demonstration.		
FY 2022 Plans: N/A		
Congressional Add: Warfighter as a System Human Digital Twin Research	2.896	0.000
FY 2021 Accomplishments: Continued development of the human digital twin project known as I-PREDICT. The research will involve development of the roadmap for integration and the integration process itself of the human body model with sub-system human models, simulations of aircraft, aircraft components and equipment, personal protective equipment and specialized equipment for casualty transport.		
FY 2022 Plans: N/A		
Congressional Add: Advanced nanocomposite coatings	0.000	6.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research in advanced nanocomposite coatings		
Congressional Add: Anticorrosion nanotechnology	0.000	7.500
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research supporting anticorrosion nanotechnology		
Congressional Add: Development of chromate-free corrosion inhibitor coatings for marine application	0.000	1.750
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research for development of chromate-free corrosion inhibitor coatings for marine application		
Congressional Add: Engineered systems to preserve and restore hearing	0.000	5.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research in engineered systems to preserve and restore hearing		
Congressional Add: Human digital twin	0.000	3.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct applied research supporting human digital twin		
Congressional Add: High mobility ground robots to assist dismounted infantry in urban operations	0.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602236N / <i>Warfighter Sustainment Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022
FY 2021 Accomplishments: N/A			
FY 2022 Plans: Conduct applied research for high mobility ground robots to assist dismounted infantry in urban operations			
Congressional Adds Subtotals		47.786	48.250
C. Other Program Funding Summary (\$ in Millions)			
N/A			
Remarks			
D. Acquisition Strategy			
N/A			

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	89.516	91.041	92.444	-	92.444	94.160	96.043	97.964	99.923	Continuing	Continuing
0000: Electromagnetic Systems Applied Research	0.000	81.793	85.041	92.444	-	92.444	94.160	96.043	97.964	99.923	Continuing	Continuing
9999: Congressional Adds	0.000	7.723	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.723

A. Mission Description and Budget Item Justification

Freedom of maneuver on a global scale for U.S. naval forces depends upon assured access to the electromagnetic spectrum and the ability to deny adversary exploitation. Electromagnetic technologies must fluidly deliver communication, surveillance electronic warfare and digital integration to understand, shape and defend the battlespace. The Electromagnetic Systems Applied Research Program addresses technology needs associated with Naval platforms for new capabilities in Electro-Optic and Infrared (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. Activities and efforts within this Program have attributes that focus on enhancing the affordability of warfighting systems.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		PE 0602271N I Electromagnetic Systems Applied Research			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	92.624	85.157	0.000	-	0.000
Current President's Budget	89.516	91.041	92.444	-	92.444
Total Adjustments	-3.108	5.884	92.444	-	92.444
• Congressional General Reductions	-	-0.116			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	6.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.891	0.000			
• SBIR/STTR Transfer	-2.217	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	92.444	-	92.444
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Navigation Technology					
Congressional Add: Dark Swarm in Degraded Environments					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Financial: No significant change.					
Technical: No significant change.					
Schedule: No significant change.					

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.					

FY 2021	FY 2022
2.896	0.000
4.827	6.000
7.723	6.000
7.723	6.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602271N / <i>Electromagnetic Systems Applied Research</i>				Project (Number/Name) 0000 / <i>Electromagnetic Systems Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: <i>Electromagnetic Systems Applied Research</i>	0.000	81.793	85.041	92.444	-	92.444	94.160	96.043	97.964	99.923	Continuing	Continuing

A. Mission Description and Budget Item Justification

Freedom of maneuver on a global scale for U.S. naval forces depends upon assured access to the electromagnetic spectrum and the ability to deny adversary exploitation. Electromagnetic technologies must fluidly deliver communication, surveillance electronic warfare and digital integration to understand, shape and defend the battlespace. This project addresses technology opportunities associated with Naval platforms for new capabilities in Electro-Optic and Infrared (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 Program Element (PE), the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Electronic Warfare Technology 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. Technology development is focused on Distributed Electronic Warfare in support of Distributed Maritime Operations. 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. The current objectives are: - Electronic Warfare (EW) Radio Frequency (RF) Technology: Develop and demonstrate technologies in the RF spectrum (covering frequencies from kilohertz to terahertz) that include developments in detection, signal	40.584	41.770	43.933	0.000	43.933

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>processing and passive/active techniques for wideband Electronic Attack (EA), Electronic Protection (EP) and the Electronic Support (ES) mission areas.</p> <p>- Electronic Warfare (EW) Electro-Optic/Infrared (EO/IR) Technology: Develop and demonstrate counter EO/IR technologies extending from the ultraviolet to the far infrared spectral bands. This includes advances in multispectral sensors, multiband sources, beam forming/steering, and signal processing and transmission.</p> <p>- 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.</p> <p>- Advanced EW Enabling Technologies: Develop classified advanced electronic warfare technology in support of current and predicted capability requirements emphasizing distributive effects.</p> <p>FY 2022 Plans:</p> <p>Electronic Warfare (EW):</p> <p>- Continue research in federated, coordinated, and integrated EW systems for the development of distributed Electronic Warfare (EW) technologies for Electronic Surveillance (ES), decoys and countermeasures, and Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance and Targeting (C4ISRT). This Electronic Warfare (EW) research includes Electronic Protection (EP) for our own weapons and Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance and Reconnaissance (C5ISR) systems allowing them to operate in a heavily contested environment.</p> <p>- Continue development and implementation of Artificial Intelligence (AI) algorithms and deep learning techniques for adaptive Electronic Attack (EA) and Electronic Support (ES) applications onto new AI compute processing architectures developed for Electronic Warfare (EW) applications.</p> <p>- Continue research into developing AI-generated tactics against modern and emerging radar sources to improve naval mission effectiveness.</p> <p>- Initiate research and development in the area of hard-kill and soft-kill coordination and planning.</p> <p>- Initiate research into simultaneous multi-spectral (RF and optical) countermeasure development to increase survivability across the entire electromagnetic spectrum and continue development of coordinated EW techniques between RF and EO/IR transmitters and receivers for single and distributed platforms.</p> <p>- Initiate development and implementation of combined EW and cyber effects to increase the reach and effectiveness of each domain in support of distributed maritime operations.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Initiate the development of a variable-ratio coupler approach to phase demodulation, allowing for the active tuning of a photonics based processor.</div><div>- Initiate the development of artificial intelligence algorithms to automatically classify tracks for an advanced weapons system and to distinguish anomalous targets, which have not been previously seen by the combat system.</div><div>- Initiate the development of a quantitative understanding of the relationship between transverse laser fluence profiles and resultant emission, determine to what extent fluctuation in irradiance and fluence profile affects spatial, temporal, and spectral characteristics of generated emission and demonstrate improved quantitative prediction of effects in laboratory and at range based upon deeper understanding.</div></div> <div>Electromagnetic Warfare:<div><div>- Continue diverse research spanning multiple projects across a broad spectrum of Radio Frequency (RF) and Electro-Optic/Infrared (EO/IR) technologies that cover the detection of energy in the environment to the formulation of active and passive engagement techniques.</div><div>- Continue efforts with focus on near-real-time geolocation of stationary (or slowly moving) Radio-Frequency (RF) emitters, and in particular, emerging threat radars employing unusual waveforms resulting in accurate geolocation.</div><div>- Continue novel real-time signal processing techniques to dramatically increase the useful information content reported in receiver measurements of radar-band signals providing the warfighter with a low-ambiguity warning of detection.</div><div>- Continue efforts to improve the effectiveness of emitter classification of modern radars for several functions including Automated Identification Systems (AIS) validation increasing Maritime Domain Awareness.</div><div>- Continue research applying recently developed machine learning methods to the problem of functional classification of radar emissions and demonstrate the ability to perform the functional classification in real time to overcome the inadequacy conventional emitter classification methods.</div><div>- Continue efforts focused on discovering and defeating unknown and adaptive radios by developing algorithms to observe their behavior, analyze their networking protocols, and optimize engagement techniques to interfere with their objectives.</div><div>- Continue research to develop and demonstrate high gain distributed aperture technologies compatible with micro-jammer glide vehicles to increase the effective radiated power of a ground-based micro-jammer constellation to provide sufficient power to radars.</div><div>- Continue development and demonstration of an evolvable Electronic Warfare (EW) transceiver design that optimizes cuing receiver processing to increase situational awareness and enable adaptive electronic attack</div></div></div>								

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
response in complex electromagnetic environments to provide effective processing of emergent complex radar modes. FY 2023 Base Plans: Electronic Warfare (EW): - Complete early development and demonstrate implementation of Artificial Intelligence (AI) algorithms and deep learning techniques for adaptive Electronic Attack (EA) and Electronic Support (ES) applications on new AI compute processing architectures developed for Electronic Warfare (EW) applications. - Continue research in federated, coordinated, and integrated Electronic Warfare (EW) systems for the development of distributed Electronic Warfare (EW) technologies for Electronic Surveillance (ES), decoys and countermeasures, and Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance and Targeting (C4ISRT). This EW research includes Electronic Protection (EP) for our own weapons and Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance and Reconnaissance (C5ISR) systems allowing them to operate in a heavily contested environment. - Continue research into developing AI-generated tactics against modern and emerging radar sources to improve naval mission effectiveness. - Continue research and development in the area of hard-kill and soft-kill coordination and planning. - Continue research into simultaneous multi-spectral (Radio Frequency (RF) and optical) countermeasure development to increase survivability across the entire electromagnetic spectrum and continue development of coordinated EW techniques between RF and Electro-Optic/Infrared (EO/IR) transmitters and receivers for single and distributed platforms. - Continue development and implementation of combined EW and cyber effects to increase the reach and effectiveness of each domain in support of distributed maritime operations. - Continue the development of artificial intelligence algorithms to automatically classify tracks for an advanced weapons system and to distinguish anomalous targets, which have not been previously seen by the combat system. - Continue the development of a quantitative understanding of the relationship between laser fluence profiles and resultant emission, determine to what extent fluctuation in irradiance and fluence profile affects spatial, temporal, and spectral characteristics of generated emission and demonstrate improved quantitative prediction of effects in laboratory and at range based upon deeper understanding. - Continue the development of a variable-ratio coupler approach to phase demodulation, allowing for the active tuning of a photonics based processor.							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Electromagnetic Warfare:</p> <ul style="list-style-type: none">- Continue diverse research spanning multiple projects across a broad spectrum of RF and EO/IR technologies that cover the detection of energy in the environment to the formulation of active and passive engagement techniques.- Continue efforts with focus on near-real-time geolocation of stationary (or slowly moving) RF emitters, and in particular, emerging threat radars employing unusual waveforms resulting in accurate geolocation.- Continue novel real-time signal processing techniques to dramatically increase the useful information content reported in receiver measurements of radar-band signals providing the warfighter with a low-ambiguity warning of detection.- Continue efforts to improve the effectiveness of emitter classification of modern radars for several functions including Automated Identification Systems (AIS) validation increasing Maritime Domain Awareness.- Continue research applying recently developed machine learning methods to the problem of functional classification of radar emissions and demonstrate the ability to perform the functional classification in real time to overcome the inadequacy conventional emitter classification methods.- Continue efforts focused on discovering and defeating unknown and adaptive radios by developing algorithms to observe their behavior, analyze their networking protocols, and optimize engagement techniques to interfere with their objectives.- Continue research to develop and demonstrate high gain distributed aperture technologies compatible with micro-jammer glide vehicles to increase the effective radiated power of a ground-based micro-jammer constellation to provide sufficient power to radars.- Continue development and demonstration of an evolvable Electronic Warfare (EW) transceiver design that optimizes cuing receiver processing to increase situational awareness and enable adaptive electronic attack response in complex electromagnetic environments to provide effective processing of emergent complex radar modes.- Initiate the development of technology and waveforms to detect the emissions of and deny launch platform targeting radars and/or anti-ship missile seekers the capability to acquire and track ship targets across the electromagnetic spectrum. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>							

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The increase from FY 2022 to FY 2023 is due to increased investments in the development of multi-spectral countermeasure technologies and novel distributed/coordinated cognitive EW techniques that will significantly increase Naval platform survivability by denying networked, multi-spectral threat systems the ability to detect, track, and target our platforms across the electromagnetic spectrum.							
<p>Title: EO/IR Sensor Technologies</p> <p>Description: The overarching objective is to develop technologies that enable affordable, wide area, persistent surveillance optical architectures. Included are modeling and simulation required to support the development of these technologies. Efforts will also include the development of optical Radio-Frequency (RF) components, infrared technologies including lasers and focal plane arrays using narrow bandgap semiconductors. The current specific objectives are:</p> <ul style="list-style-type: none">- 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.- Wide Area Optical Architectures: Develop wide area optical architectures for persistent surveillance for severely size constrained airborne applications.- Hyperspectral sensors and processing: Develop visible, shortwave Infrared (IR), mid-wave IR, and long-wave IR hyperspectral sensors, along with processing algorithms to detect anomalies and targets.- Coherent Laser Radar (LADAR): Develop and improve components for LADAR applications including fiber lasers, coherent focal planes, and advanced processing.- Autonomous and Networked sensing: Develop algorithms and processing that supports autonomous sensing for Unmanned Autonomous Vehicles (UAV) platforms and that supports networked sensing over multiple sensors and/or sensor platforms. <p>FY 2022 Plans: EO/IR Sensor Technologies:</p> <ul style="list-style-type: none">- Complete development and initiate testing of a low Size, Weight, Power and Cost (SWaP-C) prototype room-temperature Mid-Wave Infrared (MWIR) detector array.-Continue to develop novel techniques for Electro-Optic/Infrared (EO/IR) countermeasures to detect, track and/or jam sensors.			7.354	7.207	7.887	0.000	7.887

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div><div>- Continue demonstration and test real-time combat Identification (ID) algorithms for detecting and tracking simultaneous targets from networked, high-resolution, wide field of view, and persistent surveillance systems.</div><div>- Continue work on active imaging laser systems to significantly extend operational range and imaging capabilities in degraded conditions (e.g., dense maritime fog).</div><div>- Continue efforts to develop and test optical architectures to demonstrate simultaneous wide field of view (FOV) and high-resolution imaging for search, detection, classification, identification and targeting functions.</div><div>- Initiate demonstration and test performance of previously developed sensitive passive Millimeter Wave (MMW) detectors for detection of targets in degraded visual environments (e.g., clouds, fog, haze and dust) and explore extending capability to sparse apertures to increase resolution.</div><div>- Initiate research and development of novel ISR and counter-ISR applications with tailored optical beams.</div></div> <div>Electronics:<div><div>- Complete research in advanced p-type Gallium-Free Superlattice Long Wave Infrared (LWIR) Sensors.</div><div>- Complete research efforts associated with Night and Day Maritime Infrared (IR).</div></div></div> <div>Electromagnetic Warfare:<div><div>- Complete efforts towards a new system design and data processing algorithms for small, low-power, high resolution extremely wide FOV IR systems.</div><div>- Complete efforts to detect, track and defeat an imaging threat sensor over a wide field of view using optical phase conjugation to overcome the existing field of view limitations imposed by current spatial light modulator technology.</div><div>- Complete efforts towards the improvement in resolution without changing the imaging optics by projecting patterns onto the scene then using knowledge of the patterns computationally recover a higher resolution image resulting in improved resolution enabling better intelligence, surveillance, reconnaissance, and targeting.</div><div>- Continue development of EO/IR technologies to improve imaging, target identification, threat detection, and engagement capabilities for the war fighter.</div><div>- Initiate development and demonstration of a low Size Weight and Power (SWaP) transceiver laser system with high accuracy, covert detection, and threat wavelength discrimination using Non-Mechanical Beam Steering technology (NMBS).</div><div>- Initiate development and optimization of Resonant-Cavity Infrared Detectors (RCIDs) that provide higher sensitivity and reduced optical clutter systems using active imaging.</div></div></div> <div>FY 2023 Base Plans:</div>							

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>EO/IR Sensor Technologies:</p> <ul style="list-style-type: none">- Complete demonstration and test performance of previously developed sensitive passive Millimeter Wave (MMW) detectors for detection of targets in degraded visual environments (e.g., clouds, fog, haze and dust) and explore extending capability to sparse apertures to increase resolution.- Continue to develop novel techniques for Electro-Optic/Infrared (EO/IR) countermeasures to detect, track and/or jam sensors.- Continue demonstration and test real-time combat Identification (ID) algorithms for detecting and tracking simultaneous targets from networked, high-resolution, wide field of view, and persistent surveillance systems.- Continue work on active imaging laser systems to significantly extend operational range and imaging capabilities in degraded conditions (e.g., dense maritime fog).- Continue efforts to develop and test optical architectures to demonstrate simultaneous wide Field Of View (FOV) and high-resolution imaging for search, detection, classification, identification and targeting functions.- Continue research and development of novel ISR and counter-ISR applications with tailored optical beams.- Initiate research into extreme low light imaging cameras built using low-cost Si foundry services as a way to provide all domain imaging for some missions or platforms that can't afford infrared sensors. <p>Electromagnetic Warfare:</p> <ul style="list-style-type: none">- Continue development of Electro-Optical/Infra-Red (EO/IR) and Radio Frequency (RF) technologies to improve imaging, target identification, threat detection, and engagement capabilities for the war fighter.- Continue development and demonstration of a low Size Weight and Power (SWaP) transceiver laser system with high accuracy, covert detection, and threat wavelength discrimination using Non-Mechanical Beam Steering technology (NMBS).- Continue development and optimization of Resonant-Cavity Infrared Detectors (RCIDs) that provide higher sensitivity and reduced optical clutter systems using active imaging.- Initiate demonstration of new high performance single band Short-Wave (SW) and dual band SW/Mid-Wave (MW) Infrared (IR) sensors that will substantially improve the Navy's primary night & day maritime MWIR systems, which will show that a broad range of Naval MWIR imagers can be upgraded with a much more capable monolithic SW/MWIR dual band sensor technology, with minimal impact on Size Weight and Power (SWaP) and system cost. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The increase from FY 2022 to FY 2023 is due to increased investments in coherent combination and computational imaging techniques that will increase the resolution and long range imaging capability for Naval systems, thus increasing their survivability, autonomy, and stand-off range.							
<p>Title: Navigation Technology</p> <p>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 non-Global Positioning System (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).</p> <p>The following are non-inclusive examples of plans for projects funded in this activity.</p> <p>FY 2022 Plans: Navigation Technology: -Continue research on automated celestial navigation for submarine platforms to increase operational effectiveness. -Continue research on thermal atomic beam inertial capability to improve non-Global Positioning System (GPS) navigation. -Continue research on next generation atomic clocks to improve long-term stability and precision. -Continue development of earth magnetic anomaly maps for improved magnetic navigation. -Initiate development of navigation capability using very low frequency signals. -Initiate development of a gravity navigation system using a strap down gravimeter.</p> <p>FY 2023 Base Plans: Navigation Technology: - Complete research on automated celestial navigation for submarine platforms to increase operational effectiveness. - Complete research on thermal atomic beam inertial capability to improve non-Global Positioning System (GPS) navigation. - Complete development of navigation capability using very low frequency signals.</p>			8.968	11.315	14.366	0.000	14.366

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none">- Continue research on next generation atomic clocks to improve long-term stability and precision.- Continue development of earth magnetic anomaly maps for improved magnetic navigation.- Continue development of a gravity navigation system using a strap down gravimeter.- Initiate development of magnetic anomaly aided navigation systems. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY 2022 to FY 2023 is due to additional efforts and investment to enhance platform operability by advancing the development of alternative navigation systems utilizing geophysical features and to support advanced inertial navigation technology. This increased development is partially to support enhanced demand in response to FY21 NDAA Sec. 1601 which directs the DOD to generate and deploy resilient and survivable alternative PNT solutions.</p>						
<p>Title: Solid State Electronics</p> <p>Description: The overarching objective of this activity is to develop higher performance components and subsystems for all classes of military Radio-Frequency (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 (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.</p>		9.573	9.539	10.140	0.000	10.140

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
FY 2022 Plans: Solid State Electronics: - Continue research of solid-state devices for high frequency analog and digital operation; high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications; superconducting and other technologies which are prototyped to demonstrate the ability of these components to deliver superior functionality in a system environment. - Continue development and transition of nitrogen-polar based High-Electron-Mobility Transistor (HEMT) technology for advanced linear receivers and efficient transmitters. - Continue development of new materials, devices, components, and circuits that apply quantum phenomena of entanglement, superposition and/or wave function correlation for performance not achievable by classical methods. - Continue integrated circuit technologies in conventional superconductors and Gallium Nitride (GaN) as platforms for quantum-based functional components. - Initiate development of superconducting GaN/niobium nitride heterostructures for Josephson junctions and Millimeter Wave (MMW) resonator circuits. - Initiate Millimeter Wave (MMW) to Terahertz (THz) plasmonic photomixer-based focal plane arrays for imaging systems. - Initiate efforts into Acoustoelectric ScAlN RF Signal Processing Devices (T080-21) and Continuous 3D-Cooled Atom Beam Gyroscope. - Initiate development of chip-scale, acoustic Radio-Frequency (RF) signal processing components, utilizing acoustoelectric effect with high internal gain, in the 1 to 18 Gigahertz (GHz) range using a Scandium Aluminum Nitride (ScAlN) based device architecture with enhanced power handling up to 10 W. - Initiate development of Phase-Change Material (PCM) based couplers with dynamically controllable coupling coefficients to create broadband, low loss, high-tap-count analog canceler filters to provide enhanced TX/RX isolation. - Complete AlN Tunneling Hot Electron Transfer Amplifier for MMW Power. - Complete Phase Change Material RF Components. - Complete Autonomous-Reconfigurable RF and mm-Wave Components. - Complete Memristive Neuromorphic Computing Elements. - Complete Rapid RF IC Prototyping and Manufacture via Micro-assembly. - Complete Neural Red-Out Integrated Circuits.							

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete ScAlN Based High Power Density MM Wave Transistors.</p> <p>FY 2023 Base Plans: Solid State Electronics:</p> <p>- Complete efforts into Acoustoelectric Scandium Aluminum Nitride (ScAlN) Radio-Frequency (RF) Signal Processing Devices (T080-21) and Continuous 3D-Cooled Atom Beam Gyroscope.</p> <p>- Continue research of solid-state devices for high frequency analog and digital operation; high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications; superconducting and other technologies which are prototyped to demonstrate the ability of these components to deliver superior functionality in a system environment.</p> <p>- Continue development and transition of nitrogen-polar based High-Electron-Mobility Transistor (HEMT) technology for advanced linear receivers and efficient transmitters.</p> <p>- Continue development of new materials, devices, components, and circuits that apply quantum phenomena of entanglement, superposition and/or wave function correlation for performance not achievable by classical methods.</p> <p>- Continue integrated circuit technologies in conventional superconductors and Gallium Nitride (GaN) as platforms for quantum-based functional components.</p> <p>- Continue development of superconducting GaN/niobium nitride heterostructures for Josephson junctions and Millimeter Wave (MMW) resonator circuits.</p> <p>- Continue Millimeter Wave (MMW) to Terahertz (THz) plasmonic photomixer-based focal plane arrays for imaging systems.</p> <p>- Continue development of chip-scale, acoustic RF signal processing components, utilizing acoustoelectric effect with high internal gain, in the 1 to 18 Gigahertz (GHz) range using a ScAlN based device architecture with enhanced power handling up to 10 W.</p> <p>- Continue development of Phase-Change Material (PCM) based couplers with dynamically controllable coupling coefficients to create broadband, low loss, high-tap-count analog canceler filters to provide enhanced TX/RX isolation.</p> <p>- Initiate metal nitride heterostructure mm-wave device investigations.</p> <p>- Initiate relaxed III-nitride channel mm-wave N-polar device development.</p> <p>- Initiate investigations into high throughput, large-area nano-scale lithography for plasmonic devices.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate development of new types of quantum based sensors for the measurement of motion and fields, which combine high sensitivity with features that improve the practicality of the technologies, to include continuous, high-bandwidth measurement, and low Size Weight and Power (SWaP). FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Title: Surveillance Technology 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, affordable apertures, distributed sensing systems, and includes modeling and simulation required to support the development of these technologies. The current specific objectives are: 1) 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. 2) 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 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. 3) 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. FY 2022 Plans: Surveillance Technology: - Complete technology development to enable full spectrum battlespace awareness through an ultra-wideband aperture for simultaneously 360-degree beamforming and low profile, ultra-low cross-polarization, ultra-wide-band apertures to provide resilient electronic protection for naval platforms.		13.396	13.413	14.087	0.000	14.087

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base
<ul style="list-style-type: none"> - Continue research in sensors, networking and communication connectivity for developing an affordable and fully automated network of collaborative time-coordinated mono-static and Multi-Input Multi-Output (MIMO), surveillance sensors providing real-time tracking, identification, targeting and engagement information with persistent wide area awareness. - Continue efforts to develop affordable and scalable advanced antenna apertures. - Continue efforts to develop electronics and signal processing to enable Radio Frequency (RF) agility and waveform diversity to provide enhanced capability to find, fix, track, target, and assess targets and threats as well as provide automatic target identification. - Continue research in the use of interferometric, polar metric, RF agility, and sophisticated signal processing algorithms to enable the detection, geolocation, tracking, and identification of targets in harsh natural and man-made clutter and interference. - Continue research to enable sensor RF convergence, surveillance allocations, data fusion, multi-hypothesis decision-making, multi-target tracking, and methods for handling and fusing disparate and intermittent data sources. - Continue efforts to develop methods to mitigate Electronic Attack (EA) and Electromagnetic Interference (EMI) to RF sensors and networks. - Continue experimentation with fixed and mobile digital array radars to test and validate MIMO capabilities to provide improved detection, tracking, targeting, electronic protection and survivability. - Initiate development low-cost dielectric lens antennas. - Initiate development of hardware and software for arbitrary waveform generation for agile radar systems. - Initiate development of advanced signal processing and signal data converter. - Initiate development of low-cost components for High Frequency (HF) sensor systems with reduced size, weight, and power needs. - Initiate development of distributed aperture radar systems with improved spatial and waveform agility. <p>Electromagnetic Warfare:</p> <ul style="list-style-type: none"> - Continue development of radar techniques for detection and identification of small Unmanned Autonomous Vehicles (UAV) and to develop classification and identification techniques for addressing evolving DHS/USMC requirements for assessing this type of threat in tactical environments. - Continue validation of algorithms using innovative concepts from discrete mathematics to accurately predict ship Radar Cross Section (RCS) so as better assess platform vulnerability. 					
					FY 2023 OCO
					FY 2023 Total

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue development of innovative target detection and clutter suppression algorithms for ultra-high frequency SAR that exploits fluctuation and motion within the scene to provide wide-area, automated detection of small targets at long ranges.</p> <p>- Initiate development of the maritime target detection capabilities of a UHF SAR through novel approaches to the fundamental challenge of separating target backscatter from ocean clutter by exploiting both differences in the manner in which the polarimetric signatures of the target and clutter vary as a function of aspect angle and RF frequency, as well as differences between target and clutter motion characteristics.</p> <p>FY 2023 Base Plans:</p> <p>Surveillance Technology:</p> <p>- Continue efforts to develop affordable and scalable advanced antenna apertures.</p> <p>- Continue efforts to develop electronics and signal processing to enable Radio Frequency (RF) agility and waveform diversity to provide enhanced capability to find, fix, track, target, and assess targets and threats as well as provide automatic target identification.</p> <p>- Continue research in the use of interferometric, polarimetric, RF agility, and sophisticated signal processing algorithms to enable the detection, geolocation, tracking, and identification of targets in harsh natural and man-made clutter and interference.</p> <p>- Continue efforts to develop methods to mitigate Electronic Attack (EA) and Electromagnetic Interference (EMI) to RF sensors and networks.</p> <p>- Continue development low-cost dielectric lens antennas and material resilience in high power transmitters.</p> <p>- Continue development of hardware and software for arbitrary waveform generation for agile radar systems.</p> <p>- Continue development of low-cost components for High Frequency (HF) sensor systems with reduced size, weight, and power needs.</p> <p>- Continue development of distributed aperture radar systems with improved spatial and waveform agility.</p> <p>- Complete research in sensors, networking and communication connectivity for developing an affordable and fully automated network of collaborative time-coordinated mono-static and Multi-Input Multi-Output (MIMO), surveillance sensors providing real-time tracking, identification, targeting and engagement information with persistent wide area awareness.</p> <p>- Complete research to enable sensor Radio Frequency (RF) convergence, surveillance allocations, data fusion, multi-hypothesis decision-making, multi-target tracking, and methods for handling and fusing disparate and intermittent data sources.</p> <p>- Complete development of advanced signal processing and signal data converter.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602271N / <i>Electromagnetic Systems Applied Research</i>		Project (Number/Name) 0000 / <i>Electromagnetic Systems Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Complete experimentation with fixed and mobile digital array radars to test and validate Multi-Input Multi-Output (MIMO) capabilities to provide improved detection, tracking, targeting, electronic protection and survivability.</div> <div>- Initiate development of front-end components and phased array architectures that enable concurrent wideband radar and Electronic Support (ES) functions.</div> <div>Electromagnetic Warfare:</div> <div>- Continue development of radar techniques for detection and identification of small Unmanned Autonomous Vehicles (UAV) and to develop classification and identification techniques for addressing evolving DHS/USMC requirements for assessing this type of threat in tactical environments.</div> <div>- Continue validation of algorithms using innovative concepts from discrete mathematics to accurately predict ship Radar Cross Section (RCS) so as better assess platform vulnerability.</div> <div>- Continue the development of innovative target detection and clutter suppression algorithms for Ultra-High Frequency (UHF) SAR that exploits fluctuation and motion within the scene to provide wide-area, automated detection of small targets at long ranges.</div> <div>- Complete the development of the maritime target detection capabilities of a Ultra-High Frequency (UHF) SAR through novel approaches to the fundamental challenge of separating target backscatter from ocean clutter by exploiting both differences in the manner in which the polarimetric signatures of the target and clutter vary as a function of aspect angle and RF frequency, as well as differences between target and clutter motion characteristics.</div> <div>- Initiate applied research into technology base for Radio Frequency (RF) surveillance using active and passive monostatic and distributed sensor concepts. Current efforts seek to contribute to this objective by developing and demonstrating improved planar antennas and cylindrical.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>There is no significant funding change from FY 2022 to FY 2023.</div>						
Title: Vacuum Electronics Power Amplifiers		1.918	1.797	2.031	0.000	2.031
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,						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602271N / <i>Electromagnetic Systems Applied Research</i>		Project (Number/Name) 0000 / <i>Electromagnetic Systems Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
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 Millimeter Wave (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 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: - 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. - Lithographic Fabrication Techniques: Develop lithographic fabrication techniques for upper-millimeter wave amplifiers. - 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.						
FY 2022 Plans: Electronics: - Complete Monolithic, Microfabricated Traveling Wave Amplifier Arrays. - Complete Electron Focusing Heterostructures for Compact High-Power MM Wave Amplifiers. - Complete Multiple Electron Beam Architecture for Upper-MMW Power Amplifiers. - Initiate development of broadband (3:1) traveling-wave-tube amplifier circuit using hybrid manufacturing techniques. - Initiate development of low-Size, Weight, and Power (SWaP)-C millimeter-wave traveling-wave tube amplifier technology for unmanned platforms, based on Additive Manufacturing (AM) and a high level of Radio Frequency (RF) component integration.						
FY 2023 Base Plans: - Complete the development of broadband (3:1) traveling-wave-tube amplifier circuit using hybrid manufacturing techniques.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602271N / <i>Electromagnetic Systems Applied Research</i>		Project (Number/Name) 0000 / <i>Electromagnetic Systems Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete the development of low-Size, Weight, and Power (SWaP)-C millimeter-wave traveling-wave tube amplifier technology for unmanned platforms, based on Additive Manufacturing and a high level of RF component integration.</p> <p>- Initiate the development of Millimeter Wave and sub-MMW power amplifiers for use in Naval all-weather radar, surveillance, reconnaissance, electronic attack, and communications systems. Efforts are focused on the development of technologies for high-data-rate communications, electronic warfare and high-power radar applications at MMW and sub-MMW regimes.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase from FY 2022 to FY 2023 is due to increased investments in the development of high-power millimeter-wave (mmW) amplifiers, which either do not exist or are too large to fit on envisioned platforms, to protect Naval platforms from growing threat systems which are becoming more prolific and capable.</p>						
Accomplishments/Planned Programs Subtotals		81.793	85.041	92.444	0.000	92.444
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602271N / <i>Electromagnetic Systems Applied Research</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	7.723	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.723
<p>A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.</p>												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Navigation Technology								2.896	0.000			
FY 2021 Accomplishments: Conducted work supporting the Navy Precision Optical Interferometer (NPOI). NPOI has been in operation since 1993 providing a large amount of scientific and other technical data and being used a test-bed for numerous scientific demonstrations. The instrument is in need of long delayed maintenance and modern upgrades to make sure that it is a viable scientific instrument for the 21st century and maintain its world class unique capabilities in the future.												
FY 2022 Plans: N/A												
Congressional Add: Dark Swarm in Degraded Environments								4.827	6.000			
FY 2021 Accomplishments: Conducted applied Dark Swarm in Degraded Environments applied research.												
FY 2022 Plans: Conduct applied Dark Swarm in Degraded Environments applied research.												
Congressional Adds Subtotals								7.723	6.000			
<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p>												
<p>D. Acquisition Strategy N/A</p>												

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	77.935	103.586	74.622	-	74.622	75.626	77.139	78.682	80.255	Continuing	Continuing
0000: Ocean Wrfghtg Env Applied Res	0.000	59.593	70.086	74.622	-	74.622	75.626	77.139	78.682	80.255	Continuing	Continuing
9999: Congressional Adds	0.000	18.342	33.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	51.842

A. Mission Description and Budget Item Justification

Assuring access to the global maritime domain is ensured by technologies that reliably and accurately sense and predict the ocean environment. Coordinated distributed maritime operations is only possible when timely, actionable information is delivered to commanders. This program element (PE) addresses applied research to develop and exploit tactical understanding of the ocean environment to maintain U.S. maritime superiority and ensure national security. Research performed in this PE transforms basic oceanographic, geologic, acoustic, optical and chemical research into predictive models and technologies that provide new or enhanced warfare capabilities for the Battlespace Environment (BSE). The objectives of this program are met through direct observation of the ocean environment by shipboard, unmanned vehicle, drifting, profiling and remote sensing modalities, among others; assimilation of these observations into predictive environmental models; and provision of critical environmental knowledge to tactical decision aids.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity		R-1 Program Element (Number/Name)				
1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		PE 0602435N I Ocean Wrfghtg Env Applied Res				
B. Program Change Summary (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		79.881	70.086	0.000	-	0.000
Current President's Budget		77.935	103.586	74.622	-	74.622
Total Adjustments		-1.946	33.500	74.622	-	74.622
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	33.500			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-0.077	0.000			
• SBIR/STTR Transfer		-1.869	0.000			
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	74.622	-	74.622
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Task Force Ocean						
Congressional Add: Navy Special Warfare Superiority in Underseas and Maritime Environments						
Congressional Add: Ocean Acoustics for Monitoring						
Congressional Add: Climate change hydraulic modeling risk analysis						
Congressional Add: Continuous distributed sensing systems						
Congressional Add: Research vessel cyber infrastructure improvements						
Congressional Add: Ocean acoustics						
Congressional Add: Operational demonstration of commercially available, long endurance USV						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Schedule: No significant change.						
Technical: No significant change.						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
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	
Funding: No significant change. --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Ocean Wrfghtg Env Applied Res	0.000	59.593	70.086	74.622	-	74.622	75.626	77.139	78.682	80.255	Continuing	Continuing
A. Mission Description and Budget Item Justification												
This project provides the foundational environmental knowledge for undersea, surface and air-based warfighting technologies and effective operations anywhere on the globe, as well as the operation of unattended sensors and unmanned air, surface and underwater vehicles. This project includes the National Oceanographic Partnership Program (NOPP) 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 Battlespace Environment (BSE), understanding the variability between processes in the world's ocean, providing the on-scene commander with the capability to exploit the environment to tactical advantage. Research results are 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. Efforts include ocean and atmospheric analysis and prediction for real-time description of the operational environment from space to sub-seafloor, shallow water acoustics, sensors for undersea surveillance and weapon systems, and influences of the natural environment on Mine Countermeasures, Naval Mining, Anti-Submarine Warfare (ASW) and Naval Special Warfare systems.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Coastal Geosciences/Optics								9.889	10.535	9.417	0.000	9.417
Description: The Coastal Geosciences/Optics activity develops knowledge of the littoral, nearshore and riverine environments in which physical, acoustical and optical processes are dominated by the presence of the sea or river bed and air-water interface. Predictive environmental models, custom climatological databases, adaptive sampling schemes, technologies for nearshore observations and advanced remote sensing capabilities provide critical foundational information for Naval Special Warfare, Mine and Expeditionary Warfare and Amphibious operations. This Program emphasizes field research in navally relevant environments, including many that require research outside the U.S.												
FY 2022 Plans:												
-GuST turbulence probe: Conclude development of the GuST turbulence probe.												
-Satellite Based Sensing: Continue improving the world's global bathymetry map from satellite data. Specific new efforts will utilize ICESAT for shoreline digital elevation models and connect with new investigations and methods extending altimetry-based seabed models up onto the continental shelves. Continue efforts focused on determining bathymetry from satellite based-remote sensing for shallow muddy and turbid waters.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Inner Shelf Processes: Continue studies of non-hydrostatic modeling of inner shelf processes, including internal waves and fronts. Initiate a systematic study of biases introduced into the inner shelf sea-surface-temperature field by the global ocean and atmospheric models.</p> <p>-Remote Sensors: Continue optimization studies of adaptive sampling in the littorals using a small unmanned aerial vehicle that is also capable of underwater maneuver.</p> <p>-Optics: Initiate studies of underwater image prediction.</p> <p>-Sonar: Continue technology development to observe and map bottom currents and bathymetry from drifting, bottom- following sensors.</p> <p>- Continue research into exploiting various geoscience and optical environmental phenomena in the littoral ocean we will investigate and develop a novel remote sensing technology by exploring advanced machine learning methods for multi-spectral (optical and passive microwave) satellite observations to provide a high-resolution, holistic land surface analysis of surface vegetation and soil parameters and quantify their impact on numerical weather prediction (NWP) models. Continue to build capabilities to predict topographic changes in sandy, coastal environments impacting traffic</p> <p>FY 2023 Base Plans:</p> <p>- Continue Satellite Based Sensing to improve the world's global bathymetry map from satellite data. Specific new efforts will utilize ICESAT for shoreline digital elevation models and connect with new investigations and methods extending altimetry-based seabed models up onto the continental shelves. Continue efforts focused on determining bathymetry from satellite based-remote sensing for shallow muddy and turbid waters.</p> <p>- Continue Inner Shelf Processes studies of non-hydrostatic modeling of inner shelf processes, including internal waves and fronts. Initiate a systematic study of biases introduced into the inner shelf sea-surface-temperature field by the global ocean and atmospheric models.</p> <p>- Continue Remote Sensors optimization studies of adaptive sampling in the littorals using small unmanned platforms (air, surface, submerged).</p> <p>- Continue Optics studies of underwater image prediction.</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Sonar technology development to observe and map bottom currents and bathymetry from drifting, bottom- following sensors.</p> <p>- Continue research into exploiting various geoscience and optical environmental phenomena in the littoral ocean we will investigate and develop a novel remote sensing technology by exploring advanced machine learning methods for multi- spectral (optical and passive microwave) satellite observations to provide a high- resolution, holistic land surface analysis of surface vegetation and soil parameters and quantify their impact on numerical weather prediction (NWP) models.</p> <p>- Continue to build capabilities to predict topographic changes in sandy, coastal environments impacting traffic capability.</p> <p>- Continue to conduct research into exploiting various geoscience and optical environmental phenomena in the littoral ocean that will be investigated to develop a novel remote sensing technology by exploring advanced machine learning methods for multi-spectral (optical and passive microwave) satellite observations. This will provide a high-resolution, holistic land surface analysis of surface vegetation and soil parameters and quantify their impact on numerical weather prediction (NWP) models. Continue to build capabilities to predict topographic changes in sandy, coastal environments impacting trafficabiity.</p> <p>-Continue to focus on the development of suitable atmospheric correction, calibration, and optical inversion algorithm methods for the emerging and rapidly growing nano and microsatellite technologies.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The decrease from FY22 to FY23 is from the decreased usage of small unmanned platforms (air, surface, submerged) during optimization studies of adaptive sampling in the littorals.</p>							
Title: Marine Mammals and Biology			3.462	3.543	3.589	0.000	3.589
Description: The goal of the Marine Mammals and Biology activity focus is to better understand and characterize the effects of underwater sounds produced by Navy acoustic sources on marine mammals. Studies address characterizing marine mammal and their ecosystems, quantifying effects of sound exposure							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
on marine mammals, and improving the ability to monitoring and detect marine mammals in the open ocean. Research results supports Navy environmental compliance information needs and facilitates acquiring Letter of Authorizations from regulators that enable all Navy training and testing operations, and the development of appropriate state-of-the-art mitigation measures.							
FY 2022 Plans: This focus area conducts applied research in areas including monitoring and detection, integrated ecosystem, and effects of sound on marine mammals.							
- Passive Acoustics: Continue research efforts on passive acoustics and other technology, including the development and testing of new autonomous hardware platforms and signal processing algorithms for detection, classification, and localization of marine mammals. Continue research using animal tagging and passive acoustic monitoring to quantify behaviors, movement and distribution of marine mammals relative to key biotic and abiotic environmental properties.							
- Sound Effects Modeling: Continue research to quantify the behavioral and physiological effects to potentially population-level consequences of sound exposure on marine life.							
- Marine Mammals: Continue research to design equipment and capability to quantify the gas management and kinetics in marine mammals to elucidate the mechanisms that enable marine mammals to dive to deep depths.							
- Sound Reception Mechanisms in whales: Continue to pursue research to advance our understanding of sound reception mechanisms in large whales including the anatomy surrounding the ear and the whole head.							
- Sonar Exposure: Continue research into the stress response of marine mammals to sonar exposure with an emphasis on quantifying the effects of prolonged exposure effects on immune system suppression, reproductive failure, accelerated aging, and slowed growth.							
- Marine Mammal Behavior: Continue research on potential effects of Navy sources on marine mammal behavior, life functions, vital rates and population level effects.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Environmental Compliance: Continue ongoing research to provide tools to support environmental compliance efforts and decision making related to how marine mammals can be affected by anthropogenic sounds.</p> <p>FY 2023 Base Plans:</p> <p>- Continue Sound Effects Modeling research to quantify the behavioral and physiological effects to potentially population- level consequences of sound exposure on marine life.</p> <p>- Continue Marine Mammals research to design equipment and capability to quantify the gas management and kinetics in marine mammals to elucidate the mechanisms that enable marine mammals to dive to deep depths.</p> <p>- Continue Sound Reception Mechanisms in whales effort to conduct research to advance our understanding of sound reception mechanisms in large whales including the anatomy surrounding the ear and the whole head.</p> <p>- Continue Sonar Exposure research into the stress response of marine mammals to sonar exposure with an emphasis on quantifying the effects of prolonged exposure effects on immune system suppression, reproductive failure, accelerated aging, and slowed growth.</p> <p>- Marine Mammal Behavior: Continue research on potential effects of Navy sources on marine mammal behavior, life functions, vital rates and population level effects.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: No significant increase from FY22 to FY23.</p>							
<p>Title: Marine Meteorology</p> <p>Description: The Marine Meteorology activity develops observing technologies, predictive 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, Electromagnetic (EM) and electro-optical (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.</p>			11.472	12.016	14.647	0.000	14.647

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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 2021	FY 2022	FY 2023 Base
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.					
FY 2022 Plans:					
-Data Assimilation and Modeling: Continue collection of field observations; theoretical analyses; and development of data assimilation and modeling technologies. Initiate Unified Data Assimilation initiative to improve data assimilation technologies across the atmosphere, ocean, wave, and sea ice sub-disciplines.					
-Through the Sensor systems: Continue applied research and studies aimed at increasing knowledge content of data from remote sensing and through-the-sensor systems as well as improving the representation of dynamical and physical processes, coupled atmosphere/ocean/wave/ice/land processes, atmospheric predictability, and methodologies for probabilistic forecasting and characterization of uncertainty. These studies include efforts to develop appropriate techniques to obtain atmospheric environmental data from airborne and space-borne sensors.					
-Tactical Decision Aids: Continue efforts focused on parameters that affect EO and EM propagation in the marine environment with the goal of representing the real current and forecast atmosphere in tactical decision aids. Extend research of boundary layer processes, focusing on impact to state variables and their gradients. Initiate improved characterization of clouds, aerosols, and optical turbulence as they affect propagation of high energy laser systems.					
-Numerical Weather Prediction: Continue applied research to improve and optimize the Navy's regional and global numerical weather prediction systems by increasing resolution and incorporating new physics and numerical methods to provide much more accurate forecasts from the Tropics to the Arctic. Conduct applied research on a next-generation global model that incorporates efficient numerical methods, variable resolution grids, improved representation of physics, and that can operate efficiently on future computational systems.					
-Tropical Cyclone Forecast Models: Continue to develop and improve tropical cyclone forecast models to more accurately predict the rapid intensification of strong tropical cyclones. As these capabilities mature, shift focus into increasing ability to leverage better observing data, data assimilation techniques, and algorithmic analysis of storm structure and character to better understand and predict phenomenology.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / <i>Ocean Wrfghtg Env Applied Res</i>	Project (Number/Name) 0000 / <i>Ocean Wrfghtg Env Applied Res</i>

B. Accomplishments/Planned Programs (\$ in Millions)

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Atmospheric Prediction: Continue efforts on the design, performance, analysis and underlying theory of global-to-tactical scale numerical simulations specifically designed to represent atmospheric environmental processes and phenomena.</p> <p>-Initiate how the land surface impacts predictability of boundary layer processes on weather from weekly to sub-seasonal timescales using Navy atmospheric models and predictability tools to quantify feedbacks and affects.</p> <p><i>FY 2023 Base Plans:</i></p> <p>- Initiate exploration of utilizing fleet EO/IR sensors to estimate the aerosol, water vapor, and turbulent structure of the atmosphere for quantifiable state estimation and prediction for high energy laser applications.</p> <p>- Initiate the development of new decision aids that take weather and climate extremes into account for improved ship routing, fuel efficiency, and bases and infrastructure protection and optimization.</p> <p>- Initiate the development of utilizing low order models based on machine learning techniques to provide advanced computational efficiency for large member ensemble prediction systems.</p> <p>- Initiate a study on forecast skill as a function of lead time across model approaches for seamless decision support from hours to years.</p> <p>- Initiate how the land surface impacts predictability of boundary layer processes on weather from weekly to sub-seasonal timescales using Navy atmospheric models and predictability tools to quantify feedbacks and affects.</p> <p>Data Assimilation and Modeling: Continue collection of field observations; quality control and process oriented analyses; and development of data assimilation and modeling technologies. Continue Unified Data Assimilation initiative to improve data assimilation technologies across the atmosphere, thermosphere, ocean, wave, and sea ice sub-disciplines</p> <p>- Through the Sensor systems: Continue applied research and studies aimed at increasing knowledge content of data from remote sensing and through-the-sensor systems as well as improving the representation of dynamical and physical processes, coupled atmosphere/thermosphere/ocean/wave/ice/land processes, atmospheric predictability, and methodologies for probabilistic forecasting and characterization of uncertainty. These studies</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
include efforts to develop appropriate techniques to obtain atmospheric environmental data from airborne and space-borne sensors.						
-Tactical Decision Aids: Continue efforts focused on parameters that affect Radar, Radio Communications, Imaging Sensors, and Laser propagation in the marine environment with the goal of representing the real current and forecast atmosphere in tactical decision aids.						
- Continue to extend research of boundary layer processes, focusing on impact to state variables and their gradients.						
- Continue improved characterization of clouds, aerosols, and optical turbulence as they affect propagation of high energy laser systems.						
- Numerical Weather Prediction: Continue applied research to improve and optimize the Navy's regional and global numerical weather prediction systems by increasing resolution and incorporating new physics and numerical methods to provide much more accurate forecasts from the Tropics to the Arctic. Conduct applied research on a next-generation global model that incorporates efficient numerical methods, variable resolution grids, improved representation of physics, and that can operate efficiently on future computational systems.						
- Tropical Cyclone Forecast Models: Continue to develop and improve tropical cyclone forecast models to more accurately predict the rapid intensification of strong tropical cyclones. As these capabilities mature, shift focus into increasing ability to leverage better observing data, data assimilation techniques, and algorithmic analysis of storm structure and character to better understand and predict phenomenology.						
- Atmospheric Prediction: Continue efforts on the design, performance, analysis and underlying theory of global-to-tactical scale numerical simulations specifically designed to represent atmospheric environmental processes and phenomena.						
- Continue to investigate how the land surface impacts predictability of boundary layer processes on weather from weekly to sub-seasonal timescales using Navy atmospheric models and predictability tools to quantify feedbacks and affects.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to improve Naval simulation and prediction capabilities of the dynamic and thermodynamic processes in the atmosphere and ocean on a wide spectrum of scales, and to quantify and better represent the uncertainty in these predictions. This includes improvements to the forecast models, as well as improvements to ensemble forecast systems, which provide uncertainty estimates of forecasts and probabilistic predictions of particular events. As the Navy conducts a significant portion of its operations near the ocean surface up to a height of several thousand feet above the surface, in a region typically known as the atmospheric boundary layer, it is critical that our simulation and prediction capabilities of the dynamic and thermodynamic processes in this region, as well as new and emerging observational capabilities such as unmanned vehicles, are accurate.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The Increase from FY22 to FY23 of \$2.631M is for a new effort focused on developing decision aids that take weather and climate extremes into account for improved ship routing, fuel efficiency, and bases and infrastructure protection and optimization.</p>							
<p>Title: National Oceanographic Partnership Program (NOPP)</p> <p>Description: This activity focuses on Navy investments in the National Oceanographic Partnership Program (NOPP). NOPP, established by the US Congress (Public Law 104-201) in FY97, is a unique collaboration among U.S. 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, reduces costs, or both. NOPP topics address scientific problems that cross agency missions, fall in gaps between agencies or are too large for any single agency to fund.</p> <p>FY 2022 Plans: -National Oceanographic Partnership Program (NOPP): NOPP focus areas include topics of interest to multiple federal agencies that share ocean-related missions and are effectively investigated via partnerships. Topics include ocean, atmosphere, and coastal dynamical process studies; development of sensors, communications, and data acquisition approaches and methodologies for ocean research; modernization of ocean research and observation infrastructure; and studies of soundscapes in the ocean related to marine mammal research.</p>			8.687	8.893	9.007	0.000	9.007

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Oceanographic Observations and Modeling: Continue oceanographic studies focused on model verification, constraint of boundary conditions and fluxes of mass, heat and momentum across them (air-sea, deep ocean-seabed, land-sea), and responses to storm and/or persistent forcing.</p> <p>-Space Based Sensors: Continue the development and utilization of small space-based sensors for oceanographic and atmospheric dynamics research. - Next Generation Oceanographic sensors: Continue development of miniaturized, low- power, next generation sensors for ocean measurements including soft materials.</p> <p>-Initiate hurricane coastal impact forecasting, including space-based remote sensing for multi-dimensional digital elevation models, suitable to initialize and ground-truth forecasts..</p> <p>FY 2023 Base Plans:</p> <p>- Continue National Oceanographic Partnership Program (NOPP) to focus topics of interest to multiple federal agencies that share ocean-related missions and are effectively investigated via partnerships. Topics include ocean, atmosphere, and coastal dynamical process studies; development of sensors, communications, and data acquisition approaches and methodologies for ocean research; modernization of ocean research and observation infrastructure; and studies of soundscapes in the ocean related to marine mammal research.</p> <p>- Continue Oceanographic Observations and Modeling studies focused on model verification, constraint of boundary conditions and fluxes of mass, heat and momentum across them (air-sea, deep ocean-seabed, land-sea), and responses to storm and/or persistent forcing.</p> <p>- Continue Space Based Sensors effort for the development and utilization of small space-based sensors for oceanographic and atmospheric dynamics research. - Next Generation Oceanographic sensors: Continue development of miniaturized, low- power, next generation sensors for ocean measurements including soft materials.</p> <p>- Continue hurricane coastal impact forecasting, including space-based remote sensing for multi-dimensional digital elevation models, suitable to initialize and ground-truth forecasts.</p> <p>FY 2023 OCO Plans:</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: No significant increase from FY22 to FY23.						
Title: Task Force Ocean (formerly Ocean Acoustics)		15.107	23.614	27.328	0.000	27.328
Description: The Task Force Ocean activity focuses on the impact of the natural ocean environment on acoustic wave phenomena in support of 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 has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic systems, are the shallow water, 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. This activity will also focuses on efforts addressing research needs identified by Task Force Ocean that will enable tactical maneuver for the future submarine force. The efforts funded by this Program Element (PE) fall generally into two topic areas: Analysis and understanding of the impact of environmental conditions on sonar data, and the development of reduced order ocean-acoustic models to enable environmental awareness and prediction on forward platforms.						
FY 2022 Plans: - Anti-Submarine Warfare: Continue to conduct applied research developing improved Anti-Submarine Warfare (ASW) performance assessment models and tactical decision aids to plan ASW operations, evaluate effectiveness of ASW systems, and enable environmental adaptive system control - Sensors: Continue to provide Anti-Submarine Warfare (ASW) sensor and system performance models, realistic simulations, and measures of effectiveness. This includes incorporating and exploiting critical environmental knowledge and requires coupling ocean dynamics and acoustics, ambient noise characterization in the littorals. It also includes applied research in acoustic and optical scattering and propagation characterization, through-the-sensor measurement techniques for in situ environmental parameters, measurement and prediction of uncertainty, and development of tactical decision tools. Conduct research efforts to enable environmental awareness and tactical exploitation of the environment by forward naval platforms. Activities will include the development of technologies and algorithms to incorporate in situ environmental sensing into an on-scene						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>environmental characterization capability, inversion of sensor data to infer the local environment, and the development of capabilities to exploit the ocean environment for tactical advantage. Research efforts are informed by activities conducted by Task Force Ocean, which involve academic researchers, industry partners, and the operational Navy.</p> <p>- Passive Sonar: Continue to further applied research to enhance passive sonar performance capability in the Arctic environment by developing a better passive sonar performance prediction model and new acoustic ice-characterization methods.</p> <p>- Environmental Acoustics: Continue development of ensemble prediction products that exploit improved computational speeds for both underwater and atmospheric acoustics.</p> <p>- Sensors: Continue development of improved performance prediction products that exploit emerging space based sensing/characterization for rough bubbly surface boundaries.</p> <p>- Continue efforts that will lead to in-situ estimation of environmental parameters; optimized sensing and behaviors by adapting in dynamic and uncertain environments; and capturing uncertainty in system performance prediction and tactical decision aids for ASW, MIW, and Seabed Warfare.</p> <p>- Continue development of parameterizations to predict the contribution from breaking waves to acoustic ambient noise, quantifying the increased accuracy vice using wind speed alone.</p> <p>- Initiate new efforts centered on intensive data collection and modeling of a specific region of the ocean that will be chosen to balance scientific and operational priorities. Specific efforts will focus on improved understanding of the complex relationships amongst a large number of ocean processes and variables that include sound propagation, ambient sound, ocean and atmosphere physical processes, and biological communities. The objectives to achieve include development of innovative tools that provide insight into uncertainty that may be suitable for transition to tactical decision aids. Objectives also include prototype development of new sensors and systems that address ocean observing and exploitation requirements from Naval Oceanography at large to the unit level, as well as novel exploitation of existing sensing infrastructure. Coupled/hybrid assimilation techniques that leverage a combination of numerical modeling and AI/ML will also be developed and tested</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
using a variety of approaches including through the sensor collection and real time analysis.that exploit emerging space based sensing/characterization for rough bubbly surface boundaries.						
FY 2023 Base Plans: - Continue efforts centered on intensive data collection and modeling of the Atlantis II region of the New England Seamounts, The area was chosen to balance scientific and operational priorities. Specific efforts will focus on improved understanding of the complex relationships amongst a large number of ocean processes and variables that include sound propagation, ambient sound, ocean and atmosphere physical processes, and biological communities. The objectives to achieve include development of innovative tools that provide insight into uncertainty that may be suitable for transition to tactical decision aids. Objectives also include prototype development of new sensors and systems that address ocean observing and exploitation requirements from Naval Oceanography at large to the unit level, as well as novel exploitation of existing sensing infrastructure. Coupled/ hybrid assimilation techniques that leverage a combination of numerical modeling and AI/ML will also be developed and tested using a variety of approaches including through the sensor collection and real time analysis. - Continue Anti-Submarine Warfare effort to conduct applied research developing improved Anti-Submarine Warfare (ASW) performance assessment models and tactical decision aids to plan ASW operations, evaluate effectiveness of ASW systems, and enable environmental adaptive system control - Continue Sensors development to provide Anti-Submarine Warfare (ASW) sensor and system performance models, realistic simulations, and measures of effectiveness. This includes incorporating and exploiting critical environmental knowledge and requires coupling ocean dynamics and acoustics, ambient noise characterization in the littorals. It also includes applied research in acoustic and optical scattering and propagation characterization, through-the-sensor measurement techniques for in situ environmental parameters, measurement and prediction of uncertainty, and development of tactical decision tools. Conduct research efforts to enable environmental awareness and tactical exploitation of the environment by forward naval platforms. Activities will include the development of technologies and algorithms to incorporate in situ environmental sensing into an on-scene environmental characterization capability, inversion of sensor data to infer the local environment, and the development of capabilities to exploit the ocean environment for tactical advantage. Research efforts are informed by activities conducted by Task Force Ocean, which involve academic researchers, industry partners, and the operational Navy.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue Passive Sonar work to further applied research to enhance passive sonar performance capability in the Arctic environment by developing a better passive sonar performance prediction model and new acoustic ice-characterization methods.</div> <div>- Continue Environmental Acoustics development of ensemble prediction products that exploit improved computational speeds for both underwater and atmospheric acoustics.</div> <div>- Continue Sensors development of improved performance prediction products that exploit emerging space based sensing/ characterization for rough bubbly surface boundaries.</div> <div>- Continue efforts that will lead to in-situ estimation of environmental parameters; optimized sensing and behaviors by adapting in dynamic and uncertain environments; and capturing uncertainty in system performance prediction and tactical decision aids for ASW, MIW, and Seabed Warfare.</div> <div>- Continue development of parameterizations to predict the contribution from breaking waves to acoustic ambient noise, quantifying the increased accuracy vice using wind speed alone.</div> <div>- Continue development and advances to ambient noise characterization, source property and location estimation, expansion of varied data assimilation methodologies and improvements to metrics used for such capabilities in a variety of acoustic scenarios.</div> <div>- Continue development of parameterizations to predict the contribution from breaking waves to acoustic ambient noise, quantifying the increased accuracy vice using wind speed alone.</div> <div>- Continue efforts that will lead to in-situ estimation of environmental parameters; optimized sensing and behaviors by adapting in dynamic and uncertain environments; and capturing uncertainty in system performance prediction and tactical decision aids for ASW, MIW, and Seabed Warfare</div> <div>FY 2023 OCO Plans: N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
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 2021	FY 2022	FY 2023 Base
The increase from FY22 to FY23 is tied to the growing scope with FY23 increase associated with the increased costs of intensive data collection and modeling of the Atlantis II region of the New England Seamounts activities initiated in FY22. This is a multi-year endeavor that ramps up with the first field effort in FY22 conducting a mini-pilot with only about a week on site. The full pilot is in 2023 and requires about a month at the seamount area, and the main experiment spans 2024 to 2025 with yearlong moorings with each phase incurring additional and increased cost as the effort progresses.					FY 2023 OCO
					FY 2023 Total
<p>Title: Physical Oceanography</p> <p>Description: The Physical Oceanography activity develops knowledge of the physics of the ocean to enable tactical naval use and exploitation of the battlespace. 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 column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve Surface Warfare, Anti-Submarine Warfare, Naval Special Warfare, and Mine and Expeditionary Warfare operations. Oceanographic field research that uses active acoustic transmissions requires modeling of the acoustic effects of sound on marine life in order to meet Navy environmental requirements.</p> <p>FY 2022 Plans:</p> <ul style="list-style-type: none"> - Sensors: Continue to conduct testing and integration of turbulence sensors and other ocean oceanographic sensors into unmanned platforms to expand ocean sampling capabilities. Continue development of autonomous sensors and platforms for use in the Arctic ocean environment. Continue field campaigns to study ocean processes and dynamics, ocean model development, and data assimilation from the open ocean to the nearshore environments. Continue to conduct studies to develop new or enhance existing shipboard, in-situ, airborne, and space borne sensors and appropriate inversion and through the sensor techniques to obtain physical oceanographic environmental data. - Data Assimilation: Continue data assimilation development to coupled modeling approaches including air-ice-wave- ocean-land models. 		10.976	11.485	10.634	0.000
					10.634

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Earth System Prediction Models: Continue development of the capability to utilize Earth System Prediction Models to forecast the global ocean using ensemble prediction methods to enable risk assessment with skill to 30 days.</p> <p>- Ocean Battlespace: Continue efforts to develop a new capability for accurate and rapid characterization of the local ocean battlespace utilizing the ability of gliders to work in coordinated teams and 4-dimensional variation assimilation to maximize impact of the glider data in a high-resolution local forecast model for more accurate ocean predictions.</p> <p>- Task Force Ocean: Continue research coordinated with Task Force Ocean including efforts to develop new and enhance existing shipboard, in-situ, airborne, and space-borne sensors, appropriate inversion methods, and through the sensor techniques to obtain physical oceanographic environmental data in conjunction with acoustical observations.</p> <p>- Initiate new techniques and capabilities to improve our ability to handle the near future large amounts of ocean data (including SWO altimetry data) available for assimilation into analysis and forecast systems. This includes translating the data assimilation problem to wavelet space in order to accurately correct the model background while largely retaining the realistic fractal dynamics generated by the model physics and the sparsification of covariance matrices.</p> <p>FY 2023 Base Plans:</p> <p>- Continue efforts into investigating new techniques and capabilities to improve our ability to handle large amounts of ocean data (including SWOT altimetry data) available in the near future for assimilation into analysis and forecast systems. This includes translating the data assimilation problem to wavelet space in order to accurately correct the model background while largely retaining the realistic fractal dynamics generated by the model physics and the sparsification of covariance matrices.</p> <p>- Continue to model/simulate ocean current variability, including the deep ocean boundary providing improved ocean environmental information for Seabed Warfare. Model/simulate high-resolution coupled wave-circulation-sediment transport on multiple timescales including storm event and seasonal timescales providing the capability to estimate environmental conditions in shallow water (<100 m) to support MIW and NSW.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Sensors effort to conduct testing and integration of turbulence sensors and other ocean oceanographic sensors into unmanned platforms to expand ocean sampling capabilities. Continue development of autonomous sensors and platforms for use in the Arctic ocean environment. Continue field campaigns to study ocean processes and dynamics, ocean model development, and data assimilation from the open ocean to the nearshore environments. Continue to conduct studies to develop new or enhance existing shipboard, in-situ, airborne, and space borne sensors and appropriate inversion and through the sensor techniques to obtain physical oceanographic environmental data.</p> <p>- Continue Data Assimilation development to coupled modeling approaches including air-ice-wave- ocean-land models.</p> <p>- Continue Earth System Prediction Models development of the capability to utilize Earth System Prediction Models to forecast the global ocean using ensemble prediction methods to enable risk assessment with skill to 30 days.</p> <p>- Continue Ocean Battlespace efforts to develop a new capability for accurate and rapid characterization of the local ocean battlespace utilizing the ability of gliders to work in coordinated teams and 4-dimensional variation assimilation to maximize impact of the glider data in a high-resolution local forecast model for more accurate ocean predictions.</p> <p>- Continue Task Force Ocean research coordinated with Task Force Ocean including efforts to develop new and enhance existing shipboard, in-situ, airborne, and space-borne sensors, appropriate inversion methods, and through the sensor techniques to obtain physical oceanographic environmental data in conjunction with acoustical observations.</p> <p>- Continue new techniques and capabilities to improve our ability to handle the near future large amounts of ocean data (including SWO altimetry data) available for assimilation into analysis and forecast systems. This includes translating the data assimilation problem to wavelet space in order to accurately correct the model background while largely retaining the realistic fractal dynamics generated by the model physics and the sparsification of covariance matrices.</p> <p>FY 2023 OCO Plans:</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> No significant change from FY22 to FY23.						
Accomplishments/Planned Programs Subtotals		59.593	70.086	74.622	0.000	74.622
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	18.342	33.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	51.842

A. Mission Description and Budget Item Justification

Developed a customized integrated sensor to enable new unmanned systems data collections in complex operating environments. Tested the integrated sensor performance in various environmental conditions to identify performance expectations and performance model development.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Task Force Ocean	9.654	10.000
FY 2021 Accomplishments: Continued exploration of analytic techniques linking physical oceanographic variability with acoustic propagation, including field efforts to collect relevant data sets. The development and use of artificial intelligence and machine learning techniques for large ocean and acoustic data sets. Through-the-sensor environmental characterization, including assimilation into nested local environmental prediction models. Explored and developed advanced signal processing techniques that incorporate local ocean structure, including ambient noise characterization		
FY 2022 Plans: Continue exploration of analytic techniques linking physical oceanographic variability with acoustic propagation, including field efforts to collect relevant data sets. The development and use of artificial intelligence and machine learning techniques for large ocean and acoustic data sets. Through-the-sensor environmental characterization, including assimilation into nested local environmental prediction models. Explored and developed advanced signal processing techniques that incorporate local ocean structure, including ambient noise characterization		
Congressional Add: Navy Special Warfare Superiority in Underseas and Maritime Environments	4.827	0.000
FY 2021 Accomplishments: Conducted applied research supporting Navy Special Warfare Superiority in Underseas and Maritime Environments.		
FY 2022 Plans: N/A		
Congressional Add: Ocean Acoustics for Monitoring	3.861	0.000
FY 2021 Accomplishments: Conducted applied research supporting Ocean Acoustics for Monitoring.		
FY 2022 Plans: N/A		
Congressional Add: Climate change hydraulic modeling risk analysis	0.000	1.500

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / <i>Ocean Wrfghtg Env Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct climate change hydraulic modeling risk analysis applied research		
<i>Congressional Add:</i> Continuous distributed sensing systems	0.000	5.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct applied research in continuous distributed sensing systems		
<i>Congressional Add:</i> Research vessel cyber infrastructure improvements	0.000	4.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct research vessel cyber infrastructure improvements for applied research		
<i>Congressional Add:</i> Ocean acoustics	0.000	8.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct applied research in ocean acoustics		
<i>Congressional Add:</i> Operational demonstration of commercially available, long endurance USV	0.000	5.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct basic research supporting the operational demonstration of commercially available, long endurance USV		
Congressional Adds Subtotals	18.342	33.500

C. Other Program Funding Summary (\$ in Millions)
 N/A

Remarks

D. Acquisition Strategy
 N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602651M / <i>JT Non-Lethal Wpns Applied Res</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	6.150	6.405	6.700	-	6.700	7.419	8.090	8.345	8.512	Continuing	Continuing
0000: <i>JT Non-Lethal Wpns Applied Res</i>	0.000	6.150	6.405	6.700	-	6.700	7.419	8.090	8.345	8.512	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DoD Non-Lethal Weapons (NLW) Program was established by the FY96 National Defense Authorization Act. The Office of the Secretary of Defense 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 nonlethal weapons and technology through the Joint Non-Lethal Weapons Program (JNLWP). The Office of the Under Secretary of Defense for Acquisition and Sustainment (A&S) serves as the OSD Principal Staff Assistant and oversees, in consultation with the Under Secretary of Defense for Policy, the DoD NLW Executive Agent.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions by the Joint Non-Lethal Weapons 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 requirements and capabilities sought by the Services 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 most relevant 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 National Defense Strategy (NDS) objective of strategic competition by providing options to the joint force in pursuit of national objectives in legal or policy constrained scenarios, as well as complementing the use of lethal effects in complex combat scenarios, for example, in urban environments with large civilian populations. Ongoing NLW Intermediate Force Capability (IFC) studies, analyses and exercise efforts with NATO and Allies also support NDS objectives to strengthen alliances and partnerships. Resulting capabilities facilitate a fully integrated non-lethal competency as a complement to lethal firepower, providing force application options for below lethal threshold engagements.

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 incapacitation, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.

This PE funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602651M / <i>JT Non-Lethal Wpns Applied Res</i>
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B. Program Change Summary (\$ in Millions)	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	6.316	6.405	0.000	-	0.000
Current President's Budget	6.150	6.405	6.700	-	6.700
Total Adjustments	-0.166	0.000	6.700	-	6.700
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.166	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	6.700	-	6.700

Change Summary Explanation

Funding: No significant change

Technical: No significant change

Schedule: No significant change

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602651M / JT Non-Lethal Wpns Appli ed Res				Project (Number/Name) 0000 / JT Non-Lethal Wpns Applied Res			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: JT Non-Lethal Wpns Applied Res	0.000	6.150	6.405	6.700	-	6.700	7.419	8.090	8.345	8.512	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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: (U) Joint Non-Lethal Weapons	6.150	6.405	6.700	0.000	6.700
FY 2022 Plans: Continue research and investigation of intermediate force effects and emergent technologies with the potential to further address the Joint Requirements Oversight Council (JROC)-approved non-lethal counter-personnel and counter-materiel capability gaps. Specifically, explore new non-lethal effects and evaluate alternative innovative applications of existing technologies to address future non-lethal capability needs as escalation of force platforms. Some examples of counter-personnel research include further optimization of non-lethal human effects, and enhanced understanding of human target behavioral effects. Conduct applied research to characterize non-lethal phenomena and to assess target human effects and weapon effectiveness, including the development of dose response and injury correlates for new Non-Lethal Weapons (NLW) technologies. Other research includes the assessment and study of new technologies related to NLW effectiveness and behavioral response, such as advancing the understanding of Flash Bang effects on humans to support novel non-explosive alternatives to pyrotechnic non-lethal devices. Some examples of counter-materiel research include the investigation of novel intermediate force capabilities for increased delivery and employment options for applications such as vehicle and vessel stopping, and the further optimization of intermediate force materials for integration into future escalation of force platforms. Other research includes feasibility and design studies for high peak power radio frequency directed energy sources and other high power microwave directed energy technologies (e.g., lasers, millimeter-waves) with extended range applications and longer duration of effect. Other examples of counter-materiel research include the investigation and conceptual design of high power microwave technologies to enable improved reduce overall size, weight,					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
power consumption, thermal cooling requirements, and overall system costs (SWAP-C) performance. Results will support the transition of viable technologies to higher levels of development and demonstration to further mitigate the JROC-approved joint non-lethal effects capability-gaps.								
High Peak Power Radio Frequency Assessment And Capability Development (HIPR ACTv): Continue industry engagement, complete vulnerability assessment, complete technology trade studies and concept design. Plan spectrum allocation, plan preliminary design and subsystem/component procurements to transition to the use of BA3 funds in PE 0603651M.								
FY 2023 Base Plans: Continue: -Research and investigation of intermediate force effects and emergent technologies with the potential to further address the Joint Requirements Oversight Council (JROC)-approved non-lethal counter-personnel and counter-material capability gaps. Results will support the transition of viable technologies to higher levels of development and demonstration to further mitigate the JROC-approved joint non-lethal effects capability-gaps. Current efforts include: -Explore new non-lethal effects and evaluate alternative innovative applications of existing technologies to address future non-lethal capability needs as escalation of force platforms. -Conduct counter-personnel research addressing further optimization of non-lethal human effects, and enhanced understanding of human target behavioral effects. -Conduct applied research to characterize Non-Lethal Weapons (NLWs) and Intermediate Force Capability (IFC) phenomena, and to assess target human effects and weapon effectiveness, including the development of dose response and injury correlates for new Non-Lethal Weapons (NLW) technologies. -Assess and study new technologies related to NLW effectiveness and behavioral response, such as advancing the understanding of Flash Bang effects on humans to support novel non-explosive alternatives to pyrotechnic non-lethal devices. -Conduct counter-materiel research to include the investigation of novel intermediate force capabilities for increased delivery and employment options for applications such as vehicle and vessel stopping, and the further optimization of intermediate force materials for integration into future escalation of force platforms. -Conduct feasibility and design studies for high peak power radio frequency directed energy sources and other high power microwave directed energy technologies (e.g., lasers, millimeter-waves) with extended range applications and longer duration of effect.								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Investigate and conceptual design research of high power microwave technologies to enable improved performance and reduce overall size, weight, power consumption, thermal cooling requirements, and overall system costs (SWAP-C).</p> <p>Complete:</p> <p>- Complete specific "Human Effects" (HE) dose response studies portion of the NLW IFC characterization effort directed at effects of NLW on areas such as the human thorax, lower abdomen, head, arms, and legs. These HE studies better inform the development of theoretical advanced total body models to support future NLW and IFC technology design parameters for counter-personnel applications.</p> <p>Initiate:</p> <p>- Research and investigation of novel NLW and IFC effects (such as novel dazzlers, flashbang, smoke, sting ball, and directed energy (DE) capabilities) to ultimately integrate onto future manned, unmanned, and autonomous weapons delivery platforms.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		6.150	6.405	6.700	0.000	6.700
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	93.280	107.734	58.111	-	58.111	59.278	60.463	61.673	62.907	Continuing	Continuing
0000: Undersea Warfare Applied Res	0.000	54.665	57.484	58.111	-	58.111	59.278	60.463	61.673	62.907	Continuing	Continuing
9999: Congressional Adds	0.000	38.615	50.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	88.865

A. Mission Description and Budget Item Justification

The Undersea Warfare Applied Research Program Element (PE) funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. 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 PE.

The activities described in this PE address future Navy and Marine Corps capabilities needed to maintain maritime superiority and ensure national security. Targeted capabilities are based on input from Naval Research Enterprise stakeholders including combatant commands, Office of the Chief of Naval Operations (OPNAV) and Headquarters Marine Corps and are designed to exploit breakthroughs in science and technology in order to deliver maximum undersea warfighting benefit to our sailors and marines.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		96.039	57.484	0.000	-	0.000
Current President's Budget		93.280	107.734	58.111	-	58.111
Total Adjustments		-2.759	50.250	58.111	-	58.111
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	50.250			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-0.022	0.000			
• SBIR/STTR Transfer		-2.737	0.000			
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	58.111	-	58.111
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Persistent Maritime Surveillance						
Congressional Add: Undersea sensing and communications						
Congressional Add: Cross Domain Autonomy for Persistent Maritime Operations						
Congressional Add: Partnerships for Undersea Vehicle Research						
Congressional Add: Resident Undersea Autonomous Robotics						
Congressional Add: Academic partnerships for innovative research						
Congressional Add: Energetic global awareness						
Congressional Add: Bomb technicians training innovations						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Schedule: No significant change.						
Technical: No significant change.						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
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	
Funding: No significant change. --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Undersea Warfare Applied Res	0.000	54.665	57.484	58.111	-	58.111	59.278	60.463	61.673	62.907	Continuing	Continuing
A. Mission Description and Budget Item Justification												
This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Anti-Submarine Warfare (ASW) Distributed Search								14.329	14.722	14.882	0.000	14.882
Description: ASW Distributed Search focuses on the development of technologies for the 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. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Related efforts include the development of distributed systems; Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components; and active acoustic sensing and processing techniques, navy-unique transduction and underwater networking technologies. 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.												
FY 2022 Plans:												
- Active Sonar: Continue development of advanced signal and information processing for high duty cycle active sonar. Further development of concepts for next-generation active sonar system automation, leveraging the latest advances in machine learning and artificial intelligence. Continue non-acoustic, orthogonal concepts that complement and augment active sonar concepts.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Sensors: Continue applied research in improved sensor technology to include both passive and active acoustic and optical sensing to extend the capabilities of platform-based systems as well as innovative sensor technology for off-board and rapidly deployable systems.</p> <p>- Signal Processing: Continue development of advanced signal and information processing for high duty cycle active sonar. Continue to leverage advances in machine learning, e.g. deep learning, to improve performance in clutter type classification and clutter/target discrimination in current active sonar systems. Continue to leverage advances in artificial intelligence, with the objective to develop next-generation intelligent active sonar systems that optimally adapt operating parameters for the operating environment.</p> <p>- Initiate development of technologies and techniques for exploiting structural acoustic vulnerabilities of adversary undersea platforms conducting an at sea trial.</p> <p>- Initiate efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats.</p> <p>- Continue development of technologies and signal processing, verified through sea trials that exploit the structural acoustics of undersea vehicles and structures.</p> <p>FY 2023 Base Plans:</p> <p>- Continue Active Sonar development of advanced signal and information processing for high duty cycle active sonar. Further development of concepts for next-generation active sonar system automation, leveraging the latest advances in machine learning and artificial intelligence. Continue non-acoustic, orthogonal concepts that complement and augment active sonar concepts.</p> <p>- Continue Sensors applied research in improved sensor technology to include both passive and active acoustic and optical sensing to extend the capabilities of platform-based systems as well as innovative sensor technology for off-board and rapidly deployable systems.</p> <p>- Continue Signal Processing development of advanced signal and information processing for high duty cycle active sonar. Continue to leverage advances in machine learning, e.g. deep learning, to improve performance in</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>clutter type classification and clutter/target discrimination in current active sonar systems. Continue to leverage advances in artificial intelligence, with the objective to develop next-generation intelligent active sonar systems that optimally adapt operating parameters for the operating environment.</p> <p>- Continue development of technologies and techniques for exploiting structural acoustic vulnerabilities of adversary undersea platforms conducting an at sea trial.</p> <p>- Continue efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats.</p> <p>- Continue development of technologies and signal processing, verified through sea trials that exploit the structural acoustics of undersea vehicles and structures.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Anti-Submarine Warfare (ASW) Precision Localization</p> <p>Description: ASW 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 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.</p> <p>FY 2022 Plans:</p>		3.447	3.528	3.573	0.000	3.573

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Precision Localization: Continue research on advanced sensing modalities and sampling approaches. Investigate alternative methods for Precision Localization leveraging magnetic and electric field sensing technologies and incorporating alternative technologies and approaches.</p> <p>-Sensors: Continue research into novel methods to develop smaller and power efficient, high performance magnetic, electric field, acoustic, and novel sensors. Continue research on advanced concepts for processing arrays of independent sensors to create adaptive information theoretic sensor systems. Continue applied research into information theoretic optical sampling and telemetry characteristics to better support sensor performance and data integrity; improve the effectiveness of photonic sensor operations across the air-water interface; and extend the distance optical sensors can effectively operate within the water column.</p> <p>-Remote and Optical Sensing: Continue research into remote methods of sensing target signatures. Continue research on optical sensing for precision localization and to better exploit the information capacity available in photonic systems to increase sensor performance.</p> <p>FY 2023 Base Plans:</p> <p>-Continue Precision Localization research on advanced sensing modalities and sampling approaches. Investigate alternative methods for Precision Localization leveraging magnetic and electric field sensing technologies and incorporating alternative technologies and approaches.</p> <p>-Continue sensors research into novel methods to develop smaller and power efficient, high performance magnetic, electric field, acoustic, and novel sensors. Continue research on advanced concepts for processing arrays of independent sensors to create adaptive information theoretic sensor systems. Continue applied research into information theoretic optical sampling and telemetry characteristics to better support sensor performance and data integrity; improve the effectiveness of photonic sensor operations across the air-water interface; and extend the distance optical sensors can effectively operate within the water column.</p> <p>-Continue Remote and Optical Sensing research into remote methods of sensing target signatures. Continue research on optical sensing for precision localization and to better exploit the information capacity available in photonic systems to increase sensor performance.</p> <p>FY 2023 OCO Plans:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.						
Title: Anti-Submarine Warfare (ASW) Surveillance		21.122	23.093	23.308	0.000	23.308
Description: ASW Surveillance focuses on improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of existing 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 forward and contested operating areas, and in complex operational environments against all submarine threats, including new threats with unknown target signatures and tactics. Covertiness 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 2022 Plans:						
- Sonar: Continue signal processing related research to develop artificial intelligence technology providing optimized sonar system line-ups that adjust themselves in real time to the current undersea environment.						
- Sonar: Initiate exploitation of the information content of ambient noise, creating novel tactical detection methods that exploit ambient noise information content and conducting at sea measurements to validate.						
- Sonar: Initiate development and assessment of signal approaches for low complexity sonars, focusing on passive analysis and the generation of actionable warnings. Validate single processing approaches using at sea data.						
- Sensors: Continue studies to improve performance of acoustic vector sensors, vector magnetometers, electrochemical sensors and three-axis magnetometers.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Sensors: Initiate development of automation approaches that will modernize undersea passive acoustic detection and classification techniques conducting a major at sea trial to collect data for algorithm training and assessment.</p> <p>- Underwater Vehicle Propulsion: Continue development of approaches for fluid-loaded elastic structures and soft-bodied unmanned underwater vehicle propulsion.</p> <p>- Underwater Vehicle Propulsion: Initiate development of technologies for a solar sea glider focused on develop a wavelength tailored photovoltaic cell with selectable layers for use at surface and sub-surface conditions and begin to look at mitigation approaches to bio-fouling.</p> <p>- Signal Processing: Continue investigating applicable non-acoustic methods of detection and classification of ultra-quiet, low-Doppler submarines in complex operating environments. Initiate applied research to exploit recent advances in basic / theoretical computer science to efficiently implement signal processing and artificial-intelligence algorithms using mathematical approaches including randomized methods.</p> <p>- Initiate efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats; and new processing techniques which increase performance and expand the tactical utility of current systems.</p> <p>FY 2023 Base Plans:</p> <p>- Continue Sonar signal processing related research to develop artificial intelligence technology providing optimized sonar system line-ups that adjust themselves in real time to the current undersea environment.</p> <p>- Continue Sonar exploitation of the information content of ambient noise, creating novel tactical detection methods that exploit ambient noise information content and conducting at sea measurements to validate.</p> <p>- Continue Sonar development and assessment of signal approaches for low complexity sonars, focusing on passive analysis and the generation of actionable warnings. Validate single processing approaches using at sea data.</p>								

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Sensor studies to improve performance of acoustic vector sensors, vector magnetometers, electrochemical sensors and three-axis magnetometers.</p> <p>- Continue Sensors development of automation approaches that will modernize undersea passive acoustic detection and classification techniques conducting a major at sea trial to collect data for algorithm training and assessment.</p> <p>- Continue Underwater Vehicle Propulsion development of approaches for fluid-loaded elastic structures and soft-bodied unmanned underwater vehicle propulsion.</p> <p>- Continue Underwater Vehicle Propulsion development of technologies for a solar sea glider focused on develop a wavelength tailored photovoltaic cell with selectable layers for use at surface and sub-surface conditions and begin to look at mitigation approaches to bio-fouling.</p> <p>- Continue Signal Processing investigating applicable non-acoustic methods of detection and classification of ultra-quiet, low-Doppler submarines in complex operating environments. Initiate applied research to exploit recent advances in basic / theoretical computer science to efficiently implement signal processing and artificial-intelligence algorithms using mathematical approaches including randomized methods.</p> <p>- Continue efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats; and new processing techniques which increase performance and expand the tactical utility of current systems.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
Title: Marine Mammals		2.449	2.507	2.539	0.000	2.539
Description: The goal of the Marine Mammals and Biology activity focus is to better understand and characterize the effects of underwater sounds produced by Navy acoustic sources on marine mammals.						

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Studies address characterizing marine mammal and their ecosystems, quantifying effects of sound exposure on marine mammals, and improving the ability to monitoring and detect marine mammals in the open ocean. Research results supports Navy environmental compliance information needs and facilitates acquiring Letter of Authorizations from NOAA regulators that enable all Navy training and testing operations, and the development of appropriate state-of-the-art mitigation measures.</p> <p>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 Ocean Warfighting Environment Applied Research.</p> <p>FY 2022 Plans: Efforts include applied research in areas including monitoring and detection, integrated ecosystem, and effects of Anti-Submarine Warfare (ASW) sonar on marine mammals.</p> <p>-Passive Acoustic Monitoring: Continue research efforts on passive acoustics and other technology supporting wide area surveillance, including the development and testing of new autonomous hardware platforms and signal processing algorithms for detection, classification, and localization of marine mammals. Continue research using animal tagging and passive acoustic monitoring to quantify behaviors, movement and distribution of marine mammals relative to key environmental properties and sonar exposure, both incidental and experimental.</p> <p>-Sonar Exposure: Continue research to quantify the behavioral and physiological effects to potentially population-level consequences of sonar exposure on marine life to develop risk criteria for Navy's sound effects modeling, and develop quantitative inputs for modeling biologically significant effects on marine mammal populations. Navy sound effects modeling is used in Environmental Impact Statements, and subsequent Letters of Authorization issued by the NOAA regulator that enable all Navy ASW exercises and testing.</p> <p>- Marine Mammals: Continue with further research to design equipment and capability to quantify the gas management and kinetics in marine mammals to evaluate the mechanisms that enable marine mammals to dive to deep.</p> <p>- Sound Reception Mechanisms in Whales: Continue to pursue research to advance our understanding of sound reception mechanisms in large whales including the anatomy surrounding the ear and the whole head to improve and validate finite element models of sound propagation through various tissues.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Marine Mammal Behavior: Continue research into the stress response of marine mammals to ASW sonar exposure with an emphasis on quantifying the effects of prolonged exposure effects on immune system suppression, reproductive failure, accelerated aging, and slowed growth. Conduct research on potential effects of Navy Anti-Submarine Warfare (ASW) sonar sources on marine mammal behavior, life functions, vital rates, and population level effects. The goal is to understand and quantify the effects of naval activities on species or stocks of marine mammals, including effects on annual rates of recruitment and survival.</p> <p>- Environmental Compliance: Continue research to provide tools to support environmental compliance efforts and decision making related to how marine mammals can be affected by anthropogenic sounds.</p> <p>FY 2023 Base Plans:</p> <p>- Continue efforts include applied research in areas including monitoring and detection, integrated ecosystem, and effects of Anti- Submarine Warfare (ASW) sonar on marine mammals.</p> <p>- Continue Passive Acoustic Monitoring research efforts on passive acoustics and other technology supporting wide area surveillance, including the development and testing of new autonomous hardware platforms and signal processing algorithms for detection, classification, and localization of marine mammals. Continue research using animal tagging and passive acoustic monitoring to quantify behaviors, movement and distribution of marine mammals relative to key environmental properties and sonar exposure, both incidental and experimental.</p> <p>- Continue Sonar Exposure research to quantify the behavioral and physiological effects to potentially population-level consequences of sonar exposure on marine life to develop risk criteria for Navy's sound effects modeling, and develop quantitative inputs for modeling biologically significant effects on marine mammal populations. Navy sound effects modeling is used in Environmental Impact Statements, and subsequent Letters of Authorization issued by the NOAA regulator that enable all Navy Anti- Submarine Warfare (ASW) exercises and testing.</p> <p>- Continue Marine Mammals with further research to design equipment and capability to quantify the gas management and kinetics in marine mammals to evaluate the mechanisms that enable marine mammals to dive to deep.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Sound Reception Mechanisms in Whales to pursue research to advance our understanding of sound reception mechanisms in large whales including the anatomy surrounding the ear and the whole head to improve and validate finite element models of sound propagation through various tissues.</p> <p>- Continue Marine Mammal Behavior research into the stress response of marine mammals to ASW sonar exposure with an emphasis on quantifying the effects of prolonged exposure effects on immune system suppression, reproductive failure, accelerated aging, and slowed growth. Conduct research on potential effects of Navy ASW sonar sources on marine mammal behavior, life functions, vital rates, and population level effects. The goal is to understand and quantify the effects of naval activities on species or stocks of marine mammals, including effects on annual rates of recruitment and survival.</p> <p>- Continue Environmental Compliance research to provide tools to support environmental compliance efforts and decision making related to how marine mammals can be affected by anthropogenic sounds.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>							
<p>Title: Undersea Weaponry</p> <p>Description: Undersea Weaponry focuses on the development of technologies for current and next-generation, offensive and defensive weapons capable of engaging submarines, surface ships and threat torpedoes. Specific efforts focus on increasing probability of kill and probability of counter-kill by improving sensor performance, engagement tactics, vehicle propulsion and warhead lethality. New weapon and delivery concepts are being assessed.</p> <p>Detailed information regarding Undersea Weaponry Applied Research program plans and objectives is at a higher classification.</p> <p>FY 2022 Plans: - Continue applied research related to critical Science and Technology (S&T) for Rapid-Reaction Undersea Weapons and Counter-Measures, High-Speed Vehicle Technology, Undersea Warheads Technology, RPG-of-</p>			13.318	13.634	13.809	0.000	13.809

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>the-Sea and Air-Independent Power and Energy. Support related field activities under the Torpedo Field/Lab Experimentation Program.</p> <p>- Continue applied research to assess transition potential of technologies developed under the High-Speed Vehicle Technology and determine program continuation.</p> <p>FY 2023 Base Plans:</p> <p>- Continue applied research related to critical Science and Technology (S&T) for Rapid-Reaction Undersea Weapons and Counter-Measures, High-Speed Vehicle Technology, Undersea Warheads Technology, RPG-of-the-Sea and Air-Independent Power and Energy. Support related field activities under the Torpedo Field/Lab Experimentation Program.</p> <p>- Continue applied research to assess transition potential of technologies developed under the High-Speed Vehicle Technology and determine program continuation.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant funding change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		54.665	57.484	58.111	0.000	58.111
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	38.615	50.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	88.865
A. Mission Description and Budget Item Justification Efforts for Undersea Warfare Applied Research												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Persistent Maritime Surveillance								0.000	10.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct basic research supporting persistent maritime surveillance												
Congressional Add: Undersea sensing and communications								4.827	4.000			
FY 2021 Accomplishments: Regional research teams from several universities will jointly pursue applied research related to oceanographic processes, models and innovative technologies. Peer-reviewed scientific publications and final technical reports are the anticipated deliverables.												
FY 2022 Plans: Regional research teams from several universities will jointly pursue applied research related to oceanographic processes, models and innovative technologies. Peer-reviewed scientific publications and final technical reports are the anticipated deliverables.												
Congressional Add: Cross Domain Autonomy for Persistent Maritime Operations								9.654	0.000			
FY 2021 Accomplishments: The Office of Naval Research has Task Force Ocean grants in place with University of California, Massachusetts Institute of Technology, Woods Hole Oceanographic Institution, University of Rhode Island, and University of New Hampshire, as well as other ongoing efforts with CA, MA, and RI institutions to continue the Task Force Ocean research program.												
FY 2022 Plans: N/A												
Congressional Add: Partnerships for Undersea Vehicle Research								13.515	0.000			
FY 2021 Accomplishments: Develop technology that will enhance the undersea warfare domain that will strengthen collaboration between UCONN, URI, Navy Research laboratories, academia, and industry.												
FY 2022 Plans: N/A												
Congressional Add: Resident Undersea Autonomous Robotics								10.619	7.000			

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Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602747N / <i>Undersea Warfare Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> The OSU/APL-UW effort will develop critical technologies and at-sea testing to develop an undersea testbed for resident autonomy.		
<i>FY 2022 Plans:</i> The OSU/APL-UW effort will develop critical technologies and at-sea testing to develop an undersea testbed for resident autonomy.		
<i>Congressional Add:</i> Academic partnerships for innovative research	0.000	25.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct academic partnerships for innovative research applied research		
<i>Congressional Add:</i> Energetic global awareness	0.000	2.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct energetic global awareness applied research		
<i>Congressional Add:</i> Bomb technicians training innovations	0.000	2.250
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct applied research supporting bomb technicians training innovations		
Congressional Adds Subtotals	38.615	50.250

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602750N I Future Naval Capabilities Applied Research							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	165.813	198.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing
0000: Future Naval Capabilities Applied Research	0.000	158.090	171.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing
9999: Congressional Adds	0.000	7.723	27.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.723

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) works closely across the Department of the Navy (DON) and Naval Research Enterprise (NRE) to develop high priority technological capabilities needed by the operational forces. From their beginnings, the U.S. Navy and Marine Corps have leveraged technology innovation to gain decisive advantage. However, breakthroughs don't happen overnight. Critical to sustaining the pipeline of new capabilities, is maintaining a priority-driven portfolio of naval science and technology (S&T) to deliver solutions to known requirements, and experiment with potential game-changing ideas. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy. This PE funds Future Naval Capabilities (FNC) Technology Candidates, which are at lower Technology Readiness Level (TRLs), and is focused on maturing technologies to higher TRLs to reduce FNC transition risk. Efforts in this PE are coordinated with related work in the USMC Technology Candidates Activity of PE 0602131M Marine Corps Landing Force Technology.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. Most of the work in this PE can be classified between TRL 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments).

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	170.681	173.356	0.000	-	0.000
Current President's Budget	165.813	198.233	173.641	-	173.641
Total Adjustments	-4.868	24.877	173.641	-	173.641
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-2.123			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.406	0.000			
• SBIR/STTR Transfer	-3.462	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000

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Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research				Project (Number/Name) 0000 / Future Naval Capabilities Applied Research			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Future Naval Capabilities Applied Research	0.000	158.090	171.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing
A. Mission Description and Budget Item Justification												
Future Naval Capabilities (FNC) budget activity (BA) 2 investments develop candidate FNC technologies in an agile fashion by exploiting technology advances that respond rapidly to Naval needs. This approach facilitates an optimum response when developing and maturing the technology options that can be developed further in Program Element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development.												
The FNC Program favors a high level of collaboration. PE R-2 activities are mostly organized by the Office of Naval Research (ONR) Science and Technology Departments, which are tasked to collaborate with the acquisition stakeholders and their resource sponsors. A complete accounting of the technology candidates being developed and a full disposition of each technology development effort funded in this PE is provided annually to the Congressional oversight committees.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Expeditionary Maneuver Warfare (EMW) and Combating Terrorism								14.193	16.168	16.599	0.000	16.599
Description: The objective of this activity is to develop and mature technologies in asymmetric and irregular warfare, distributed operations, information warfare, survivability and self-defense to a point where they can be proposed and continued as FNCs in PE 0603673N, Future Naval Capabilities Advanced Technology Development.												
FY 2022 Plans:												
Human Performance Education and Training Thrust:												
- Progress and expand in the area of providing new training technologies, knowledge products, architectures, and systems that can accelerate mental, emotional and cognitive decision-making skill, to include human-machine teaming and greater naval capability to detect, localize and neutralize mines and improvised explosive devices that challenge the naval forces ability to operate in contested maritime environments.												
Logistics Thrust:												
- Continue novel technologies and innovative concepts that will improve the maneuverability of the Marine Corps Air Ground Task Force (MAGTF) by enhancing the movement of troops and equipment from shipboard to inland objectives.												
- Investigate ways to reduce the length of the supply chain for small units to include alternative local shipping and delivery methods and storage and power production and storage.												

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Force Protection Thrust:</p> <ul style="list-style-type: none">- Extend focus on the technologies that will enhance long-range fires capabilities so warfighters employed in small distributed units will have the tools they need to locate and decisively destroy larger enemy forces.- Develop technologies to improve warfighter effectiveness in command, control, computers and communication, intelligence, surveillance and reconnaissance for small unit naval expeditionary warfighters to include multi-domain sensing of the electronic spectrum.- Develop methods to defend against adversarial unmanned vehicles to include swarming attacks. <p>FY 2023 Base Plans:</p> <p>Human Performance Education and Training Thrust:</p> <ul style="list-style-type: none">- Continue research in new training technologies, knowledge products, architectures, and systems.- Continue research to accelerate mental, emotional and cognitive decision-making skills.- Continue research to improve human-machine teaming.- Continue research in the areas of detecting, localizing and neutralization of mines and improvised explosive devices that challenge the ability to operate in contested maritime environments.- Initiate efforts to develop and evaluate modeling and simulation-based capabilities to accelerate performance in training and education settings and increase readiness in the expeditionary environment. This includes the continuation of Warfighter Training research completed in PE 0602131M in FY22. <p>Logistics Thrust:</p> <ul style="list-style-type: none">- Continue research to enhance movement of troops and equipment from ship to inland objectives.- Continue research to develop higher material readiness and reduce the length of the supply chain for small units. This includes the continuation of New Repair Techniques research completed in PE 0602131M in FY22.- Continue Fleet Vehicle research completed in PE 0602131M in FY22 by continuing research in the area of unmanned platform power systems.- Initiate research in the area of advanced manufacturing materials.- Initiate applied research in the area of small scale, energy efficient water purification in support of distributed operations and Expeditionary Advance Base Operations (EABO). <p>Force Protection Thrust:</p> <ul style="list-style-type: none">- Continue research to improve warfighter effectiveness in command, control, computers and communication, intelligence, surveillance and reconnaissance in the area of electromagnetic spectrum analysis and signature							

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B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
management. This includes the continuation of Flexible Software Development research completed in PE 0602131M in FY22. - Complete applied research to defend against adversarial unmanned vehicles in the area of Counter Small Unmanned Aerial Systems (UAS). This effort will transition to Advanced Technology Demonstration. - Complete applied research to enhance long-range fires capabilities in the area of Ground Based Air Defense High Energy Laser. This effort will transition to Advanced Technology Demonstration. - Initiate research in the area of increased range and lethality for small form factor weapon systems in support of EABO. Firepower Thrust: - Initiate effort to conduct feasibility demonstration of a missile launcher capable of launching multiple calibers of militarily relevant munitions from a single platform. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY 2022 to FY 2023 is due to the initiation of investments in Firepower to conduct feasibility demonstration of a missile launcher capable of launching multiple calibers of militarily relevant munitions from a single platform. These investments will enhance the USMC fires capabilities by providing smaller and more agile, multi-platform compatible, affordable Long Range Precision Fires.						
Title: C4ISR and Special Projects Description: The objective of this activity is to develop and mature technologies in data science, mathematical optimization, computational and information sciences, quantum information sciences, electronics, command and control (C2), combat systems, communications, cyber security, cyber operations, electronic warfare (EW), sensing and surveillance, and precision timing and navigation (PTN), as well as technologies for surface and airborne vehicles, and cruise missile defense weapons to a point where they can be proposed and continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. FY 2022 Plans: Future Naval Capabilities (FNC) Technology Candidate development in FY 2022 will initiate efforts in:		54.825	47.581	45.141	0.000	45.141

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B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>sensing in a distributed environment.</p> <p>- Developing ultra-efficient neural network hardware.</p> <p>Complete efforts in:</p> <p>- A low-cost, high-fidelity network deception framework (CyberMoat) that lies to attackers' on-demand, and automated tools to coerce malware agents to deceive adversary Command and Control.</p> <p>- An operating system that enables automatic and efficient use of heterogeneous computing architectures for cyber resilience without requiring change to legacy source code.</p> <p>FY 2023 Base Plans:</p> <p>Communications and Networking Thrust:</p> <p>- Continue analyzing Fifth generation (5G) security and protocol to identify vulnerabilities to close security gaps to increase resiliency and robustness against adversarial attack.</p> <p>- Continue maturing promising over the horizon communications that include low probability of detection and low probability of intercept features to enable distributed maritime operations.</p> <p>- Continue developing hardware and software routing and applications for resilient networking in contested warfighting scenarios and improving data dissemination across both forward and back fit Joint heterogeneous networks.</p> <p>- Initiate multi-beam communications for data dissemination and unmanned and autonomous control applications.</p> <p>- Initiate development of promising low-frequency RF and optical technologies for multi-platform communication capabilities.</p> <p>Intelligence, Decision-Making Superiority, C2 and Combat Systems Thrust:</p> <p>- Continue developing frameworks for cross platform intelligent resource management and data dissemination providing both enhanced Distributed Maritime Operations and system resilience.</p> <p>- Continue developing capabilities that allow commanders to rapidly and confidently move from data-to-options-to-informed decision both at the Maritime Operations Center and Afloat.</p> <p>- Initiate optimization of machine learning and AI algorithms for planning to execution synchronization of hard kill, cyber and electromagnetic engagements.</p> <p>- Initiate development of advanced computing for machine learning on the tactical edge.</p>							

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Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Full Spectrum Cyber Thrust:</p> <ul style="list-style-type: none">- Continue developing tools for convergence and coordinate cyber and EW effects.- Continue maturing innovative cyber approaches to enhance naval platform and warfighting resilience, safety, reliability and efficiency.- Initiate machine learning for automation of cyber defense approaches.- Initiate efforts to automate identification and leveraging of over-permissioned protocol implementations. <p>Electromagnetic Warfare Thrust:</p> <ul style="list-style-type: none">- Continue developing technologies, techniques and algorithms that degrade, neutralize, or destroy an adversary's C5ISR capabilities.- Continue developing cross platform technologies to mature electro-magnetic techniques that rely on geographic separation of platform sensors to deliver enhanced operational capabilities.- Continue developing and maturing the necessary component technologies for spectrum access both in EO and RF that enable defeat of adversarial sensors and systems.- Initiate counter ISR technology to defeat and degrade EO sensor and seekers. <p>Surveillance, Sensors and Phenomenology Thrust:</p> <ul style="list-style-type: none">- Continue developing and implementing novel hardware, algorithms and high speed processing to enable detection of advanced maritime threats in both manmade and natural clutter at stand-off ranges.- Continue developing and implementing new electro-optic and infrared sensing capabilities including digital readouts for improved passive sensing of difficult threats in cluttered backgrounds.- Continue providing advanced sensor processing that improve Intelligence, Surveillance, Reconnaissance and Targeting of hard targets.- Continue developing key technologies for off-board RF illumination sources to enable Multi-Input Multi-Output and receive-only sensing in a distributed environment. <p>Quantum, Positioning, Navigation, and Timing Thrust:</p> <ul style="list-style-type: none">- Initiate development of quantum gravimetry mapping and navigation techniques. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research		Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The decrease from FY 2022 to FY 2023 was predominately due to the completion in FY 2022 of a high-fidelity network deception framework (CyberMoat) and an operating system that enables automatic and efficient use of heterogeneous computing architectures for cyber resilience.								
Title: Ocean Battlespace Sensing				23.613	26.421	31.977	0.000	31.977
Description: The objective of this activity is to enable maritime domain access and distributed operations for Naval forces in contested ocean environments through superior maritime battlespace awareness and undersea threat detection, identification and neutralization. Specifically, activities will develop and mature technologies that ultimately support Mine and Expeditionary Warfare, Undersea Warfare, and Ocean, Atmosphere and Space Sciences. Activities will also develop and mature methods and technological approaches for environmental sensing and prediction for the maritime battlespace. The desired outcome for efforts in this activity is to mature the applied research results to a point where they can be focused on particular enabling capabilities and proposed to be continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. Additionally, a subset of technologies explored herein are intended to support expeditionary access and will be further matured, focused, and ultimate demonstrated under the USMC's Advanced Technology Demonstration effort in PE 0603640M MC Advanced Technology Demo.								
FY 2022 Plans: Continue efforts in: - Advanced minesweeping including development of compact, efficient approaches for sweeping advanced influence mines. The objective is to increase the safe standoff of various tactical platforms and surface ships. - Development of robotic technologies to respond to detected targets including work on dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to interact with the mine and/or obstacle to achieve neutralization, clearance, render-safe or removal for exploitation. - Development of advanced acoustic arrays for floating ASW active sonar sensing systems. - Developing a large, low-noise volumetric array that can be deployed in an A-size sonobuoy that will have superior detection performance against relevant targets. Complete efforts in: - High temperature superconducting approaches to minesweeping; innovative naval mine delivery methods; advanced								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research		Project (Number/Name) 0000 / Future Naval Capabilities Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>acoustic sources for floating and mobile ASW sensing systems as well as expeditionary SURTASS; and storm surge and inundation forecasting models.</p> <p>- Algorithm development for theater-level Anti-Submarine Warfare (ASW) battle management and techniques to achieve noise reduction for expeditionary Surveillance Towed Array Sensor System (SURTASS).</p> <p>Initiate efforts in:</p> <p>- Prototype autonomous system to enhance detection and classification of emerging and novel threats in challenging operating environments. Efforts will develop and mature adaptive object recognition algorithms, modeling and simulation tools, and self-assessment autonomous behaviors. These technologies will improve MCM UUV object detection and recognition capabilities.</p> <p>- Compact broadband acoustic sources for floating and mobile ASW sensing systems.</p> <p>FY 2023 Base Plans:</p> <p>Mine and Expeditionary Warfare Thrust:</p> <p>- Complete the investigation of housing designs to both maximize range and improve lethality for aerial mine subcomponents.</p> <p>- Complete initial design and integration of unmanned platform capability for alternate deployment options.</p> <p>- Completed advanced minesweeping capabilities for unmanned surface vehicles. Technology transitioned to Magnetic and Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS) Future Naval Capability.</p> <p>- Initiate area coverage rate mine warfare capability in contested shallow water to surf zone to support expeditionary operations in the South Pacific.</p> <p>Undersea Warfare Thrust:</p> <p>- Continue to develop acoustic sources for floating and mobile anti-submarine warfare (ASW) sensing systems.</p> <p>- Continue testing of glider towed arrays for detection of ASW threats in the ocean environment.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate development of a methodology of modeling and measurement of EO/IR naval sensors in various weather conditions to determine and predict performance in non-ideal environmental conditions.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 supports the initiation of additional efforts in novel signal processing for submarine active sonar, new computational methods to synergistically leverage multiple acoustic arrays for quiet targets, development of novel long duration unmanned undersea vehicle (UUV) navigation concepts for complex environments, development of prototype decision support tool to assess environmental effects on electro-optical (EO), infrared (IR) and high-energy laser (HEL) weapons, and development of new decision support products that leverage novel high fidelity atmospheric characterization for airborne and space-based ISR mission planning in FY 2023.</p>							
<p>Title: Sea Warfare and Weapons</p> <p>Description: The objective of this activity is to develop and mature technologies that enable superior warfighting capabilities for surface and sub-surface naval platforms and undersea weaponry to a point where they can be proposed and continued as Future Naval Capabilities in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development.</p> <p>FY 2022 Plans: Initiate efforts in: - Addressing platform design and engineering, power energy and propulsion, materials, manufacturing and sustainment and logistics.</p> <p>Continue efforts in: - Addressing platform endurance, survivability and resiliency; naval force sustainment; and logistics. These efforts include signature management, undersea weapons improvements, digital twin development and ship hull-based coatings.</p> <p>Complete efforts in:</p>			24.396	33.715	30.926	0.000	30.926

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Flux-Core Additive Manufacturing (FCAM) efforts enable metal additive manufacturing afloat without creating a large logistics burden to carry shielding gas. (Initiated in FY22)</div> <div>- COTS Battery Phase II (COTS B II) research to develop and demonstrate a custom battery design that uses automotive industry commercial-off-the-shelf (COTS) battery hardware and lifecycle data-driven reliability approaches to battery management. (Initiated in FY22)</div> <div>- Electrical Ship Asset efforts: aging modelling and Reliability and Condition Assessment (ESARCA) efforts to investigate methods that lead to effective use of electrical insulation materials on ships employing high voltage electrical equipment. (Initiated in FY22)</div> <div>- Digital Evaluation of Implodable Composite Payloads (DEIComp) effort involves developing a suite of validated digital engineering tools and experimental findings that will improve prediction accuracy and improve speed and affordability of implodable integration with the fleet while increasing deployed technologies and survivability. (Initiated in FY22)</div> <div>- Flow Induced Machinery Noise Silencing (FIMNS) efforts to develop an increased knowledge base and an improved computational toolset for the design of efficient and reduced acoustic noise submarine machinery system blowers, cooling fans, and treatments; and deliver a prototype quiet cooling fan. (Initiated in FY22)</div> <div>- Stern Area System+ (SAS+) efforts to develop and demonstrate, through laboratory and in-water tests, algorithms which allow SAS to perform a new function to replace a legacy system, with enhanced capability, in the VIRGINIA Class. (Initiated in FY22)</div> <div>- Own Ship Electro-Magnetic Monitoring (OSEM) efforts to complete external sensor requirements and specifications development, continue sensor design, and develop the sensor qualification test plan. (Initiated in FY22)</div> <div>- Low-Observable Communications Mast for Undersea Platforms (LOCM-UP) efforts to reduce the radar cross section (RCS) and overall counterdetection risk of the submarine multifunction mast (MFM) while maintaining or increasing broad spectrum communications capability. (Initiated in FY22)</div> <div>- Corrosion-Informed Materials Section and Design Tool (CIMaD Tool) efforts to develop a DoN corrosion materials database and associated corrosion simulation algorithms, and validate a set of simulation algorithms using the developed database to predict corrosion damage which is critical to pursue a research to design against corrosion prior to production of DoN assets. (Initiated in FY22)</div> <div>- Next Generation Structural Steel for Enhanced Platform Capability (10% Ni Steel) efforts to develop processing conditions for adequate NIL-Ductility temperature, crack arrest, and stress-corrosion cracking (SCC) resistance; develop machine-learning process-structure-properties models to predict behavior and development of welding consumables and processes requiring no preheat. (Initiated in FY22)</div>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research		Project (Number/Name) 0000 / Future Naval Capabilities Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Complete the following: - AVIA efforts by delivering details from testing and simulation to the new ATBM/L technical candidate. - Digital twin related efforts by proposing to transition to an INP. - Condition Based Maintenance (CBM) efforts to deliver prototype EDAPO hardware and software modules for vehicle PHMS. - VIPB efforts by delivering models for the shaft-line components to the Future Naval Capability. - Own Ship Acoustic Monitoring efforts by delivering technical details from monitoring, studies and training to support transition to the Future Naval Capability. - Transparent Marine Antifouling Coatings (TMAC) efforts by delivering proposed down-select coatings for scale-up and additional testing. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease from FY 2022 to FY 2023 is due to efforts associated with the Platforms and Sustainment areas completing.						
Title: Warfighter Performance Description: The objective of this activity is to conduct research and mature technologies that enhance Naval warfighting effectiveness and efficiency within the broad array of Warfighter Performance science and technology domains (Undersea Medicine, Biological Sciences, Bio-robotics, Capable Manpower, Command Decision Making, Force Health Protection, Human/Robot Interaction, Noise-Induced Hearing Loss, and Training and Simulation) to a point where they can be proposed and continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. FY 2022 Plans: Continue efforts in: - Information model for expressing and managing mission priorities and authorities between unmanned systems, autonomy, and warfighters to enable transfer of tactical control of vehicles and/or payloads during routine missions in contested communications environments. This continuing effort is derived from applied human-level artificial intelligence and		11.818	16.617	18.343	0.000	18.343

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>autonomy research identified in FY21.</p> <p>- Modular Live-Virtual-Constructive information environment for training, experimentation, wargaming and assessment.</p> <p>This continuing effort is derived from social media incorporation for C4ISR research identified in FY21.</p> <p>- Dive suit capability to enable mobility for divers to work on the bottom of the ocean while accomplishing majority of tasks that previously required a 'wet diver' and cannot be accomplished by robotics. This continuing effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21.</p> <p>Complete efforts in:</p> <p>- Developing a customizable bio-fidelic model of the warfighter to improve risk assessment, injury and incapacitation prediction to enable better testing criterion for PPE and platforms development. This effort will transition to PE 0603673N Future Naval Capabilities for continued development in FY22. This concluding effort is derived from biomedical capabilities to increase warfighter lethality and survivability research identified in FY21.</p> <p>- Decision support system to evaluate alternative manpower courses of action across Manpower, Personnel, Training and Education (MPTE) enterprise. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21.</p> <p>- Analytic tool to reduce the number of counter-productive workplace behaviors and correlating indicators through data mining and analytics. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21.</p> <p>- Communication platform to monitor health status of military personnel in operational environments. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21.</p> <p>Initiate efforts in:</p> <p>- Maturing a low viscosity corrosion preventative wash primer to increase paint adhesion for the repair of tiles on</p>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / <i>Future Naval Capabilities Applied Research</i>	Project (Number/Name) 0000 / <i>Future Naval Capabilities Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)					
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO
submarines. - Integrating automated data fusion and asset allocation techniques into a single Battle Management Aid for real-time decision support for operations and training. - Evidence-based, model-driven integrated software solution that will support, reinforce, and enhance career forecasting and manpower modeling by providing necessary data, differentiating metrics, and providing modern decision support to those involved in the selection and assignment processes. FY 2023 Base Plans: Advanced Analytics and Decision Making Thrust: - Continue development of an information warfare training system that teaches tactics, techniques and procedures for decisive, effective engagement that is suitable for public affairs, information operations, psychological operations, and intelligence operations. - Complete development of automated data fusion and asset allocation techniques that support the E-2D Hawkeye tactical airborne early warning aircraft's role in orchestrating Carrier Strike Group air defense. Integrate into Virtual/Constructive training environments and enable E-2D crew to train as it fights. - Initiate technology to automatically identify man-made structures in high resolution 3D datasets by defining use cases, workflows, outline methods, and algorithms for existing software applications. Program will reduce the task load for defining structures by identifying specific features unique to man-made structures and using them to outline the structures. - Initiate feasibility studies to explore next generation applications of advanced analytics and decision making in Navy and Marine Corps environments. Autonomy, Artificial Intelligence and Robotics Thrust: - Complete development of information model for expressing and managing mission priorities and authorities between unmanned vehicles, autonomous systems and warfighters to enable transfer of tactical control of vehicles and/or their payloads during missions in contested communications environments. - Initiate development of techniques to manage data sharing requirements to support logistics tools and minimize bandwidth requirement to enable meta-optimization across multiple planners and tactical decision aids. - Initiate feasibility studies to explore next generation applications of autonomy, artificial intelligence, and robotics in Navy and Marine Corps environments. Manpower, Performance, Protection, and Medical Support Thrust:					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue development of models that provide decision support tools during the selection and assignment process of military personnel in order to maximize organizational effectiveness.</div> <div>- Complete development of a flexible, dry dive suit enabling mobility for divers to work on the bottom of the ocean to accomplish the majority of tasks that previously required a 'wet diver' and cannot be accomplished by robotics.</div> <div>- Initiate development of a Modular, Live-Virtual-Constructive integrated warfare environment to support training, mission rehearsal, and assessment of Carrier Strike Group and Air Wing forces while at sea.</div> <div>- Initiate feasibility studies to explore next generation applications of manpower, performance, protection, and medical support in Navy and Marine Corps environments.</div> <div>Materials Thrust:</div> <div>- Complete maturation of a low viscosity corrosion preventative wash primer to increase paint adhesion for the repair of tiles on submarines.</div> <div>- Complete characterization of a biomimetic and a bioinspired seawater curing adhesive to assess its suitability for adhering submarine hull treatment to steel submarine hulls.</div> <div>- Initiate feasibility studies to explore next generation applications of materials in Navy and Marine Corps environments.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>The increase in funding from FY 2022 to FY 2023 will be used for the initiation of three new efforts to: 1) develop a Live-Virtual-Constructive warfare environment to support at-sea training, mission rehearsal, and assessment of Carrier Strike Group and Air Wing forces, eliminating the need for an expert observer to be present, 2) develop algorithms for existing software applications to automatically identify man-made structures in high resolution 3D datasets, eliminating the need to manually redefine target and collateral structures for each scenario, and 3) develop software to enable proactive logistics planning based on mission-critical events and route planning and artificial intelligence-informed decision making.</div>							
Title: Naval Air Warfare and Weapons			29.245	30.731	30.655	0.000	30.655
Description: The objective of this activity is to develop and mature technologies in directed energy, energetic materials, autonomy, electromagnetic launch, and high speed conventional air and surface weapons to a							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
point where they can be proposed and continued as Future Naval Capabilities in PE 0603673N, Future Naval Capabilities Advanced Technology Development.							
FY 2022 Plans: Initiate efforts in: - Developing novel energy/power generation, management and storage technologies applicable to advanced future missile capabilities and requirements. - Investigating novel concepts for solid rocket motor initiation, safety and thrust profile management. - Investigating advanced material and structural capabilities in aerodynamics for high-speed/hypersonic weapons. Continue efforts in: - Mature key solid fuel ramjet technologies identified in FY21 to increasing range, speed and maneuverability for missiles and projectiles. - Leverage ongoing collaborative weapons technologies for application to additional munitions and weapons - Leveraging ongoing reactive materials initiatives for application to additional munitions and weapons. - The investigation of advanced air-to-surface/ground seeker technologies, focusing largely on efficacy in a hypersonic regime. - Investigating and maturing system of systems concepts and associated technologies necessary to fully implement manned and unmanned teaming operations. Complete efforts in: - Maturing technologies leading to development of kinetic kill and/or directed energy for self-defense of high value, low density aircraft against next generation air-to-air threats. Includes solid state, High-Power Microwave (HPM) systems and kinetic-kill defenses against adversary hypersonic weapons research. Initiate/Complete efforts in: - Maturation of mission planning software that is able to aggregate, manage and optimize all data input for maximum							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602750N / Future Naval Capabilities Applied Research	Project (Number/Name) 0000 / Future Naval Capabilities Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
effectiveness of Naval strike operations.							
FY 2023 Base Plans: Kinetic Weapons Thrust: - Continue investigating advanced material and structural capabilities in aerodynamics for high-speed/hypersonic weapons. - Continue the investigation of advanced air-to-surface/ground seeker technologies, focusing largely on efficacy in a hypersonic regime. - Continue maturing design concepts, fabricating sample components, and performing preliminary testing to inform future system level design trades. - Continue leveraging ongoing reactive materials initiatives for application to additional munitions and weapons. Establish weight/volume versus range increase potential for conceptual warhead designs. Establish warhead interface constraints for system integration. - Continue developing novel energy/power generation, management and storage technologies applicable to advanced future missile capabilities and requirements. - Complete investigating novel concepts for solid rocket motor initiation, safety and thrust profile management. - Complete maturing key solid fuel ramjet technologies for increasing range, speed and maneuverability for missiles and projectiles. - Complete leveraging ongoing collaborative weapons technologies for application to additional munitions and weapons. - Initiate feasibility studies for tactical decision aids that support advanced strike weapons. - Initiate feasibility studies and possible development of terminal defense fire control architectures that support low cost and easy integration onto ships and into expeditionary forces for terminal defense suitable for multiple engagement weapons.							
Directed Energy / Electric Weapons Thrust: - Continue maturing technologies leading to development of directed energy for self-defense of high value, low density aircraft against next generation advanced threats. Includes solid state and pulsed laser systems. - Continue designing, developing and testing of solid state, High-Power Microwave (HPM) systems for enhanced lethality. - Continue the initial susceptibility testing of Out Board Motor assets utilizing developed waveforms from FY21, modeling potential dynamic engagements matched to Joint Counter UAS operational requirements, and performing scaled demonstration of waveform engagement capability facility.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602750N / <i>Future Naval Capabilities Applied Research</i>	Project (Number/Name) 0000 / <i>Future Naval Capabilities Applied Research</i>
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602750N / <i>Future Naval Capabilities Applied Research</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	7.723	27.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.723

A. Mission Description and Budget Item Justification
Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>Congressional Add:</i> Cooperative Engagement Capability Mission Based Networking for Data Distribution	2.896	0.000
<i>FY 2021 Accomplishments:</i> Conducted applied research for CEC mission based networking for data distribution systems.		
<i>FY 2022 Plans:</i> N/A		
<i>Congressional Add:</i> Improved Detection of Submarine Threats	4.827	5.000
<i>FY 2021 Accomplishments:</i> Conducted applied research for improved detection of submarine threats.		
<i>FY 2022 Plans:</i> Conduct applied research for improved detection of submarine threats.		
<i>Congressional Add:</i> Long endurance, autonomous, mobile acoustic detection systems	0.000	22.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct long endurance, autonomous, mobile acoustic detection systems applied research		
Congressional Adds Subtotals	7.723	27.000

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602782N <i>I Mine and Expeditionary Warfare Applied Research</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	33.228	42.160	31.649	-	31.649	32.285	32.932	33.591	34.263	Continuing	Continuing
0000: <i>Mine and Expeditionary Warfare Applied Research</i>	0.000	30.815	32.160	31.649	-	31.649	32.285	32.932	33.591	34.263	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	2.413	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.413

A. Mission Description and Budget Item Justification

Sea mines remain a significant threat to ships. In fact, fifteen U.S. Navy ships have been sunk or damaged by mines since World War II, almost four times more than any other weapon. The Mine and Expeditionary Warfare Applied Research Program Element (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) as well as continuing support to research vessels of the U.S. Academic Research Fleet for operations and maintenance that enable applied research at sea. This program strongly aligns 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. This investment will enable Ship-to-Objective Maneuver (STOM) and focus 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 and Neutralization efforts include technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic mine hunting 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. The activities described in this PE address future Navy and Marine Corps capabilities needed to maintain maritime superiority and ensure national security. They are based on input from Naval Research Enterprise stakeholders including the Naval enterprises, the combatant commands, Office of the Chief of Naval Operations (OPNAV) and Headquarters Marine Corps and are designed to exploit breakthroughs in science and technology in order to deliver maximum warfighting benefit to our sailors and Marines. These efforts align with shared priorities throughout the whole of RDT&E in order to quickly advance new capabilities from discovery to deployment across the warfighting domains.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602782N <i>I Mine and Expeditionary Warfare Applied Research</i>
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This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. 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).

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	33.081	32.160	0.000	-	0.000
Current President's Budget	33.228	42.160	31.649	-	31.649
Total Adjustments	0.147	10.000	31.649	-	31.649
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	10.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.635	0.000			
• SBIR/STTR Transfer	-0.488	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	31.649	-	31.649

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

Project: 9999: *Congressional Adds*

Congressional Add: *Robotics for Mine Neutralization*

Congressional Add: *Human fusion tech for EOD robot applications*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

FY 2021	FY 2022
2.413	0.000
0.000	10.000
2.413	10.000
2.413	10.000

Change Summary Explanation

Technical: Not applicable

Schedule: Not applicable

Funding: no significant change

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research		R-1 Program Element (Number/Name) PE 0602782N I Mine and Expeditionary Warfare Applied Research
<p>---</p> <p>FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.</p>		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research				Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Mine and Expeditionary Warfare Applied Research	0.000	30.815	32.160	31.649	-	31.649	32.285	32.932	33.591	34.263	Continuing	Continuing
A. Mission Description and Budget Item Justification This Project focuses on reducing the time involved in conducting Mine Countermeasure (MCM) operations and increasing safe standoff from minefields. It develops and transitions technologies for MCM-related and UAEO-related Future Naval Capabilities (FNC). The MCM effort includes technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic mine-hunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as C4ISR, fires, maneuver, sustainment. 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Mine Technology Description: This activity primarily focuses on developing and demonstrating technologies to support on-demand battlespace shaping through advanced undersea weapons and next generation mining concepts. Efforts include Command & Control to support remote control, advanced sensing technologies, compatibility with options for unmanned delivery, detection & classification, and targeting solutions. Mine technology research supports Fleet demand for capability and prototype development for next generation naval mining concepts. FY 2022 Plans: - Target Detection Devices (Mine & Expeditionary Warfare): Continue efforts in developments in advanced sensors and algorithmic capabilities that are applicable toward existing target detection devices (TDDs), development of concepts for remote controlled mines, and assessment of sea mine technologies in order to maintain a level of expertise in naval mines. Specific effort will include advanced sensing modalities for improved discrimination. The objective is to achieve a miniaturized, highly capable TDD to advance legacy mine capacity. - Naval Mine Subcomponents (Mine & Expeditionary Warfare): Continue efforts in alternative packaging and miniaturization of naval mine subcomponents. Specific efforts include advanced sensing, remote control and communications, and advanced energetics. The objective is to achieve alternative capability to incrementally advance legacy mine capacity, and find new capability within legacy delivery mechanisms. FY 2023 Base Plans:								2.107	2.110	2.095	0.000	2.095

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N I Mine and Expeditionary Warfare Applied Research		Project (Number/Name) 0000 I Mine and Expeditionary Warfare Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Target Detection Devices (Mine & Expeditionary Warfare): Continue efforts in developments in advanced sensors and algorithmic capabilities that are applicable toward existing target detection devices (TDDs), development of concepts for remote controlled mines, and assessment of sea mine technologies in order to maintain a level of expertise in naval mines. Specific effort will include advanced sensing modalities for improved discrimination. The objective is to achieve a miniaturized, highly capable TDD to advance legacy mine capacity.</p> <p>- Continue Naval Mine Subcomponents (Mine & Expeditionary Warfare): Continue efforts in alternative packaging and miniaturization of naval mine subcomponents. Specific efforts include advanced sensing, remote control and communications, and advanced energetics. The objective is to achieve alternative capability to incrementally advance legacy mine capacity, and find new capability within legacy delivery mechanisms.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>						
<p>Title: Mine/Obstacle Detection</p> <p>Description: This activity focuses on applied research to enable longer detection ranges and precise detection and mine location with fewer false alarms in a variety of challenging environments. It supports Mine Countermeasures (MCM) related Future Naval Capabilities (FNCs). Efforts include novel sonar technologies for longer range detection and classification of mine-like targets, magnetic gradiometer sensing, electro-optic (EO) technology for buried mine identification, and sensor integration onto Unmanned Underwater Vehicles (UUVs). EO sensor research develops algorithms to enable image processing for rapid overt reconnaissance from an Unmanned Aerial Systems (UAS). Efforts include the development of processing, classification and data fusion techniques to reduce operator workload, and an expert system used to predict mine burial. Efforts also support development of MCM Mission Modules for Littoral Combat Ships.</p> <p>The program is strongly aligned with the Oceanographer of the Navy and the research topics addressed by this activity reflect the priorities for improved forecasts of the operational environment and the development and use of autonomous systems for the collection of environmental observations and continuing support to research vessels of the U.S. Academic Research Fleet for operations and maintenance that enable science at sea. Field</p>		17.990	19.155	18.574	0.000	18.574

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research	Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
research within this activity that uses active acoustic transmissions requires modeling of the acoustic effects of sound on marine life in order to meet Navy environmental requirements.							
FY 2022 Plans:							
- Autonomous Vehicles (Mine & Expeditionary Warfare): Continue efforts to develop approaches for coupling between autonomous vehicles and their sensor payloads. Continue efforts to characterize flow generated by biomimetic propulsion approaches. Initiate development of a learning and planning framework, conducting field experiments that demonstrate simultaneous exploration and navigation in an unknown environments while attempting to execute a complex mission.							
- Mine Countermeasures (MCM) Data (Mine & Expeditionary Warfare): Continue efforts to aggregate, curate and interrogate real and simulated data sets for in-situ algorithm adaptation, optimization, and performance assessment. The objective is to enable unmanned systems to operate flexibly across a wide range of dynamic and unstructured environments.							
- MCM Sensor (Mine & Expeditionary Warfare): Continue development of next-generation small, highly capable MCM sensors. Specific efforts include sensors, electronics, and computing technology. The objective is to increase deployment options for unmanned systems.							
- Mine & Expeditionary Warfare (Target Recognition and Signal Processing): Initiate machine learning algorithm development efforts that yield principled understanding of sensor information content, are robust to challenging operating conditions and produce human-interpretable or traceable predictions.							
- Threat Detection/Robotic Techniques (Mine & Expeditionary Warfare): Continue development of robotic technologies to respond to detected threats. Specific effort will include dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to sense and interact with the environment and threats.							
- Continue advance underwater optical imager technology focusing on laboratory measurements in various turbidity conditions and environments.							
- Continue development and demonstration of adaptive control systems for bio-inspired unmanned underwater vehicles advancing oscillating fin propulsor models, and embedding these models on vehicle hardware.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research		Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue development of a learning and planning framework, conducting field experiments that demonstrate simultaneous exploration and navigation in an unknown environments while attempting to execute a complex mission.</p> <p>- Continue efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify underwater mobile threats.</p> <p>FY 2023 Base Plans:</p> <p>- Continue Autonomous Vehicles (Mine & Expeditionary Warfare) efforts to develop approaches for coupling between autonomous vehicles and their sensor payloads. Continue efforts to characterize flow generated by biomimetic propulsion approaches. Initiate development of a learning and planning framework, conducting field experiments that demonstrate simultaneous exploration and navigation in an unknown environments while attempting to execute a complex mission.(NRL)</p> <p>- Continue Mine Countermeasures (MCM) Data (Mine & Expeditionary Warfare) efforts to aggregate, curate and interrogate real and simulated data sets for in-situ algorithm adaptation, optimization, and performance assessment. The objective is to enable unmanned systems to operate flexibly across a wide range of dynamic and unstructured environments.</p> <p>- Continue MCM Sensor (Mine & Expeditionary Warfare development of next-generation small, highly capable MCM sensors. Specific efforts include sensors, electronics, and computing technology. The objective is to increase deployment options for unmanned systems.</p> <p>- Continue Mine & Expeditionary Warfare (Target Recognition and Signal Processing) machine learning algorithm development efforts that yield principled understanding of sensor information content, are robust to challenging operating conditions and produce human-interpretable or traceable predictions.</p> <p>- Continue Threat Detection/Robotic Techniques (Mine & Expeditionary Warfare development of robotic technologies to respond to detected threats. Specific effort will include dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to sense and interact with the environment and threats.</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research		Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue advance underwater optical imager technology focusing on laboratory measurements in various turbidity conditions and environments.</p> <p>- Continue development and demonstration of adaptive control systems for bio-inspired unmanned underwater vehicles advancing oscillating fin propulsor models, and embedding these models on vehicle hardware.</p> <p>- Continue development of a learning and planning framework, conducting field experiments that demonstrate simultaneous exploration and navigation in an unknown environments while attempting to execute a complex mission.</p> <p>- Continue efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify underwater mobile threats.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>						
<p>Title: Mine/Obstacle Neutralization</p> <p>Description: This activity includes applied research to support selected Mine Countermeasures-related Future Naval Capabilities (FNC) for the rapid neutralization of mines and obstacles, and sea mine jamming techniques to increase surface ship safe standoff from threat mines. It includes computational tools and models to assess mine and obstacle vulnerability and lethality of novel approaches for neutralization to support various far-term Surf Zone and Beach Zone mine and obstacle breaching system concepts.</p> <p>FY 2022 Plans: -Rapid Neutralization of Mines and Obstacles: Continue effort in rapid neutralization of mines and obstacles including development of lethality and vulnerability models, technology concept assessments, and approaches for neutralization of mines and obstacles in all water depths, the surf zone, beach and inland. The objective is to enable maneuver of joint forces from ship to inland objective.</p>		0.433	0.443	0.449	0.000	0.449

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research		Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>-Advanced Minesweeping: Continue effort in advanced minesweeping including development of compact, efficient approaches for sweeping advanced influence mines. The objective is to increase the safe standoff of various tactical platforms and surface ships.</p> <p>-Robotics: Continue development of robotic technologies to respond to detected targets including work on dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to interact with the mine and/or obstacle to achieve neutralization, clearance, render-safe or removal for exploitation.</p> <p>FY 2023 Base Plans:</p> <p>- Continue Rapid Neutralization of Mines and Obstacles effort in rapid neutralization of mines and obstacles including development of lethality and vulnerability models, technology concept assessments, and approaches for neutralization of mines and obstacles in all water depths, the surf zone, beach and inland. The objective is to enable maneuver of joint forces from ship to inland objective.</p> <p>- Continue Advanced Minesweeping effort in advanced minesweeping including development of compact, efficient approaches for sweeping advanced influence mines. The objective is to increase the safe standoff of various tactical platforms and surface ships.</p> <p>- Continue Robotics development of robotic technologies to respond to detected targets including work on dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to interact with the mine and/or obstacle to achieve neutralization, clearance, render-safe or removal for exploitation.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant change from FY 2022 to FY 2023.</p>						
<p>Title: Special Warfare/EOD</p> <p>Description: The goal of this effort is to develop technologies to extend stand-off of special operations and Explosive Ordnance Disposal (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 Naval Special Warfare (NSW) and EOD autonomous</p>		10.285	10.452	10.531	0.000	10.531

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N I Mine and Expeditionary Warfare Applied Research	Project (Number/Name) 0000 I Mine and Expeditionary Warfare Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and handheld sonar systems to increase detection range and accuracy in harsh environments. Other efforts include such mission support technology improvements as communications, navigation and life support for UUVs and human divers.							
FY 2022 Plans:							
- Advanced Robotic Techniques: Continue efforts in advanced robotic technologies including development of human-like manipulators and haptics.							
- Platforms: Continue development of air, surface and subsurface platforms to conduct operations in the littorals to improve diver mobility and safety, address drag reduction, diver propulsion, communications, navigation, thermal envelope, life support and contamination protection.							
- Ordnance Detection: Continue efforts for sensors to detect buried mines and improvised explosive devices. Specific effort includes technologies for compact, held-hand radar concepts. The objective is to improve the performance of hand-held radar technology to achieve a low false alarm rate.							
- Sensor Techniques: Continue effort to develop compact sensor technologies to diagnose explosive threats and unexploded ordnance including the development of hand-held or robot deployable sensor technologies. The objective is to determine the status of explosive threats and unexploded ordnance.							
- Neutralization Explosive Threats: Continue effort to develop technologies to enable render-safe or neutralization of explosive threats and unexploded ordnance.							
- Unmanned Systems Situational Awareness: Continue onboard processing in unmanned systems to enable environmental situational awareness (SA) in the littorals.							
- Continue Rapid Operational Clearance efforts to develop technologies to rapidly clear operational areas of munitions. The objective is to decrease the amount of time needed for services to clear munitions and conduct clearance operations at standoff.							
FY 2023 Base Plans:							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research	Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue Advanced Robotic Techniques efforts in advanced robotic technologies including development of human-like manipulators and haptics. The objective is to provide access to underwater, buried and surface munitions and enable standoff operations with high precision.</p> <p>- Continue Platforms development of air, surface and subsurface platforms to conduct operations in the littorals to improve diver situational awareness, mobility and safety, address drag reduction, diver propulsion, communications, navigation, thermal envelope, life support and contamination protection.</p> <p>- Continue Ordnance Detection efforts for sensors to detect munitions and improvised explosive devices. Specific efforts include compact electromagnetic, optical and next generation magnetometer sensors which are held-hand or robot deployable. The objective is to improve performance by achieving a lower false alarm rates and higher probability of detection.</p> <p>- Continue Sensor Techniques effort to develop compact sensor technologies to diagnose explosive threats and unexploded ordnance including the development of hand-held or robot deployable sensor technologies. The objective is to determine the status of explosive threats and unexploded ordnance.</p> <p>- Continue Neutralization Explosive Threats effort to develop technologies to enable render-safe or neutralization of explosive threats and unexploded ordnance. The objective is to enable precision render-safe or neutralization operations at standoff distances.</p> <p>- Continue Unmanned Systems Situational Awareness development of onboard processing in unmanned systems to enable environmental situational awareness (SA) in the littorals.</p> <p>- Continue Rapid Operational Clearance efforts to develop technologies to rapidly clear operational areas of munitions. The objective is to decrease the amount of time needed for services to clear munitions and conduct clearance operations at standoff.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research		Project (Number/Name) 0000 / Mine and Expeditionary Warfare Applied Research				
B. Accomplishments/Planned Programs (\$ in Millions)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
There is no significant change from FY 2022 to FY 2023.								
Accomplishments/Planned Programs Subtotals				30.815	32.160	31.649	0.000	31.649
C. Other Program Funding Summary (\$ in Millions)								
N/A								
Remarks								
D. Acquisition Strategy								
N/A								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602782N / Mine and Expeditionary Warfare Applied Research				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	2.413	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.413

A. Mission Description and Budget Item Justification
 Congressional Interest Items not included in other Projects.

<u>B. Accomplishments/Planned Programs (\$ in Millions)</u>	FY 2021	FY 2022
<i>Congressional Add:</i> Robotics for Mine Neutralization	2.413	0.000
<i>FY 2021 Accomplishments:</i> Conducted applied research in Robotics for Mine Neutralization.		
<i>FY 2022 Plans:</i> N/A		
<i>Congressional Add:</i> Human fusion tech for EOD robot applications	0.000	10.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct human fusion tech for EOD robot applications applied research		
Congressional Adds Subtotals	2.413	10.000

C. Other Program Funding Summary (\$ in Millions)
 N/A

Remarks

D. Acquisition Strategy
 N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	146.926	155.976	120.637	-	120.637	133.828	134.128	132.198	137.056	Continuing	Continuing
0000: Innovative Naval Prototypes (INP) Applied Res	0.000	2.341	2.480	3.000	-	3.000	18.837	58.688	77.798	85.606	Continuing	Continuing
2958: Cyberspace Activities	0.000	26.867	25.988	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	52.855
3416: HIJENKS	0.000	21.033	9.916	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.949
3423: LOCUST	0.000	20.776	8.031	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	28.807
3450: AMOS	0.000	7.918	6.446	8.320	-	8.320	0.000	0.000	0.000	0.000	0.000	22.684
3451: CLAWS	0.000	19.943	25.871	2.475	-	2.475	0.000	0.000	0.000	0.000	0.000	48.289
3452: ELEKTRA	0.000	5.686	3.967	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.653
3453: Hypersonic Booster	0.000	3.740	29.915	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	33.655
3454: MDUSV	0.000	4.570	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.570
3455: MINERVA	0.000	5.621	3.966	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.587
3456: Full Spectrum Undersea Warfare	0.000	14.916	20.940	39.600	-	39.600	42.570	42.570	42.570	43.421	Continuing	Continuing
3461: MASS	0.000	0.000	4.487	4.950	-	4.950	7.920	0.000	0.000	0.000	0.000	17.357
3462: DEALRS	0.000	0.000	5.983	6.930	-	6.930	10.890	6.930	0.000	0.000	0.000	30.733
3463: MATes	0.000	0.000	4.986	6.435	-	6.435	9.900	9.900	4.950	5.049	Continuing	Continuing
5891: INP Operational Analysis, Support and Experimentation Activity	0.000	0.000	0.000	4.461	-	4.461	2.000	2.000	2.000	2.000	Continuing	Continuing
5892: Full Spectrum Information Warfare	0.000	0.000	0.000	4.000	-	4.000	7.000	0.000	0.000	0.000	0.000	11.000
5893: Decision Superiority	0.000	0.000	0.000	1.700	-	1.700	1.200	0.000	0.000	0.000	0.000	2.900
5894: Direct-X	0.000	0.000	0.000	2.500	-	2.500	0.000	0.000	0.000	0.000	0.000	2.500
5895: DMO through IAS	0.000	0.000	0.000	2.950	-	2.950	4.500	0.000	0.000	0.000	0.000	7.450
5896: Echidna	0.000	0.000	0.000	1.777	-	1.777	0.750	0.000	0.000	0.000	0.000	2.527
5897: Hypersonic Technologies	0.000	0.000	0.000	8.000	-	8.000	6.000	0.000	0.000	0.000	0.000	14.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022			
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy I BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602792N I Innovative Naval Prototypes (INP) Applied Res								
5899: Precision Fire Control	0.000	0.000	0.000	23.539	-	23.539	22.261	14.040	4.880	0.980	Continuing	Continuing	
9999: Congressional Adds	0.000	13.515	3.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.515	

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) portfolio includes efforts that solve problems, respond to mission requirements, and perform exploratory research for new and breakthrough capabilities, which will define the future of U.S. Naval forces. Larger in scope, scale, and risk Innovative Naval Prototypes (INP) are selected for their high-payoff and potential to revolutionize operational concepts. Due to high technical risk, INPs typically have long durations with no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both the Applied Research, detailed in this PE; and Advanced Technology Development (ATD) funding, detailed in PE 0603801N. Developing INPs requires a systematic expansion and application of knowledge to develop useful materials, devices, and systems oriented toward the design and development of prototypes applicable to specific mission area requirements. The efforts funded within this PE translate promising basic research into solutions for broadly defined military needs. These efforts include developing breadboard hardware and algorithms that establish the initial feasibility and practicality of proposed solutions to technological challenges, such as concept exploration efforts, studies, investigations, and non-system specific technology efforts. Applied Research INPs do not develop hardware for service use; rather they provide feeder technology that can be demonstrated in prototypes in the ATD portion of the INP program.

Information security concerns preclude full disclosure of project efforts, research activities, and technology development plans within this exhibit. Detailed information will be provided to the Congressional oversight committees.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	161.028	152.976	0.000	-	0.000
Current President's Budget	146.926	155.976	120.637	-	120.637
Total Adjustments	-14.102	3.000	120.637	-	120.637
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	3.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-7.746	0.000			
• SBIR/STTR Transfer	-6.356	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	120.637	-	120.637

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

Project: 9999: *Congressional Adds*

FY 2021	FY 2022

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 2: Applied Research</i>		R-1 Program Element (Number/Name) PE 0602792N <i>I Innovative Naval Prototypes (INP) Applied Res</i>	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2021	FY 2022
Congressional Add: <i>Thermoplastic tailorable universal feedstock composites</i>		9.654	0.000
Congressional Add: <i>Thermoplastic Composites for Lightweight Naval Applications</i>		3.861	0.000
Congressional Add: <i>Accelerate proliferated LEO narrowband capability</i>		0.000	3.000
Congressional Add Subtotals for Project: 9999		13.515	3.000
Congressional Add Totals for all Projects		13.515	3.000
<u>Change Summary Explanation</u> Funding: Not applicable. Technical: Not applicable. Schedule: Not applicable. --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 0000 / Innovative Naval Prototypes (INP) Applied Res			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Innovative Naval Prototypes (INP) Applied Res	0.000	2.341	2.480	3.000	-	3.000	18.837	58.688	77.798	85.606	Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Project address the Applied Research associated with the Innovative Naval Prototypes (INP) Program. These investments represent game-changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both Budget Activity (BA) 2 and BA3 funding. The BA3 INP funds are specified in a separate Program Element (PE), 0603801N Innovative Naval Prototypes (INP) Adv Tec Dev. INPs do not develop hardware for service use; rather they provide feeder technology that can be demonstrated in prototypes in the 6.3 portion of the INP program. Developing INPs requires a systematic expansion and application of knowledge to develop useful materials, devices, and systems oriented toward the design and development of prototypes applicable to specific mission area requirements. The efforts funded within this PE translate promising basic research into solutions for broadly defined military needs. These efforts include developing breadboard hardware and algorithms that establish the initial feasibility and practicality of proposed solutions to technological challenges, such as concept exploration efforts, studies, investigations, and non-system specific technology efforts. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Directed Energy / Electric Weapons	2.341	2.480	0.000	0.000	0.000
Description: Effective in FY 2023, the Directed Energy/Electric Weapons Activity was discontinued and its funding was realigned to the new stand-alone Proj:5891 Operational Analysis, Support and Experimentation Activity to broaden the spectrum of promising applied research efforts investigated within this Project.					
FY 2022 Plans: Continue operational analysis and support to inform INP investment decisions in this activity to include identifying technologies that will provide scalable lethality through enabling multi-domain, integrated, scalable kinetic and non-kinetic systems for offensive of defensive purposes.					
FY 2023 Base Plans: NA					
FY 2023 OCO Plans:					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 0000 / Innovative Naval Prototypes (INP) Applied Res		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The funding decrease from FY 2022 to FY 2023 is due to the re-alignment of funding to initiate stand-alone Proj: 5891 Operational Analysis, Support and Experimentation Activity within this PE.						
Title: INP Applied Research		0.000	0.000	3.000	0.000	3.000
Description: The efforts described in this Project address the Applied Research associated with the Innovative Naval Prototypes (INP) Program. These investments represent game-changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both Budget Activity (BA) 2 and BA3 funding. The BA3 INP funds are specified in a separate Program Element (PE), 0603801N Innovative Naval Prototypes (INP) Adv Tec Dev. INPs do not develop hardware for service use; rather they provide feeder technology that can be demonstrated in prototypes in the 6.3 portion of the INP program. Developing INPs requires a systematic expansion and application of knowledge to develop useful materials, devices, and systems oriented toward the design and development of prototypes applicable to specific mission area requirements. The efforts funded within this PE translate promising basic research into solutions for broadly defined military needs. These efforts include developing breadboard hardware and algorithms that establish the initial feasibility and practicality of proposed solutions to technological challenges, such as concept exploration efforts, studies, investigations, and non-system specific technology efforts. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.						
FY 2022 Plans: N/A						
FY 2023 Base Plans: Initiate applied research in support of the development of the INP Applied Research INP. Specific efforts include the following: - Investigate investments which may represent game-changing technologies with the potential to revolutionize operational concepts.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 0000 / <i>Innovative Naval Prototypes (INP) Applied Res</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Explore concepts that are disruptive in nature and would dramatically change the way naval forces fight. <i>FY 2023 OCO Plans:</i> N/A <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 in Proj: 0000 INP Applied Research is due to the desire to investigate a broader spectrum of technology efforts within this Project and identify the most promising applied research technologies to fund.						
Accomplishments/Planned Programs Subtotals		2.341	2.480	3.000	0.000	3.000
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 2958 / Cyberspace Activities			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2958: Cyberspace Activities	0.000	26.867	25.988	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	52.855

A. Mission Description and Budget Item Justification

This Project contains all Applied Research Innovative Naval Prototype (INP) investments that are developing new technologies for cyber warfare. Potential adversaries are investing in advanced technologies that will challenge our advantages in the critical information domain. Nation states and non-state actors seek to degrade our command and control capabilities, networks and computer systems. Cyber threats continue to grow and rapidly proliferate. Technologies developed in this R-2 Activity will enable the warfighter to take immediate, appropriate action at any time, against any desired adversary, target or network by assuring that autonomous, continuous analyses of intelligence, persistent surveillance and open information sources have, at all times, optimized the possible courses of action based on commander's guidance. Technologies within this activity will foster operational endurance and enable sustained operations and resiliency for warfighters and platforms through enhanced cyber security/protection.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Cyber Description: This Project contains all Applied Research Innovative Naval Prototype (INP) investments that are developing new technologies for cyber warfare. Potential adversaries are investing in advanced technologies that will challenge our advantages in the critical information domain. Nation states and non-state actors seek to degrade our command and control capabilities, networks and computer systems. Cyber threats continue to grow and rapidly proliferate. Technologies developed in this R-2 Activity will enable the warfighter to take immediate, appropriate action at any time, against any desired adversary, target or network by assuring that autonomous, continuous analyses of intelligence, persistent surveillance and open information sources have, at all times, optimized the possible courses of action based on commander's guidance. Technologies within this activity will foster operational endurance and enable sustained operations and resiliency for warfighters and platforms through enhanced cyber security/protection. FY 2022 Plans: Complete Applied Research studying the unique technical challenges required to achieve a systematic reduction and dynamic reshaping of any computing system's attack surface across all its layers of computing by development of automated tools and techniques to remove bloat and unused features from both new and existing applications and communications protocols. FY 2023 Base Plans:	26.867	25.988	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 2958 / <i>Cyberspace Activities</i>							
B. Accomplishments/Planned Programs (\$ in Millions)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
N/A											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding is due to program completion.											
Accomplishments/Planned Programs Subtotals		26.867	25.988	0.000	0.000	0.000					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0603801N /2958: <i>Cyberspace Activities</i>	15.537	15.893	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	45.273
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3416 / HIJENKS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3416: HIJENKS	0.000	21.033	9.916	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.949

A. Mission Description and Budget Item Justification

HIJENKS is a non-kinetic High Power Microwave (HPM) payload integrated on an airborne platform will enable the prosecution of multiple targets with area coverage across each target and open targets previously restricted due to collateral damage. HIJENKS increases operational access by disrupting land-based infrastructure facilities tied to adversary systems, decreases cost exchange ratios through non-kinetic engagement, and addresses targets previously restricted due to collateral damage concerns/moral hardening. It expands the competitive space in the electromagnetic spectrum to disrupt, degrade, and destroy critical electronic targets. The Activity identified in Project Unit 3416 specifically addresses Applied Research in support of the HIJENKS INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: HIJENKS	21.033	9.916	0.000	0.000	0.000
Description: The High Power Joint Electromagnetic Non-Kinetic Strike (HIJENKS) program is a proof-of-concept demonstration of a multi-target, advanced airborne High Power Microwave (HPM) payload capable of disrupting electronic targets non-kinetically. HIJENKS is capable of disrupting land-based electronic system infrastructure and engaging multiple targets with a single airborne weapon, increasing operational access/ decreasing cost exchange ratios, providing area lethality with increased pulse rate, providing options to address limitations on collateral damage, increasing standoff range and expanding magazine depth. HIJENKS will advance the current state-of-the-art in HPM technology and demonstrate the near-term operational benefits of integrating HPM-based Electronic Warfare/Electronic Attack (EW/EA) into the current force structure.					
FY 2022 Plans: Continue applied research to further the State-of-the-Art Advancement for HPM technology areas including source, antenna, pulsed power, and high voltage power supplies to support prototype development. Perform Additional platform-agnostic Science and technology (S&T) efforts to advance transition of HPM. Transition Risk Reduction for future HPM systems due to S&T investments in reliability, shelf life, maintainability. Complete HPM Lethality Predictions via effects testing focused on reducing uncertainties and enhancing weaponeering tools and catalog of target models. Continue to pursue investments in manufacturing of critical payload systems; development of materials for storage shelf life & other environmental requirements; and range extension.					
FY 2023 Base Plans: N/A					
FY 2023 OCO Plans:					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 3416 / HIJENKS	

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A					
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding from FY 2022 to FY 2023 in Proj: 3416 HIJENKS is due to program completion.					
Accomplishments/Planned Programs Subtotals	21.033	9.916	0.000	0.000	0.000

C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0603801N/3416: HIJENKS	13.630	7.621	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.251
Remarks											
D. Acquisition Strategy											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3423 / LOCUST			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3423: LOCUST	0.000	20.776	8.031	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	28.807

A. Mission Description and Budget Item Justification

Adversary military modernization and increasing contested domains require a shift in approach "...to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This will include capabilities to enhance close combat lethality in complex terrain." The Low-Cost UAV Swarming Technology (LOCUST) effort will develop and deliver autonomy, C2 architecture, and a series of modular payloads on a robust, scalable, flexible, multifunctional UAV system; employable from surface, sub-surface, airborne, and ground manned and un-manned systems to provide a dispersed, resilient, and adaptive capability to gain a competitive military advantage. LOCUST will provide ISR and precision loitering munitions capable of being launched from air, surface, ground, and sub-surface platforms to conduct both singular and swarm operations across battlespace in conjunction with Joint and manned operations. It will demonstrate multi-domain launch and strike operations, heterogeneous air platform payloads, unmanned from unmanned operations, distributed control of the strike mission, and refined cost elements for critical technologies that have supply chain assurance addressed. The Activity identified in Project Unit 3423 specifically addresses Applied Research in support of the LOCUST INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: LOCUST	20.776	8.031	0.000	0.000	0.000
Description: Adversary military modernization and increasing contested domains require a shift in approach "...to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This will include capabilities to enhance close combat lethality in complex terrain." The Low-Cost UAV Swarming Technology (LOCUST) effort will develop and deliver autonomy, C2 architecture, and a series of modular payloads on a robust, scalable, flexible, multifunctional UAV system; employable from surface, sub-surface, airborne, and ground manned and un-manned systems to provide a dispersed, resilient, and adaptive capability to gain a competitive military advantage. LOCUST will provide ISR and precision loitering munitions capable of being launched from air, surface, ground, and sub-surface platforms to conduct both singular and swarm operations across battlespace in conjunction with Joint and manned operations. It will demonstrate multi-domain launch and strike operations, heterogeneous air platform payloads, unmanned from unmanned operations, distributed control of the strike mission, and refined cost elements for critical technologies that have supply chain assurance addressed.					
FY 2022 Plans: Applied research in the areas of Collaborative, Coordinated, & Cognitive Autonomy (C3A) and largescale Command and Control (C2) of unmanned swarm air vehicle systems engaging in complex behaviors in degraded environments will complete. In FY22, the primary focus will be on methods for rapid swarm behavior					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022				
Appropriation/Budget Activity 1319 / 2			R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>			Project (Number/Name) 3423 / <i>LOCUST</i>					
B. Accomplishments/Planned Programs (\$ in Millions)											
						FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
generation and optimization in multi-target threat scenarios, non-GPS reliant swarm coordination and secure comms architectures that can support operationally relevant environments. FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding in FY 2022 to FY 2023 is due to the planned completion of applied research efforts.											
Accomplishments/Planned Programs Subtotals						20.776	8.031	0.000	0.000	0.000	
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0603801N/3423: <i>LOCUST</i>	12.184	3.373	6.000	-	6.000	0.000	0.000	0.000	0.000	0.000	21.557
• RD TEN/0603382N/3423: <i>LOCUST</i>	2.123	3.371	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.257
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3450 / AMOS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3450: AMOS	0.000	7.918	6.446	8.320	-	8.320	0.000	0.000	0.000	0.000	0.000	22.684

A. Mission Description and Budget Item Justification

The Arctic Mobile Observing System (AMOS) effort will develop a prototype mobile sensing system that can be deployed anywhere in the Arctic via the development of a sea ice-based buoy node that will enable the critical infrastructure (power, communication, environmental intelligence) to provide the Navy with a persistent Arctic presence at lower cost than manned platforms. AMOS is a mobile observing system of systems node that enables 2-way communications, under-ice vehicle navigation, and extended-duration autonomy in the complex Arctic environment. AMOS will provide a persistent, mobile, autonomous capability to monitor the operational environment and maritime operations of potential adversaries in the Arctic Ocean. The Activity identified in Project Unit 3450 specifically addresses Applied Research in support of the AMOS INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: AMOS Description: The Arctic Mobile Observing System (AMOS) effort will develop a prototype mobile sensing system that can be deployed anywhere in the Arctic via the development of a sea ice-based buoy node that will enable the critical infrastructure (power, communication, environmental intelligence) to provide the Navy with a persistent Arctic presence at lower cost than manned platforms. AMOS is a mobile observing system of systems node that enables 2-way communications, under-ice vehicle navigation, and extended-duration autonomy in the complex Arctic environment. AMOS will provide a persistent, mobile, autonomous capability to monitor the operational environment and maritime operations of potential adversaries in the Arctic Ocean. FY 2022 Plans: Continue applied research in support of the development of the Arctic Mobile Observing System (AMOS). Specific efforts include the following: - Conduct at-sea experimentation to understand spatial and temporal limits of low/medium frequency communications on navigation of platforms in the Arctic. - Model under ice communications to enable sustained and persistent communications in the Arctic. - Evaluate sensor and platform power consumption over an annual deployment cycle. - Assess network command & control strategies for AMOS subsystems such as major buoy nodes, floats, gliders and vehicles.	7.918	6.446	8.320	0.000	8.320

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 3450 / AMOS							
B. Accomplishments/Planned Programs (\$ in Millions)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
<p>This applied research is critical to achieving the persistence required for sustained presence in the Arctic.</p> <p>FY 2023 Base Plans: Continue applied research in support of the development of the Arctic Mobile Observing System (AMOS). Specific efforts include: - Continue at-sea experimentation to determine sensing and communications limits from gliders, floats & UUVs to navigation and communications buoys. - Continue evaluation of platform sensor and power consumption including UUV docking and data transmission studies during at-sea experimentation. - Continue float dispersement studies during at-sea experimentation.</p> <p>Complete the following modeling, evaluation, and assessment activities prior to final prototype deployment: - Complete sensor/platform design & establish power budget for the final prototype. - Complete 2-way communications evaluation & final system design for prototype build.</p> <p>Initiate final Arctic deployment of full AMOS prototype for test and evaluation</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY2022 to FY2023 in Proj: 3450 AMOS is due to the ramp up of at-sea experimentation to understand spatial and temporal limits of low/medium frequency communications on navigation of platforms in the Arctic.</p>											
Accomplishments/Planned Programs Subtotals		7.918	6.446	8.320	0.000	8.320					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0603801N/3450: AMOS	4.264	3.457	4.480	-	4.480	0.000	0.000	0.000	0.000	0.000	12.201
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3451 / CLAWS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3451: CLAWS	0.000	19.943	25.871	2.475	-	2.475	0.000	0.000	0.000	0.000	0.000	48.289

A. Mission Description and Budget Item Justification

The CLAWS INP effort will develop an autonomous unmanned undersea weapon system capable of providing offensive effects to the Combatant Commanders beyond Phase 0 inside the first island chain. It will clandestinely extend the reach of large UUVs and increase the mission areas into kinetic effects. CLAWS will deliver algorithms to enable all families of UUVs to operate in complex, dynamic and degraded environments. CLAWS will demonstrate autonomous missions in denied waters, develop and demonstrate autonomous technologies for survivability of large UUVs, and develop autonomy and launch capabilities for special mission payloads. CLAWS will be able to complete missions 1&2 against near peer adversary defenses, maintain critical communication with Navy C2/Fires and provide critical ISR information. The Activity identified in Project Unit 3451 specifically addresses Applied Research in support of the CLAWS INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: CLAWS	19.943	25.871	2.475	0.000	2.475
Description: The CLAWS INP effort will develop an autonomous unmanned undersea weapon system capable of providing offensive effects to the Combatant Commanders beyond Phase 0 inside the first island chain. It will clandestinely extend the reach of large Unmanned Underwater Vehicles (UUVs) and increase the mission areas into kinetic effects. CLAWS will deliver algorithms to enable all families of UUVs to operate in complex, dynamic and degraded environments. CLAWS will demonstrate autonomous missions in denied waters, develop and demonstrate autonomous technologies for survivability of large UUVs, and develop autonomy and launch capabilities for special mission payloads. CLAWS will be able to complete missions 1&2 against near peer adversary defenses, maintain critical communication with Navy Command and Control (C2) and Fires and provide critical ISR information.					
FY 2022 Plans: Initiate research into critical technology for UUV navigation in GPS denied environment. Technology goal for 10 times increase in navigation in denied environments with testing in late FY22. The navigation will feed the development of a modular compact UUV combats system. This will be demonstrated with classified payload.					
Continue applied research for the development of autonomous payloads for extra-large unmanned undersea vehicles operating in denied and contested areas. Payloads will be both kinetic and non-kinetic. Additional effort will include development of autonomy to increase the operator trust for kinetic payloads in contested areas and the development of autonomy and command and control required for swarm payload from extra-large unmanned undersea vehicle.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 3451 / CLAWS		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Specific FY 2022 objectives include: - Demonstration of autonomy algorithms to link with C2 system for deployment of effect for cross domain unmanned system - Develop of autonomy for deployment for non-kinetic effect in varying environmental conditions Develop autonomy to leverage onboard environmental measurements and C2 reach back to provide mission advantage FY 2023 Base Plans: - Complete applied research for the development of autonomous payloads for extra-large unmanned undersea vehicles operating in denied and contested areas. Payloads will be both kinetic and non-kinetic. Additional effort will include development of autonomy to increase the operator trust for kinetic payloads in contested areas and the development of autonomy and command and control required for swarm payload from extra-large unmanned undersea vehicle. Specific FY 2023 objectives include: - Demonstration of autonomy algorithms to link with C2 system for deployment of effect for cross domain unmanned system - Develop of autonomy for deployment for non-kinetic effect in varying environmental conditions including modest sea states and cloud cov-Develop autonomy to leverage onboard environmental measurements and C2 reach back to provide mission advantage. Integrate Navy Oceanographic model results into UUV mission planning. Complete: Final report and knowledge transfer of technology to navy acquisition. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease from FY2022 to FY2023 in Proj 3451 CLAWS is due to the completion of applied research for the development of autonomous payloads for extra-large unmanned undersea vehicles operating in denied and contested areas. Final reporting will occur FY2023.						
Accomplishments/Planned Programs Subtotals		19.943	25.871	2.475	0.000	2.475

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022	
Appropriation/Budget Activity 1319 / 2				R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3451 / CLAWS			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0603801N/3451: CLAWS	14.390	14.285	7.812	-	7.812	0.000	0.000	0.000	0.000	0.000	36.487
Remarks											
D. Acquisition Strategy											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3452 / ELEKTRA			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3452: ELEKTRA	0.000	5.686	3.967	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.653

A. Mission Description and Budget Item Justification

Complex multi-domain threats can overwhelm the operator and individual platforms ability to defend the force. The ELEKTRA INP effort is developing "Human on the Loop" Artificial Intelligence (AI) enabled algorithms to perform force level kinetic/non-kinetic kill chain optimization and coordination across multiple domains at machine to machine speeds to increase the lethality and survivability of the Force. ELEKTRA will demonstrate AI/ML ability to coordinate kinetic/non kinetic effects autonomously with heterogeneous platforms, the ability to operate in degraded environments for hours and the ability to coordinate and execute domain kill chains simultaneously. It will deploy artificial intelligent (AI) and machine learning (ML) architecture, neural networked computing and large data handling to enable real time, force level effects assignment, coordination and resource management. The Activity identified in Project Unit 3452 specifically addresses Applied Research in support of the ELEKTRA INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: ELEKTRA	5.686	3.967	0.000	0.000	0.000
Description: Complex multi-domain threats can overwhelm the operator and individual platforms ability to defend the force. The ELEKTRA INP effort is developing "Human on the Loop" Artificial Intelligence (AI) enabled algorithms to perform force level kinetic/non-kinetic kill chain optimization and coordination across multiple domains at machine to machine speeds to increase the lethality and survivability of the Force. ELEKTRA will demonstrate AI/machine learning (ML) ability to coordinate kinetic/non kinetic effects autonomously with heterogeneous platforms, the ability to operate in degraded environments for hours and the ability to coordinate and execute domain kill chains simultaneously. It will deploy an AI/ML architecture, neural networked computing and large data handling to enable real time, force level effects assignment, coordination and resource management.					
FY 2022 Plans: Complete applied research for the development and expansion of capabilities developed in FY 2021. Research includes advanced analytics and initial prototyping for increasing the complexity of kinetic/non-kinetic kill chains and battle management. FY 2022 thrust areas include research for applying machine learned commanders intent, threat evaluation analytics, researching Distributed Maritime Operations warfare concepts, effects coordination techniques, required data analytics, and Human-Machine teaming concepts for AI applications to					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022				
Appropriation/Budget Activity 1319 / 2			R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>			Project (Number/Name) 3452 / ELEKTRA					
B. Accomplishments/Planned Programs (\$ in Millions)											
						FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
enable synchronizing forces across Intelligence, Surveillance and Reconnaissance (ISR), C2 , Naval C2, surface combat systems and aircraft mission computers at the operational and tactical levels.											
FY 2023 Base Plans: N/A											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding from FY 2022 o FY 2023 in Proj: 3452 ELEKTRA is due to Applied Research program phase completion.											
Accomplishments/Planned Programs Subtotals						5.686	3.967	0.000	0.000	0.000	
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3452: ELEKTRA	10.242	12.876	9.847	-	9.847	4.924	5.022	0.000	0.000	0.000	42.911
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3453 / Hypersonic Booster			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3453: Hypersonic Booster	0.000	3.740	29.915	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	33.655

A. Mission Description and Budget Item Justification

The Hypersonic Booster INP is intended to leverage the best ongoing hypersonic air-breathing vehicle technologies and tailor those to address naval requirements for CVN compatibility and F/A 18E/F carriage. Originally founded upon a redesign/resizing of the DARPA Hypersonic Air-breathing Weapon Concept (HAWC) prototype, the Hypersonic Booster INP will consider all promising hypersonic air-breathing prototype vehicle candidate concepts that have already undergone significant government-industry investment and will lead to achievement of Navy goals; to include cost, schedule and performance. This INP has chosen a multiphase approach to ensure that the most promising concept and associated performer are chosen to deliver this breakthrough technology. The Activity identified in Project Unit 3453 specifically addresses Applied Research in support of the Hypersonic Booster INP effort.

In FY 2023, Proj: 3453 Hypersonic Booster is terminated and its funding realigned to other projects in this program element.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Hypersonic Booster	3.740	29.915	0.000	0.000	0.000
Description: The Hypersonic Booster INP is intended to leverage the best ongoing hypersonic air-breathing vehicle technologies and tailor those to address naval requirements for CVN compatibility and F/A 18E/F carriage. Originally founded upon a redesign/resizing of the DARPA Hypersonic Air-breathing Weapon Concept (HAWC) prototype, the Hypersonic Booster INP will consider all promising hypersonic air-breathing prototype vehicle candidate concepts that have already undergone significant government-industry investment and will lead to achievement of Navy goals; to include cost, schedule and performance. This INP has chosen a multiphase approach to ensure that the most promising concept and associated performer are chosen to deliver this breakthrough technology. The Activity identified in Project Unit 3453 specifically addresses Applied Research in support of the Hypersonic Booster INP effort.					
In FY 2023, Proj: 3453 Hypersonic Booster is terminated and its funding realigned to other projects in this program element.					
FY 2022 Plans: Continue applied research efforts in characterizing the performance of key components and assemblies to include: free jet testing of the scramjet engine while installed in the cruiser configuration, static ballistic testing of the solid propellant booster motor, and dynamic testing of the separation assembly. Efforts include fabrication					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 3453 / <i>Hypersonic Booster</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
of hardware for the vehicle's compressed forebody and engine inlet assembly for characterizing and tuning the scramjet engine via a series of freejet tests in the NAS Langley wind tunnel. FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding from FY22 to FY23 in Proj: 3453 Hypersonic Booster is due to the termination of this Project.						
Accomplishments/Planned Programs Subtotals		3.740	29.915	0.000	0.000	0.000
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3454 / MDUSV			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3454: MDUSV	0.000	4.570	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.570

A. Mission Description and Budget Item Justification

The Medium Displacement Unmanned Surface Vehicle (MDUSV) project will develop and test a 132 ft. unmanned surface vehicle with ocean-spanning range, months of endurance, good seakeeping, and substantial payload. The vessel will have a high level of autonomy for independent operations under sparse supervisory control and have utility for a variety of Navy missions. MDUSVs capable of deployed blue-water operations with operator trust in safe, reliable operation, long-range and endurance autonomous operations. This will create a new paradigm for Navy surface force, a hybrid manned/unmanned force, and enable new tactics in performing naval missions. The Activity identified in Project Unit 3454 specifically addresses Applied Research in support of the MDUSV INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: MDUSV	4.570	0.000	0.000	0.000	0.000
Description: The Medium Displacement Unmanned Surface Vehicle (MDUSV) project will develop and test a 132 ft. unmanned surface vehicle with ocean-spanning range, months of endurance, good seakeeping, and substantial payload. The vessel will have a high level of autonomy for independent operations under sparse supervisory control and have utility for a variety of Navy missions. MDUSVs capable of deployed blue-water operations with operator trust in safe, reliable operation, long-range and endurance autonomous operations. This will create a new paradigm for Navy surface force, a hybrid manned/unmanned force, and enable new tactics in performing naval missions.					
FY 2022 Plans: N/A					
FY 2023 Base Plans: N/A					
FY 2023 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	4.570	0.000	0.000	0.000	0.000

C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0603801N/3454: MDUSV	2.514	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.514

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022	
Appropriation/Budget Activity 1319 / 2				R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3454 / MDUSV			
C. Other Program Funding Summary (\$ in Millions)											
	<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023</u> <u>Base</u>	<u>FY 2023</u> <u>OCO</u>	<u>FY 2023</u> <u>Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To</u> <u>Complete</u> <u>Total Cost</u>
<u>Remarks</u>											
<u>D. Acquisition Strategy</u>											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3455 / MINERVA			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3455: MINERVA	0.000	5.621	3.966	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.587

A. Mission Description and Budget Item Justification

The need to operate in a multiple domain environment against highly capable peers requires improved decision quality and reduced decision timelines. MINERVA will develop AI and Machine-Learning (ML) capabilities to improve mission planning, intelligence gathering, execution and assessment. Minerva will deliver next-generation decision aids by combining operations research with emerging AI capabilities to create learning, self-adaptive automation that supports Composite Warfare Commander's (CWC) and their staffs at the Fleet, Force and Group echelons. It will establish a DevOps environment that includes warfighter staffs in the development and integration of new capabilities. The Activity identified in Project Unit 3455 specifically addresses Applied Research in support of the MINERVA INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: MINERVA	5.621	3.966	0.000	0.000	0.000
Description: The need to operate in a multiple domain environment against highly capable peers requires improved decision quality and reduced decision timelines. MINERVA will develop AI and Machine-Learning (ML) capabilities to improve mission planning, intelligence gathering, execution and assessment. Minerva will deliver next-generation decision aids by combining operations research with emerging AI capabilities to create learning, self-adaptive automation that supports Composite Warfare Commander's (CWC) and their staffs at the Fleet, Force and Group echelons. It will establish a DevOps environment that includes warfighter staffs in the development and integration of new capabilities.					
FY 2022 Plans: Continue applied research on emerging artificial intelligence and machine learning, and efforts associated with the development and expansion of a multi-domain integrated fires control prototype developed in FY 2021. Artificial intelligence and machine learning methods will be applied to undersea, surface, air, and space tactical decision aids to enhance the fidelity of kinetic/non-kinetic kill chains. These tactical decision aids will combine into a multi-domain battle management automation capability that will enable the synchronization of forces across Intelligence, Surveillance and Reconnaissance, Command & Control and combat systems at the operational and tactical levels.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022	
Appropriation/Budget Activity 1319 / 2				R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3455 / MINERVA			
B. Accomplishments/Planned Programs (\$ in Millions)											
				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total			
Continue applied research on emerging artificial intelligence and machine learning methods to predict an adversary's surface warship or submarine kinematic space (position, velocity) and what is the likelihood of a specific enemy course of action/intent.											
FY 2023 Base Plans: N/A											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding from FY 2022 to FY 2023 is due to maturation and completion of the applied research in this program element (PE) and project, and associated migration of efforts to advanced technology development investment in PE 0603801N, Project 3455.											
Accomplishments/Planned Programs Subtotals				5.621	3.966	0.000	0.000	0.000			
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0603801N/3455: MINERVA	10.307	12.876	11.816	-	11.816	6.894	7.031	0.000	0.000	0.000	48.924
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototype s (INP) Applied Res				Project (Number/Name) 3456 / Full Spectrum Undersea Warfare			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3456: Full Spectrum Undersea Warfare	0.000	14.916	20.940	39.600	-	39.600	42.570	42.570	42.570	43.421	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Full Spectrum Undersea Warfare (FSUSW) Project will develop new technology for offensive and defensive warfare conducted on the seabed, in the sea (i.e. subsea), and from the sea. FSUSW focuses on Theatre Undersea Warfare (TUSW), Joint Targeting and Strike, and Subsea and Seabed Warfare (SSW). There are five thrust areas of FSUSW that are key to enabling Chief of Naval Operations Guidance (CNOG), Distributed Maritime Operations (DMO), and the Commandant's Stand in Force with manned and unmanned warfighting capability. These thrust areas were specifically chosen in direct collaboration with STRATCOM, INDO-PACOM, Fleet and Undersea Warfare Commanders and validated with regular Flag officer engagements. These applied research efforts will enable future undersea weapon systems (e.g., Maritime Strike Tomahawk and ADCAP variants), COCOM campaigns, and operational plans. FSUSW thrust areas include 1) Undersea effectors, 2) Integrated expeditionary subsea system of systems, 3) Multi-Vehicle Torpedo Tube Development System (MVTDS), 4) Undersea UAV for Over-The-Horizon (OTH) effects and 5) Undersea Launched Devices to enable Commanding Officers and Regional Combatant Commander effects. The five thrust areas are technically and operationally interconnected.

The efforts described in this Project address the Applied Research associated with the Innovative Naval Prototypes (INP) Program. These investments represent game changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both Budget Activity (BA) 2 and BA3 funding. The BA3 INP funds are specified in a separate Program Element (PE), 0603801N Innovative Naval Prototypes (INP) Adv Tec Dev in the Undersea Warfare Efforts, Project 3458.

Information security concerns preclude fully detailed descriptions of project efforts, research activities, and technology development plans. Specific information on each project and activity will be provided separately to the Congressional oversight committees.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Undersea Warfare Efforts	14.916	20.940	39.600	0.000	39.600
Description: The FSUSW Project will develop new technology for offensive and defensive warfare conducted on the seabed, in the sea (i.e. subsea), and from the sea. FSUSW will address three thrusts identified in the Undersea Warfare Development Command's document, "Full Spectrum Undersea Warfare Concept of Operations (CONOPS)". These thrusts are: advanced offensive missions for submarines, subsea and seabed warfare, and distributed undersea warfare. Distributed undersea warfare technology will enable full participation					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 3456 / Full Spectrum Undersea Warfare			
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
of all undersea warfare assets in the Navy's Distributed Maritime Operations concept. FSUSW missions this Project addresses include Anti-Submarine Warfare (ASW), Anti Surface Warfare, Strike, Intelligence, Surveillance, and Reconnaissance, Mine Warfare, and Subsea and Seabed Warfare (SSW). The FSUSW Project includes the Affordable Mobile ASW Surveillance System (AMASS) research and will leverage technology developed in the separate PE 06022792N, Project Unit 3450, AMOS.							
FY 2022 Plans: Continued applied research to: - Improve the reliability and packing of components from modeling, simulation, breadboard of undersea UAV and undersea launched devices. - Conduct full scale experimentation, comparing legacy devices and developing devices to confirm performance envelopes to establish technical feasibility for scaling. - Complete applied research development for undersea launched devices with expectation to initiate advanced technology development of small devices in 2023. - Improve autonomy to enhance device sensors, emitters and communications by reducing emissions. - Develop optimized navigation and power alternatives that could have a notable mission performance enhancement for given vehicle diameter. - Conduct live, virtual, constructive experimentation with existing subsea sub-systems to characterize performance and technology options for expeditionary subsea system of systems, including data collection at sea.							
FY 2023 Base Plans: Continue: - Train and evaluate autonomy and automatic target recognition for joint undersea surveillance and targeting UUV - Conduct scaled experimentation and full scale interoperability in support of manned platform task execution, - Conduct live, virtual, constructive experimentation - Continue applied research development for larger undersea launched devices - Continue development of navigation and power alternatives that could have a notable mission performance.							
Complete: - Reliability and packing of components for small devices - Testing - Small diameter device host platform optimization.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3456 / <i>Full Spectrum Undersea Warfare</i>			
B. Accomplishments/Planned Programs (\$ in Millions)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Initiate: - Train acoustic unmanned detection algorithms for specific joint undersea surveillance and targeting UUV tasks - Independently and autonomously conduct specific undersea tasks - Design and initial prototype of undersea UAV and countermeasures with advanced autonomy, enabling warfighting task execution without humans in the loop for larger sized <i>FY 2023 OCO Plans:</i> N/A <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY 2022 to FY 2023 is due to the planned funding profile growth to support expanding Applied Research to larger devices and maturation of Applied Research in this activity through the fabrication of hardware and conducting a larger number of data collection and testing events.					
Accomplishments/Planned Programs Subtotals	14.916	20.940	39.600	0.000	39.600
C. Other Program Funding Summary (\$ in Millions)					
N/A					
Remarks					
D. Acquisition Strategy					
N/A					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3461 / MASS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3461: MASS	0.000	0.000	4.487	4.950	-	4.950	7.920	0.000	0.000	0.000	0.000	17.357

Note

This activity is being broken out from PE 0603801N Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA2 level.

A. Mission Description and Budget Item Justification

The rising use of air, surface, and sub-surface unmanned and autonomous systems requires a paradigm shift in the development, production, and life-cycle management of these systems in order to gain a competitive advantage against adversarial capabilities as well as allow for fielding of significant numbers (1000's to 10,000's) in an increasingly budget-constrained acquisition environment. The growth in rapid prototyping and additive manufacturing technologies presents an opportunity to capitalize on these advances though applied research efforts focused on scale-up both in terms of rapid production of relevant quantities as well as greatly increasing the physical size of platforms produced far beyond what is currently achievable. Manufacturing of Autonomous Systems at Scale (MASS) efforts will utilize wide range of advanced manufacturing methods combined with adaptive digital design processes with "Design for Low-Cost Platform Attriteability" as a major attribute to avoid the platform cost growths normally associated with exquisite systems development. This also represents the ability to rapidly modify platform attributes based on evolving operational needs and quickly insert into build process without costly retooling. Secondary goals focus on increasing commonality of critical components across platforms and design of these in modular fashion in order to manage supply chain vulnerability. Lastly, the project will look at ability to place manufacturing capability as far forward/afloat as possible to reduce the logistics tail and speed delivery of capability at-scale into the fleet. The activity identified in Project Unit 3461 MASS specifically addresses Applied Research in support of the MASS effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Manufacture of Autonomous Systems at Scale (MASS)	0.000	4.487	4.950	0.000	4.950
Description: The rising use of air, surface, and sub-surface unmanned and autonomous systems requires a paradigm shift in the development, production, and life-cycle management of these systems in order to gain a competitive advantage against adversarial capabilities as well as allow for fielding of significant numbers (1000's to 10,000's) in an increasingly budget-constrained acquisition environment. The growth in rapid prototyping and additive manufacturing technologies presents an opportunity to capitalize on these advances though applied research efforts focused on scale-up both in terms of rapid production of relevant quantities as well as greatly increasing the physical size of platforms produced far beyond what is currently achievable. Manufacturing of Autonomous Systems at Scale (MASS) efforts will utilize wide range of advanced manufacturing methods combined with adaptive digital design processes with "Design for Low-Cost Platform Attriteability" as a major attribute to avoid the platform cost growths normally associated with exquisite systems development. This also represents the ability to rapidly modify platform attributes based on evolving operational needs and					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 3461 / MASS		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
quickly insert into build process without costly retooling. Secondary goals focus on increasing commonality of critical components across platforms and design of these in modular fashion in order to manage supply chain vulnerability. Lastly, the project will look at ability to place manufacturing capability as far forward/afloat as possible to reduce the logistics tail and speed delivery of capability at-scale into the fleet. The activity identified in Project Unit 3461 MASS specifically addresses Applied Research in support of the MASS effort.						
FY 2022 Plans: Continue Manufacturing of Autonomous Systems at Scale (MASS) efforts to utilize wide range of advanced manufacturing methods combined with adaptive digital design processes focused on large scale (both size and quantity) platforms of interest with Design for Attriteability as a major attribute. Secondary goals focused on managing supply chain vulnerability an supply chain assurance for critical and common components and manufacturing capability as far forward/afloat as possible.						
FY 2023 Base Plans: Continue: Continue Manufacturing of Autonomous Systems at Scale (MASS) efforts to utilize wide range of advanced manufacturing methods for based on design for attritability. Continue MASS digital design efforts to couple rapid adaptive processes focused on large scale (both size and quantity) platforms of interest.						
Complete: Complete MASS down-selection of technologies for experimentation.						
Complete design workshops for experimentation.						
Initiate: Initiate design modeling and simulation for composite and metallic large structural alternatives for attritable Super Swarm (Project 3459) agents and Deployment and Employment of Autonomous Long Range Systems (DEALRS) (Project 3462) swarm delivery marsupial host platforms. New design modifications will be based on FY22 design feedback.						
Initiate methods for supply chain assurance for critical and common components and manufacturing capability for swarm agents as far forward/afloat as possible.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 3461 / MASS							
B. Accomplishments/Planned Programs (\$ in Millions)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
Initiate ruggedization of equipment for forward manufacturing.											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 is due to the planned increase in materials purchased and their utilization applied to attritable platforms.											
Accomplishments/Planned Programs Subtotals		0.000	4.487	4.950	0.000	4.950					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0603801N/3461: <i>MASS</i>	0.000	0.988	3.960	-	3.960	4.950	4.950	0.000	0.000	0.000	14.848
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3462 / DEALRS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3462: DEALRS	0.000	0.000	5.983	6.930	-	6.930	10.890	6.930	0.000	0.000	0.000	30.733

Note

This activity is being broken out from PE 0603801N Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA2 level.

A. Mission Description and Budget Item Justification

Adversary Anti-Access and Area Denial (A2/AD) capabilities continue to improve but remain focused on targeting specific US and joint force capabilities. The Deployment and Employment of Autonomous Long Range Systems (DEALRS) project will develop technologies that sidestep, operate below the threshold, or deplete adversary A2/AD capabilities. DEALRS will specifically develop technologies to enable low-cost unmanned systems that can maneuver across theater-level ranges to penetrate, operate within, and launch strikes from within adversary A2/AD system coverage. This project will develop technologies to increase the range and endurance of autonomous systems while maintaining tactically relevant speeds, loiter times, and signatures with low cost. It will also address technologies that enable the marsupial launch of terminal engagement autonomous unmanned systems across all domains from larger and/or longer-range host systems that bring them to the launch area and the associated technologies needed to ensure roboticized and autonomous startup and launch of the marsupial systems without human intervention. The Activity identified in Project Unit 3462 DEALRS specifically addresses Applied Research in support of the INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

Title: DEALRS	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
FY 2022 Plans: Continue efforts to explore concepts for the Deployment and Employment of Autonomous Long Range Systems (DEALRS) across all domains. Efforts will focus on platforms enhancements as well as marsupial concepts to allow extremely large numbers of systems to traverse long distances with minimal human intervention to bring them into the operations area.	0.000	5.983	6.930	0.000	6.930
FY 2023 Base Plans: Continue: Continue efforts to explore concepts for the DEALRS across all domains. Efforts will focus on swarm agent range/ endurance enhancements as well as marsupial host / children swarm delivery concepts to allow extremely large numbers of systems to traverse long distances with minimal human intervention to bring them into the operations area.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 3462 / <i>DEALRS</i>							
B. Accomplishments/Planned Programs (\$ in Millions)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
<p>Continue efforts to demonstrate concepts for DEALRS across all domains. Efforts will focus on scaling up promising concepts to demonstrate trans-Oceanic deployment and employment of large numbers of unmanned systems to deliver desired effects in the areas of operation.</p> <p>Initiate: Initiate efforts for scale-up of promising full-system designs and components for objective Deployment and Employment of Autonomous Long Range Systems (DEALRS) swarm delivery marsupial host platform. Design will be informed by FY22 and early FY23 activities.</p> <p>Initiate concept exploration of alternative launcher methodologies to increase numbers of swarm platforms can be transported and deployed. Effort will be informed by FY22 / early FY23 Super Swarm (Project 3459) and Manufacture of Autonomous Systems at Scale (MASS) (Project 3461) activities.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 is due to the planned development of a marsupial platform to achieve the Long-Range delivery goals of the program.</p>											
Accomplishments/Planned Programs Subtotals		0.000	5.983	6.930	0.000	6.930					
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3462: <i>DEALRS</i>	0.000	0.987	4.950	-	4.950	5.940	5.940	7.920	8.078	Continuing	Continuing
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 3463 / MATes			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3463: MATes	0.000	0.000	4.986	6.435	-	6.435	9.900	9.900	4.950	5.049	Continuing	Continuing

Note

This activity is being broken out from PE 0603801N Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA2 level.

A. Mission Description and Budget Item Justification

Traditionally, the utilization of autonomous systems is either operationally segregated from manned operations or requires a significant amount of human oversight when operating in conjunction with manned assets, which mitigates some of the advantage from using them. The goal of the Manned and Autonomous Teams (MATes) project is to develop autonomic robotic technology and collaborative autonomous behaviors that seamlessly operate across all domains in conjunction with manned units, allowing for real-time adaptation and optimization in a manner that streamlines the element of human interaction needed to share mission goals. This technology will monitor human or manned system teammate state, behavior, mission, and adversary threat status to anticipate and act in a tactically appropriate manner that is predictable, communicable, and trusted by the human/manned teammates and which enables autonomous system optimization in coordination with the human/manned teammate and mission objectives. Intuitive human/autonomous system interfaces will be developed to allow focus on higher-order decision-making tasks by the operators allowing for large numbers of autonomous systems (100's or 1000's) to be managed in support of manned operations. The activity identified in Project Unit 3463 MATes specifically addresses Applied Research in support of the MATes effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Manned and Autonomous Teams	0.000	4.986	6.435	0.000	6.435
Description: Traditionally, the utilization of autonomous systems is either operationally segregated from manned operations or requires a significant amount of human oversight when operating in conjunction with manned assets, which mitigates some of the advantage from using them. The goal of the Manned and Autonomous Teams (MATes) project is to develop autonomic robotic technology and collaborative autonomous behaviors that seamlessly operate across all domains in conjunction with manned units, allowing for real-time adaptation and optimization in a manner that streamlines the element of human interaction needed to share mission goals. This technology will monitor human or manned system teammate state, behavior, mission, and adversary threat status to anticipate and act in a tactically appropriate manner that is predictable, communicable, and trusted by the human/manned teammates and which enables autonomous system optimization in coordination with the human/manned teammate and mission objectives. Intuitive human/autonomous system interfaces will be developed to allow focus on higher-order decision-making tasks by the operators allowing for large numbers of autonomous systems (100's or 1000's) to be managed in support of manned operations. The					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 3463 / MATes		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
activity identified in Project Unit 3463 MATes specifically addresses Applied Research in support of the MATes effort.						
FY 2022 Plans: Continue efforts to explore autonomy, perception, and command and control (C2) concepts for Manned and Autonomous Teams (MATES) conducting complex multi-domain operations in proximity to each other along a spectrum of missions. Missions range from fully autonomous to highly supervised requiring an agile optimization as real-world factors change.						
FY 2023 Base Plans: Continue: Continue efforts to explore autonomy, perception, and command and control (C2) concepts for Manned and Autonomous Teams (MATES) conducting complex multi-domain operations in proximity to each other along a spectrum of missions. Autonomous systems will be swarm agents developed through Super Swarm (Project 3459) and Deployment and Employment of Autonomous Long Range Systems (DEALRS) (Project 3462). Autonomy, perception, and agent/ vehicle control schemes will be informed by Manufacture of Autonomous Systems at Scale (MASS) (Project 3461). Missions range from fully autonomous to highly supervised requiring an agile optimization as real-world factors change.						
Continue efforts to explore autonomy, perception, and command and control (C2) concepts for MATES conducting complex multi-domain operations in proximity to each other along a spectrum of missions.						
Initiate: Initiate activites researching an artificial theory of mind for Super Swarm (Project 3459) agents, allowing them to perceive current manned blue teammate behavior states and derive and act on anticipated future states and potential reactions to state changes.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY22 to FY23 is due to the planned development of MATes toward fully autonomous swarm missions.						
Accomplishments/Planned Programs Subtotals		0.000	4.986	6.435	0.000	6.435

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022		
Appropriation/Budget Activity 1319 / 2				R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res			Project (Number/Name) 3463 / MATes		

C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0603801N/3463: MATes	0.000	0.987	3.960	-	3.960	4.950	4.950	13.860	14.137	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototype s (INP) Applied Res				Project (Number/Name) 5891 / INP Operational Analysis, Support and Experimentation Activity			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5891: INP Operational Analysis, Support and Experimentation Activity	0.000	0.000	0.000	4.461	-	4.461	2.000	2.000	2.000	2.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Effective in FY23, efforts in the Directed Energy/Electric Weapons Activity within Proj: 3400 INP Applied Research in PE 0602792N are broken out into this stand-alone Proj: 5891 Operational Analysis, Support and Experimentation Activity to broaden the spectrum of promising applied research efforts investigated within this Project and to provide additional acquisition oversight, fiscal clarity, and adherence to financial management practices at the Project level.

The efforts described in this Project address the Applied Research associated with Innovative Naval Prototype (INP) Operational Analysis, Support and Experimentation Activity efforts that are used to further explore the development of future INP topics and proposals. These efforts evaluate, study/analyze and/or perform any basic applied research-focused investigative experimentation activities which will support the identification of potential INP topics for future investment consideration. The use of Operational Analysis, Support and Experimentation Activity funds can help accelerate and/or create a flexible response to emerging requirements or threats by identifying a potential INP topic for consideration in a more time-efficient and/or effective manner.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: INP Operational Analysis, Support and Experimentation	0.000	0.000	4.461	0.000	4.461
Description: Effective in FY23, efforts in the Directed Energy/Electric Weapons Activity within Proj: 3400 INP Applied Research in PE 0602792N are broken out into this stand-alone Proj: 5891 Operational Analysis, Support and Experimentation to broaden the spectrum of promising applied research efforts investigated within this Project and to provide additional acquisition oversight, fiscal clarity, and adherence to financial management practices at the Project level.					
The efforts described in this Project address the Applied Research associated with Innovative Naval Prototype (INP) Operational Analysis, Support and Experimentation efforts that are used to further explore the development of future INP topics and proposals. These efforts evaluate, study/analyze and/or perform any basic applied research-focused investigative experimentation activities which will support the identification of potential INP topics for future investment consideration. The use of Operational Analysis, Support and Experimentation funds can help accelerate and/or create a flexible response to emerging requirements or threats by identifying a potential INP topic for consideration in a more time-efficient and/or effective manner.					
FY 2022 Plans:					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 5891 / <i>INP Operational Analysis, Support and Experimentation Activity</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A FY 2023 Base Plans: - Initiate program support and applied research activities associated with exploring the development of future INP topics and proposals. - Evaluate, study/analyze and/or perform any basic applied research-focused investigative experimentation activities to inform and identify potential future INP investment areas. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5891 INP Operational Analysis, Support and Experimentation is due to the initiation of this Project which is established from the re-alignment of funding from the Directed Energy/Electric Weapons Activity within Proj: 3400 INP Applied Research in PE 0602792N to broaden the spectrum of promising applied research efforts investigated.						
Accomplishments/Planned Programs Subtotals		0.000	0.000	4.461	0.000	4.461
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5892 / Full Spectrum Information Warfare			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5892: Full Spectrum Information Warfare	0.000	0.000	0.000	4.000	-	4.000	7.000	0.000	0.000	0.000	0.000	11.000

A. Mission Description and Budget Item Justification

The Full Spectrum Information Warfare (FSIW) effort will develop integrated holistic Counter-C5ISR capability, techniques and CONOPS to defeat adversarial capacity growth to include the effects of the maritime environment on tactics and effectiveness in order to provide the proliferation of C-C5ISR payloads on small to large platforms and software to calculate EM propagation and take into account environmental conditions from "DC to Daylight" e.g. from VLF/HF through optical frequencies to optimize both passive and active C-C5ISR technology use.

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the FSIW INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Full Spectrum Information Warfare	0.000	0.000	4.000	0.000	4.000
Description: The Full Spectrum Information Warfare (FSIW) effort will develop integrated holistic Counter-C5ISR capability, techniques and CONOPS to defeat adversarial capacity growth to include the effects of the maritime environment on tactics and effectiveness in order to provide the proliferation of C-C5ISR payloads on small to large platforms and software to calculate EM propagation and take into account environmental conditions from "DC to Daylight" e.g. from VLF/HF through optical frequencies to optimize both passive and active C-C5ISR technology use.					
The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 5892 / <i>Full Spectrum Information Warfare</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.</p> <p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the FSIW INP effort.</p> <p><i>FY 2022 Plans:</i> N/A</p> <p><i>FY 2023 Base Plans:</i> Initiate applied research in support of the development of Full Spectrum Information Warfare(FSIW). Specific efforts include the following:</p> <ul style="list-style-type: none"> - Develop a test scenario with real tropospheric and ionospheric conditions based on one of the EW Field Demos (for example in the LSE or Rough Series). Identify cases of observed extended or reduced ranges, clutter, and detectability and compare predicted to observed conditions. - Analyze emerging material science for possible breakthroughs in passive countermeasures - Investigate cyber vulnerabilities in imagers and potential threat AI/ML algorithms - Investigate a high-level architecture for MUM-T C-C5ISR employment - Extend current planning aids for space-based ISR to surface and airborne fixed/ mobile systems. <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 in Proj: 5892 Full Spectrum Information Warfare (FSIW) is due to the initiation of this Project.</p>						
Accomplishments/Planned Programs Subtotals		0.000	0.000	4.000	0.000	4.000
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res	Project (Number/Name) 5892 / Full Spectrum Information Warfare
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5893 / Decision Superiority			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5893: Decision Superiority	0.000	0.000	0.000	1.700	-	1.700	1.200	0.000	0.000	0.000	0.000	2.900

A. Mission Description and Budget Item Justification

The Decision Superiority (DS) effort will improve the speed and quality of decisions when conducting undersea warfare activities at the tactical edge that does not require persistent communication reach back. This will be achieved through the development of Decision Aids (DAs) using a holistic Human-Machine-Teaming (HMT) and training approaches and processes to optimize warfighter decisions (e.g. sonar operations, maintenance repair, personnel rotations).

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the Decision Superiority INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Decision Superiority	0.000	0.000	1.700	0.000	1.700
Description: The Decision Superiority (DS) effort will improve the speed and quality of decisions when conducting undersea warfare activities at the tactical edge that does not require persistent communication reach back. This will be achieved through the development of Decision Aids (DAs) using a holistic Human-Machine-Teaming (HMT) and training approaches and processes to optimize warfighter decisions (e.g. sonar operations, maintenance repair, personnel rotations).					
The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 5893 / Decision Superiority		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the Decision Superiority INP effort.</p> <p>FY 2022 Plans: N/A</p> <p>FY 2023 Base Plans: Initiate applied research in support of the development of the Decision Superiority (DS) INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Studies and operational characterization of problems, tasks, data, decisions, and metrics related to undersea warfare. - Modeling and simulation architecture development to inform iterative development, training, and evaluation in a realistic mission environment. HMT design and evaluation analysis to support warfighter decisions making related to emerging technologies. - Develop adaptive training process informed by identified warfighter decisions, HMT evaluation process, and operational metrics - Develop and conduct initial research studies related to mental endurance and decision making performance to inform personnel rotation and scheduling technologies <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5893 Decision Superiority (DS) is due to the initiation of this Project.</p>						
Accomplishments/Planned Programs Subtotals		0.000	0.000	1.700	0.000	1.700
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5894 / Direct-X			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5894: Direct-X	0.000	0.000	0.000	2.500	-	2.500	0.000	0.000	0.000	0.000	0.000	2.500

A. Mission Description and Budget Item Justification

The Direct-X effort will develop space based ISRT with direct downlink into kill chains supporting all domain effects in a Distributed Maritime Operations construct. The focus is on advances in the following lines of effort:

P1 - Orchestration, tasking and resilient C3

P2 - Threat prioritized low cost on orbit payloads

P3 - On orbit processing and analytic AI/ML

P4 - Direct-to-shooter kill chains

P5 - On orbit effects

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the Direct-X INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Direct-X	0.000	0.000	2.500	0.000	2.500
Description: The Direct-X effort will develop space based ISRT with direct downlink into kill chains supporting all domain effects in a Distributed Maritime Operations construct. The focus is on advances in the following lines of effort: P1 - Orchestration, tasking and resilient C3 P2 - Threat prioritized low cost on orbit payloads P3 - On orbit processing and analytic AI/ML P4 - Direct-to-shooter kill chains P5 - On orbit effects The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res		Project (Number/Name) 5894 / Direct-X		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.</p> <p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the Direct-X INP effort.</p> <p>FY 2022 Plans: N/A</p> <p>FY 2023 Base Plans: Initiate applied research in support of the development of the Direct-X INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Feasibility studies to identify state-of-the-art technologies that support these five lines of effort, and analyze them to capture technological gaps for enabling the DX concept. - Determine the sequencing of payloads to threats - Study outcomes and analysis of technological gaps to develop an investment strategy for an envisioned reconfigurable Naval constellation- ultimately converging on multifunction systems to support mission areas. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5894 Direct-X is due to the initiation of this Project.</p>						
Accomplishments/Planned Programs Subtotals		0.000	0.000	2.500	0.000	2.500
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res	Project (Number/Name) 5894 / Direct-X
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5895 / DMO through IAS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5895: DMO through IAS	0.000	0.000	0.000	2.950	-	2.950	4.500	0.000	0.000	0.000	0.000	7.450

A. Mission Description and Budget Item Justification

The Distributed Maritime Operations through Intelligent Autonomous Systems (DMO-IAS) effort will demonstrate IAS teams that can maneuver and close sea denial detect through engage/ assess kill-chains over tactically relevant ranges and extended mission durations, that maintain survivability through avoidance of detection, and that do not rely on vulnerable command and control systems. It will explore novel sensing, autonomy, and communications approaches that can be applied to other Navy IAS programs that enable robust, resilient IAS kill-chains.

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the DMO through IAS INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: DMO through IAS	0.000	0.000	2.950	0.000	2.950
Description: The Distributed Maritime Operations through Intelligent Autonomous Systems (DMO-IAS) effort will demonstrate IAS teams that can maneuver and close sea denial detect through engage/ assess kill-chains over tactically relevant ranges and extended mission durations, that maintain survivability through avoidance of detection, and that do not rely on vulnerable command and control systems. It will explore novel sensing, autonomy, and communications approaches that can be applied to other Navy IAS programs that enable robust, resilient IAS kill-chains.					
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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 5895 / <i>DMO through IAS</i>		
B. Accomplishments/Planned Programs (\$ in Millions)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.</p> <p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the DMO through IAS INP effort.</p> <p>FY 2022 Plans: N/A</p> <p>FY 2023 Base Plans: Initiate applied research in support of the development of Distributed Maritime Operations through Intelligent Autonomous Systems (DMO through IAS). Specific efforts include the following:</p> <ul style="list-style-type: none"> - Conduct operationally oriented study and simulation experiment to refine the potential of AI enabled IAS platforms - conducting collaborative DMO. - Integrate autonomy, onboard AI processing, and comms modalities onto surrogate UxS (draw from existing INP efforts). - Conduct live, force-on-force experiment against fleet assets to determine and validate kill-chain vulnerabilities and opportunities. - Lessons learned will inform efficacy and impact of a potential follow-on effort along with defined technical objectives and proposed paths for autonomy, sensing, AI, platform performance, and C2. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5895 Distributed Maritime Operations through Intelligent Autonomous Systems (DMO through IAS) is due to the initiation of this Project.</p>						
Accomplishments/Planned Programs Subtotals		0.000	0.000	2.950	0.000	2.950
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototype s (INP) Applied Res	Project (Number/Name) 5895 / DMO through IAS
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5896 / Echidna			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5896: Echidna	0.000	0.000	0.000	1.777	-	1.777	0.750	0.000	0.000	0.000	0.000	2.527

A. Mission Description and Budget Item Justification

The Echidna effort will develop additive capability and additive capacity which is classified. It will explore new mine development, to include improved sensing for a highly complex environment and target, improved lethality, endurance and power technologies, cost-effective additive manufacturing subcomponent technologies, and flexible, platform-agnostic engineering design (to include safe & arming device) to allow for novel and adaptable concepts of employment (CONEMP)

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the Echidna INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Echidna	0.000	0.000	1.777	0.000	1.777
Description: The Echidna effort will develop additive capability and additive capacity which is classified. It will explore new mine development, to include improved sensing for a highly complex environment and target, improved lethality, endurance and power technologies, cost-effective additive manufacturing subcomponent technologies, and flexible, platform-agnostic engineering design (to include safe & arming device) to allow for novel and adaptable concepts of employment (CONEMP)					
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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022																				
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 5896 / <i>Echidna</i>																					
B. Accomplishments/Planned Programs (\$ in Millions)																							
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 65%;"></th> <th style="width: 10%;">FY 2021</th> <th style="width: 10%;">FY 2022</th> <th style="width: 10%;">FY 2023 Base</th> <th style="width: 10%;">FY 2023 OCO</th> <th style="width: 10%;">FY 2023 Total</th> </tr> </thead> <tbody> <tr> <td> <p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the Echidna INP effort.</p> <p><i>FY 2022 Plans:</i> N/A</p> <p><i>FY 2023 Base Plans:</i> Initiate applied research in support of the development of the Echidna INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Thrust 1: Lethality study, to include M&S for housing, and comparative analysis with legacy warhead and new explosive formulation - Thrust 2: Analysis of Alternatives (AoA) for dynamic sensing environment, target analysis - Thrust 3: Update 2021 ONR Subsea & Seabed Power (SSP) Roadmap to address Mining gaps. Establish T/O for endurance parameters, environmental considerations, approach for deployment. - Thrust 4: Additive manufacturing study for subcomponent technologies, to include prototype application <p>Exit criteria for Phase 1: Integration schedule for subcomponent design (Thrust 1-3), and parallel subcomponent design and comparative analysis of test articles in representative environment (Thrust 4)</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 in Proj: 5896 Echidna is due to the initiation of this Project.</p> </td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: right;">Accomplishments/Planned Programs Subtotals</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">1.777</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">1.777</td> </tr> </tbody> </table>							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	<p>The Activity identified in this Project Unit specifically addresses Applied Research in support of the Echidna INP effort.</p> <p><i>FY 2022 Plans:</i> N/A</p> <p><i>FY 2023 Base Plans:</i> Initiate applied research in support of the development of the Echidna INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Thrust 1: Lethality study, to include M&S for housing, and comparative analysis with legacy warhead and new explosive formulation - Thrust 2: Analysis of Alternatives (AoA) for dynamic sensing environment, target analysis - Thrust 3: Update 2021 ONR Subsea & Seabed Power (SSP) Roadmap to address Mining gaps. Establish T/O for endurance parameters, environmental considerations, approach for deployment. - Thrust 4: Additive manufacturing study for subcomponent technologies, to include prototype application <p>Exit criteria for Phase 1: Integration schedule for subcomponent design (Thrust 1-3), and parallel subcomponent design and comparative analysis of test articles in representative environment (Thrust 4)</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 in Proj: 5896 Echidna is due to the initiation of this Project.</p>						Accomplishments/Planned Programs Subtotals	0.000	0.000	1.777	0.000	1.777
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Accomplishments/Planned Programs Subtotals	0.000	0.000	1.777	0.000	1.777																		
C. Other Program Funding Summary (\$ in Millions) N/A																							
Remarks																							
D. Acquisition Strategy N/A																							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5897 / Hypersonic Technologies			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5897: Hypersonic Technologies	0.000	0.000	0.000	8.000	-	8.000	6.000	0.000	0.000	0.000	0.000	14.000

A. Mission Description and Budget Item Justification

The Hypersonic Technologies effort will develop technologies that support the unique operational and environment aspects of hypersonic weapon systems. Efforts include: advanced materials; propulsion; stability and control; seekers and sensors; guidance, navigation, and control; and payloads and energetics.

The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the Hypersonic Technologies INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Hypersonic Technologies	0.000	0.000	8.000	0.000	8.000
Description: The Hypersonic Technologies effort will develop technologies that support the unique operational and environment aspects of hypersonic weapon systems. Efforts include: advanced materials; propulsion; stability and control; seekers and sensors; guidance, navigation, and control; and payloads and energetics.					
The efforts described in this Project address the Applied Research associated with concept of a "Seedling". These "Seedling" efforts are short duration applied research efforts to explore technology concepts which have the potential to provide revolutionary and/or disruptive warfighting capability. As a "Seedling" concept matures, a determination is made whether or not a continuing INP effort is warranted or appropriate. "Seedlings" are typically one to two year efforts and use applied research to analyze the feasibility of technology and subsystems to assess if the technologies can be proposed as an INP. They will research lower TRL technologies to explore technology concepts and lay preliminary groundwork for an INP proposal to continue technology development and full-scale technology/operational demonstrations.					
The Activity identified in this Project Unit specifically addresses Applied Research in support of the Hypersonic Technologies INP effort.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 5897 / <i>Hypersonic Technologies</i>			
B. Accomplishments/Planned Programs (\$ in Millions)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
FY 2022 Plans: N/A FY 2023 Base Plans: Initiate applied research in support of the development of the Hypersonic Technologies INP. Specific efforts include the following: - Award a Base Contract, under which the vendor would deliver S&T-tailored system requirements and an S&T-tailored preliminary design. - Initiate of a Contract Option One effort, which would culminate with an S&T-tailored critical design. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5897 Hypersonic Technologies is due to the initiation of this Project.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	8.000	0.000	8.000
C. Other Program Funding Summary (\$ in Millions)					
N/A					
Remarks					
D. Acquisition Strategy					
N/A					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 5899 / Precision Fire Control			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5899: Precision Fire Control	0.000	0.000	0.000	23.539	-	23.539	22.261	14.040	4.880	0.980	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Precision Fire Control (PFC) effort will develop a fire control architecture that delivers high precision, high update rate guidance solutions to enable cruise missile defense with small, low-cost interceptors and dramatically increase number of interceptors per ship or Expeditionary Advanced Base. It will develop fire control capability for multiple interceptors (missiles and gun projectiles) that contribute to layered defense of surface combatants, expeditionary forces, and homeland protection. Develop PFC-enabled low-cost missile (LCM) based on existing 2.75" rocket components.

The Activity identified in this Project Unit specifically addresses Applied Research in support of the PFC INP effort.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Precision Fire Control Description: The Precision Fire Control (PFC) effort will develop a fire control architecture that delivers high precision, high update rate guidance solutions to enable cruise missile defense with small, low-cost interceptors and dramatically increase number of interceptors per ship or Expeditionary Advanced Base. It will develop fire control capability for multiple interceptors (missiles and gun projectiles) that contribute to layered defense of surface combatants, expeditionary forces, and homeland protection. Develop PFC-enabled low-cost missile (LCM) based on existing 2.75" rocket components. The Activity identified in this Project Unit specifically addresses Applied Research in support of the PFC INP effort. FY 2022 Plans: N/A FY 2023 Base Plans: Initiate applied research in support of the development of the Precision Fire Control (PFC) INP. Specific efforts include the following: - Leverage results of prior fire control architecture studies, experiments, and current technologies to complete requirements and functional designs for fire control hardware and software. - Begin prototyping of PFC fire control elements and HVP flight test units.	0.000	0.000	23.539	0.000	23.539

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>		Project (Number/Name) 5899 / <i>Precision Fire Control</i>							
B. Accomplishments/Planned Programs (\$ in Millions)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
- Internal warfare center investments are contributing to concept exploration and performance predictions <i>FY 2023 OCO Plans:</i> N/A <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 in Proj: 5899 Precision Fire Control (PFC) is due to the initiation of this Project.											
Accomplishments/Planned Programs Subtotals		0.000	0.000	23.539	0.000	23.539					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0603801N/5899: <i>Precision Fire Control</i>	0.000	0.000	0.527	-	0.527	8.673	10.352	19.520	15.128	Continuing	Continuing
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602792N / Innovative Naval Prototypes (INP) Applied Res				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	13.515	3.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.515

A. Mission Description and Budget Item Justification
Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
Congressional Add: Thermoplastic tailorable universal feedstock composites FY 2021 Accomplishments: Conducted research to produce highly aligned short fiber thermoplastic composite feedstock which can be formed to produce small but complex aerospace parts which are cost competitive with CNC machined Aluminum parts. FY 2022 Plans: N/A	9.654	0.000
Congressional Add: Thermoplastic Composites for Lightweight Naval Applications FY 2021 Accomplishments: Conducted applied research in Thermoplastic Composites for Lightweight Naval Applications. FY 2022 Plans: N/A	3.861	0.000
Congressional Add: Accelerate proliferated LEO narrowband capability FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct accelerate proliferated LEO narrowband capability applied research	0.000	3.000
Congressional Adds Subtotals	13.515	3.000

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy Date: April 2022

Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602861N / Science & Tech Management - ONR Field Acts							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	76.636	79.254	81.296	-	81.296	83.447	84.994	86.761	88.540	Continuing	Continuing
0000: Science & Tech Management - ONR Field Acts	0.000	73.046	75.754	78.397	-	78.397	78.263	79.704	81.348	83.018	Continuing	Continuing
0824: Science & Technology Management	0.000	3.590	3.500	2.899	-	2.899	5.184	5.290	5.413	5.522	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) is for the Office of Naval Research (ONR) to cover corporate expenses including salaries, Information Technology (IT), Financial Improvement Plan (FIP) efforts, Defense Finance and Accounting Service (DFAS) Billings, and some of the day-to-day logistical costs. The vast majority of these items represent fixed costs associated with Scientists and Engineers supporting the Navy's Science and Technology (S&T) Programs.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	76.745	79.254	0.000	-	0.000
Current President's Budget	76.636	79.254	81.296	-	81.296
Total Adjustments	-0.109	0.000	81.296	-	81.296
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.111	0.000			
• Rate/Misc Adjustments	0.002	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	81.296	-	81.296

Change Summary Explanation

Funding: Increase in FY23 due to increasing labor costs required to recruit and retain the scientists and engineers who direct 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.

Technical: No significant change.

Technical: Not applicable.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 2: Applied Research		R-1 Program Element (Number/Name) PE 0602861N / Science & Tech Management - ONR Field Acts
<p>---</p> <p>FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.</p>		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602861N / Science & Tech Management - ONR Field Acts				Project (Number/Name) 0000 / Science & Tech Management - ONR Field Acts			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: Science & Tech Management - ONR Field Acts	0.000	73.046	75.754	78.397	-	78.397	78.263	79.704	81.348	83.018	Continuing	Continuing
Note N/A												
A. Mission Description and Budget Item Justification												
This project supports ONR leadership, management and direction for the Naval S&T program. This project funds ONR HQ Non-Management Headquarters Activities (Non-MHA) salaries, communications, and other fixed costs. ONR sponsors scientific advances, which lead to Future Naval Capabilities (FNCs), supporting the Fleet's ability to operate from a position of technological superiority. Functions performed include (1) scientific and technical direction of the nationwide 6.1 basic research program with colleges, universities, non-profit organizations and Naval Laboratories and Warfare Centers; (2) scientific and technical direction of the 6.2 applied research program through the Naval R&D laboratories and Warfare Centers and industry; (3) scientific and technical direction of the Naval 6.3 advanced technology development program through the Navy's R&D laboratories, Warfare Centers and industry; (4) management, resource formulation, program assessment, and contract negotiation/administration of the Navy basic research, applied research and advanced technology development program; and (5) coordination of the Navy's Technology Base program within the context of total DoD/Government (e.g., National Science Foundation, National Academy of Sciences) R&D initiatives in order to maximize scientific advances. This project also supports ONR Non-MHA management and direction for the following Navy-wide programs: Small Business Innovation Research, Naval Research Advisory Committee, Navy Patent Program, Historically Black Colleges and Universities/Minority Institutions Program, Navy Manufacturing Technology Program and the Ballistic Missile Submarine Nuclear (SSBN) Security Technology Program.												
Additionally, this project funds ONR field salaries, communications, and other fixed costs.												
B. Accomplishments/Planned Programs (\$ in Millions)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
Title: (U) Science & Tech Management - ONR Field Acts							73.046	75.754	78.397	0.000	78.397	
Description: This Project provides funds for Non-MHA Labor costs associated with executing ONR's mission to discover, develop, and transition innovative science and technology (S&T) to meet current and future needs of naval forces. The funds in this project pay the salaries of Scientific and Engineering and corporate business personnel who direct 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.												
FY 2022 Plans:												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 2		R-1 Program Element (Number/Name) PE 0602861N / <i>Science & Tech Management - ONR Field Acts</i>		Project (Number/Name) 0000 / <i>Science & Tech Management - ONR Field Acts</i>		
<u>B. Accomplishments/Planned Programs (\$ in Millions)</u>						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>This project provides for all labor costs of ONR Headquarters in support of the entire Navy S&T program. The funds in this project pay the salaries of Scientific and Engineering and corporate business personnel who direct 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. This project provides for all basic labor costs of ONR activities in support of the entire Navy S&T program.</p> <p><i>FY 2023 Base Plans:</i> This project provides for all labor costs of ONR Headquarters in support of the entire Navy S&T program. The funds in this project pay the salaries of Scientific and Engineering and corporate business personnel who direct 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. This project provides for all basic labor costs of ONR activities in support of the entire Navy S&T program.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Increase in FY23 due to increasing labor costs required to recruit and retain the scientists and engineers who direct 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.</p>						
Accomplishments/Planned Programs Subtotals		73.046	75.754	78.397	0.000	78.397
<u>C. Other Program Funding Summary (\$ in Millions)</u>						
N/A						
<u>Remarks</u>						
<u>D. Acquisition Strategy</u>						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 2					R-1 Program Element (Number/Name) PE 0602861N / Science & Tech Management - ONR Field Acts				Project (Number/Name) 0824 / Science & Technology Management			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0824: Science & Technology Managment	0.000	3.590	3.500	2.899	-	2.899	5.184	5.290	5.413	5.522	Continuing	Continuing
Note Realignment of funds internally in the PE to create PRJ 0824 for fiscal clarity of non-labor support functions.												
A. Mission Description and Budget Item Justification This Project provides funds for Non-Labor costs associated with executing ONR's mission to discover, develop, and transition innovative science and technology (S&T) to meet current and future needs of naval forces. Most all the funds in this project are fixed costs, such as communications, training, and other support functions.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Science and Technology Management								3.590	3.500	2.899	0.000	2.899
Description: This Project provides funds for Non-Labor costs associated with executing ONR's mission to discover, develop, and transition innovative science and technology (S&T) to meet current and future needs of naval forces. The majority of the cost in this project are fixed costs, such as communications, training, and other support functions.												
FY 2022 Plans: Continue to meet costs of mission execution												
FY 2023 Base Plans: Continue to meet costs of mission execution												
FY 2023 OCO Plans: N/A												
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in this project reflects cost savings realized in some fixed costs as well as lower projected DFAS costs.												
Accomplishments/Planned Programs Subtotals								3.590	3.500	2.899	0.000	2.899
C. Other Program Funding Summary (\$ in Millions) N/A												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602861N / Science & Tech Management - ONR Field Acts	Project (Number/Name) 0824 / Science & Technology Management
C. Other Program Funding Summary (\$ in Millions)		
Remarks		
D. Acquisition Strategy		
N/A		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy</i> / BA 3: <i>Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603123N / <i>Force Protection Advanced Technology</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	26.648	36.161	16.933	-	16.933	17.262	17.621	17.920	18.248	Continuing	Continuing
2912: <i>Force Protection Advanced Technology</i>	0.000	24.280	19.150	14.374	-	14.374	14.662	14.956	15.256	15.562	Continuing	Continuing
3049: <i>Force Protection</i>	0.000	2.368	2.511	2.559	-	2.559	2.600	2.665	2.664	2.686	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	0.000	14.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.500

A. Mission Description and Budget Item Justification

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 mission capable, persistent and survivable Naval platforms (surface, subsurface, terrestrial and air) in the areas of Platform Design & Engineering, Power, Energy & Propulsion, and Materials. The program 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. The program also develops advanced technologies, critical to protecting naval installations, to provide seamless full spectrum protection against asymmetric attack by improving the ability to: detect and identify 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.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		24.305	21.661	0.000	-	0.000
Current President's Budget		26.648	36.161	16.933	-	16.933
Total Adjustments		2.343	14.500	16.933	-	16.933
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	14.500			
• Congressional Directed Transfers		-	-			
• Reprogrammings		2.779	0.000			
• SBIR/STTR Transfer		-0.436	0.000			
• Program Adjustments		0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	16.933	-	16.933
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Power electronics building block						
Congressional Add: Carbon nanotube energy storage flywheel						
Congressional Add: Laser peening of jet engines						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Funding: no significant change						
Technical: no significant change						
Schedule: no significant change						

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2912: Force Protection Advanced Technology	0.000	24.280	19.150	14.374	-	14.374	14.662	14.956	15.256	15.562	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

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 mission capable, persistent and survivable Naval platforms (surface, subsurface, terrestrial, and air) in the areas of Platform Design & Engineering, Power, Energy & Propulsion, and Materials. This project 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.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Surface Ship and Submarine Hull Mechanical and Electrical (HM&E)	22.497	12.908	8.051	0.000	8.051
Articles:	-	-	-	-	-
<p>Description: 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 mission capable, persistent and survivable naval platforms (surface, subsurface and terrestrial) in the areas of Platform Design & Engineering, Power, Energy & Propulsion and Materials. The primary research efforts within this activity are focused on Development of Advanced Manufacturing & Sustainment Technologies, Advanced Naval Power Systems Development, and Advanced Platform Development.</p> <p>FY 2022 Plans:</p> <ul style="list-style-type: none"> - Continue Autonomous Unmanned Surface Vessel (USV): conduct advance research related to the development of planing hull platforms. The technologies resulting from these efforts are being further developed for use on unmanned surface vessels. - Continue At-Sea Rearm of Vertical Launch System (ASRV): completion task and efforts will focus on demonstrating the ASRV capability in Sea State 4. - Complete Energy Systems Technology Evaluation Program (E-STEP): project efforts focus on assessing advanced energy technologies, developing cyber-physical security for energy networks, and utilizing 					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
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, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
autonomous systems, artificial intelligence and advanced manufacturing to address operational challenges in logistics and readiness. Program goals include: advance dual-use and naval-unique technologies that increase operational capabilities and efficiencies; leverage commercial technologies and private investments to provide warfighter capability at reduced cost; and evaluate innovative technologies from naval laboratories and startup companies.							
- Complete Quality Metal Additive Manufacturing (Quality MADE): complete research and demonstration for accelerated qualification of materials and manufacturing processes for structural components.							
FY 2023 Base Plans:							
- Complete Autonomous Unmanned Surface Vessel (USV): expand advanced research related to the development of planing hull platforms. The technologies resulting from these efforts are being further developed for use on unmanned surface vessels.							
- Initiate development of Advanced Manufacturing & Sustainment Technologies: Next-Gen Naval Platforms will require new materials, at a high manufacturing readiness level, to meet the required platform performance requirements and power and energy density for advanced systems, as well as cost, manufacturability, resiliency, and to reduce the sustainment burden.							
- Initiate development of Advanced Naval Power Systems: New Naval Platforms will require very high energy density, integrated power systems that require very low maintenance (people and cost), as well as operate in a resilient fashion.							
- Initiate development of Advanced Platforms: This effort will focus on developing a framework and integrating component technologies into a mature platform design capability and subsystems for next generation fully autonomous platforms and reduced crew size to reduce the logistics burden and increase warfighting capability.							
FY 2023 OCO Plans:							
N/A							
FY 2022 to FY 2023 Increase/Decrease Statement:							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The funding decrease from FY 2022 to FY 2023 is due to completion of the Vertical Launch System (VLS) Reload at Sea effort earlier than scheduled (FY22) and realignment of the E-STEP effort to PE 0603758N, Project 2918 as part of the Swampworks activity.						
Title: Aircraft Technology		1.783	6.242	6.323	0.000	6.323
Articles:		-	-	-	-	-
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 helicopter and tiltrotor rotor drive systems, aerodynamics, propulsion systems, materials and structures for future and legacy air vehicles. This activity directly supports the Naval Research and Development Framework Priorities of Operational Endurance and Scalable Lethality.						
FY 2022 Plans:						
- Complete further development of advanced technology for the Navy's (NGAD) carrier aircraft enabling technologies. NGAD Critical Technology development efforts are focused on major engine manufacturers developing highest priority, long lead propulsion system turbine engine technologies.						
- Initiate technology development and maturation through Next Generation Propulsion - Enablers (NGP-E) with major engine manufacturers on the highest priority, long lead propulsion, power and thermal management technologies, including:						
- Advanced, adaptive and modular controls.						
- Increased temperature capable Ceramic Matrix Composites (CMC) and Polymer Matrix Composites (PMC).						
- Advanced casing treatments and compression systems for increased operability and efficiency.						
- More compact combustion and augmentation systems.						
- More thermally efficient pumping systems.						
FY 2023 Base Plans:						
Continue						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Conduct technology development and maturation through Next Generation Propulsion Enablers (NGP-E) with major engine manufacturers on the highest priority, long lead propulsion, power and thermal management technologies, including:</p> <ul style="list-style-type: none"> - Advanced, adaptive and modular controls. - Advanced casing treatments and compression systems for increased operability and efficiency. - More compact combustion and augmentation systems, utilizing rotating detonation combustion. - More thermally efficient variable displacement fuel pumps - Enable "hot" fuels as an additional heat sink and provide improved energy. <p>Complete Due to unanticipated schedule delays, efforts to further develop future Navy carrier aircraft enabling technologies are being extended into and will complete in FY23. Critical Technology development efforts are focused on major engine manufacturers developing highest priority, long lead propulsion system turbine engine technologies."</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		24.280	19.150	14.374	0.000	14.374
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3049: Force Protection	0.000	2.368	2.511	2.559	-	2.559	2.600	2.665	2.664	2.686	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Develop advanced technologies, critical to protecting naval installations, to provide seamless full spectrum protection against asymmetric attack by improving the ability to: detect and identify 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, improving performance and reducing costs for the Navy.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Emerging Threats								2.368	2.511	2.559	0.000	2.559
Articles:								-	-	-	-	-
Description: Naval Installations are a critical component in support of Navy global force projection. These installations, and the Navy ships, submarines, and aircraft located on them, are under increasing risk from asymmetric attack, including from new threat vectors such as unmanned air, surface, and subsurface vehicles. This project is focused on the development advanced technologies necessary for the protection of Naval Installations. Technical efforts address the detect -to-engage-to-assess requirements for Naval Installations by improving the ability to: sense and identify threats; support improved situational awareness and decision making; and develop effective countermeasures. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.												
FY 2022 Plans:												
- Continue Autonomous Maritime Asset Protection System (AMAPS): conduct interim demonstration of autonomous assessment and response UAS capability to evaluate Unauthorized Access events on naval installation land and waterside perimeters.												
- Continue Day/night all weather sensors: conduct final demonstration of capability to detect, track, and identify small unmanned air threats using multi-static radar, Active Millimeter Wave (AMMW) and Dual Band Infrared electro-optic sensors. Optimize sensor performance and operator effectiveness using Automated Target Recognition algorithms.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
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, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue Automated Target Recognition algorithms: develop and demonstrate improved harbor security sonar capabilities to detect Unmanned Underwater Vehicles (UUVs) to include; increased volumetric coverage, passive detection and tracking algorithms, and new classification algorithms to address more capable threats.</div> <div>- Develop and demonstrate a kinetic response capability to interdict threat Unmanned Underwater Vehicles (UUV) detected in naval installation harbors.</div> <div>FY 2023 Base Plans:<div>- Continue Autonomous Maritime Asset Protection System (AMAPS): conduct final demonstration of autonomous assessment and response UAS capability to evaluate Unauthorized Access events on naval installation land and waterside perimeters.</div><div>- Continue Day/night all weather sensors: conduct final demonstration of capability to detect, track, and identify small unmanned air threats using multi-static radar, Active Millimeter Wave (AMMW) and Dual Band Infrared electro-optic sensors. Optimize sensor performance and operator effectiveness using Automated Target Recognition algorithms.</div><div>- Continue Automated Target Recognition algorithms: develop and demonstrate improved harbor security sonar capabilities to detect Unmanned Underwater Vehicles (UUVs) to include; increased volumetric coverage, passive detection and tracking algorithms, and new classification algorithms to address more capable threats. Develop capability to track and assess multiple simultaneous threat UUVs in harbors and approach channels.</div><div>- Complete development and conduct final demonstration of the RPG-S kinetic response capability to interdict threat Unmanned Underwater Vehicles (UUV) detected in naval installation harbors.</div></div> <div>FY 2023 OCO Plans: N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement: No significant change from FY 2022 to FY 2023.</div>					
Accomplishments/Planned Programs Subtotals	2.368	2.511	2.559	0.000	2.559

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / Force Protection Advanced Technology	Project (Number/Name) 3049 / Force Protection
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603123N / Force Protection Advanced Technology				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	0.000	14.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.500
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Power electronics building block								0.000	6.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct power electronics building block advanced technology development												
Congressional Add: Carbon nanotube energy storage flywheel								0.000	4.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct carbon nanotube energy storage flywheel advanced technology development												
Congressional Add: Laser peening of jet engines								0.000	4.500			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct Laser peening of jet engines advanced technology development												
Congressional Adds Subtotals								0.000	14.500			
C. Other Program Funding Summary (\$ in Millions) N/A												
Remarks												
D. Acquisition Strategy N/A												

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy Date: April 2022

Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603271N / Electromagnetic Systems Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	22.267	12.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
2913: Electromagnetic Systems Advanced Technology	0.000	7.786	8.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
9999: Congressional Adds	0.000	14.481	4.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.481

A. Mission Description and Budget Item Justification

The Navy and Marine Corps' sophisticated electronics systems place heavy demands on the electromagnetic spectrum to accommodate information flow, defensive and offensive detection, tracking, and weapon system engagement. In distributed maritime operations, each of these platforms provides a set of capabilities that can be further combined for progressively larger and more complex operations. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, Electronic Warfare (EW) sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities. 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, EW, and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy					Date: April 2022
Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 3: Advanced Technology Development (ATD)</i>			R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>		
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	22.957	8.146	0.000	-	0.000
Current President's Budget	22.267	12.146	8.253	-	8.253
Total Adjustments	-0.690	4.000	8.253	-	8.253
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	4.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.690	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	8.253	-	8.253
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: <i>All Digital Radar Technology</i>					
Congressional Add: <i>Advanced machine learning and artificial intelligence</i>					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
funding: No significant change.					
Technical: No significant change.					
Schedule: No significant change.					

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.					

FY 2021	FY 2022
14.481	0.000
0.000	4.000
14.481	4.000
14.481	4.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>				Project (Number/Name) 2913 / <i>Electromagnetic Systems Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2913: <i>Electromagnetic Systems Advanced Technology</i>	0.000	7.786	8.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Work in this project addresses cost-effective Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, Electronic Warfare (EW) sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Electronic and Electromagnetic Systems								4.065	4.252	4.307	0.000	4.307
								Articles: -				
Description: The overarching objective of the Electronic and Electromagnetic Systems Activity is to develop, test, and demonstrate Communications, Electronic Attack (EA), Electronic Surveillance (ES), Electronic Warfare (EW), and Radar functions. A portion of this Program Element (PE) is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are planned for transition at the end of their schedule into the associated acquisition program of record. Technology development is focused on Distributed Electronic Warfare in support of Distributed Maritime Operations.												
Major thrust within the Electronics and Electromagnetic Systems program are: a) Advanced EW Enabling Technologies - Develop classified advanced electronic warfare technology in support of current and predicted capability requirements.												
FY 2022 Plans: Advanced Electronic Warfare Enabling Technologies: - Continue research in the areas of Electronic Support (ES); decoys and countermeasures against weapon tracking and guidance systems; Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance, Reconnaissance and Targeting (C5ISRT). - Continue development of Electronic Protection (EP) for our own weapons and C5ISRT from intentional and unintentional interference. - Continue analysis of results of FY21 test and evaluation activities, leading to refinement and modification of designs based on results.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>		Project (Number/Name) 2913 / <i>Electromagnetic Systems Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate implementation of modified and additional Electronic Warfare (EW) capabilities.</p> <p>FY 2023 Base Plans: Advanced Electronic Warfare Enabling Technologies: - Continue research in the areas of Electronic Support (ES); decoys and countermeasures against weapon tracking and guidance systems; Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance, Reconnaissance and Targeting (C5ISRT). - Continue development of Electronic Protection (EP) for our own weapons and C5ISRT from intentional and unintentional interference. - Continue efforts based on analysis of results of FY21 test and evaluation activities. Informed by this now completed analyses of results of test and evaluation activities in FY21 and other years, initiate refinement of EW concepts, techniques and designs. Examine the improved and novel approaches regularly based on available analytical products, and update as required. - Continue implementation of modified and additional Electronic Warfare (EW) capabilities, and initiate the use of Live, Virtual, and Constructive (LVC) methods for technology identification and exploration, including concepts of employment and training.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Global Positioning System (GPS) and Navigation Technology</p> <p>Articles:</p> <p>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 non-Global Positioning System (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).</p> <p>FY 2022 Plans: Position, Navigation and Timing (PNT): - Continue research on miniature fiber optic inertial capability to improve non-GPS navigation.</p>		3.721 -	3.894 -	3.946 -	0.000 -	3.946 -

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue research on waveforms for precision two-way time transfer techniques to mitigate GPS electronic threats.</div> <div>- Continue research into mounted alternative navigation systems for USMC specific platforms to improve operational effectiveness.</div> <div>- Continue research into Low Earth Orbit constellation receivers for naval platforms to improve operational effectiveness.</div> <div>- Initiate/Complete research on atom-interferometry-based gyroscope.</div> <div>- Initiate the development of components and systems to support alternative Position, Navigation and Timing (PNT) solutions, e.g., Optical Doppler Velocity Log and Micro-Electromechanical Systems based gyroscopes.</div> <div>FY 2023 Base Plans:</div> <div>Position, Navigation and Timing (PNT):</div> <div>- Continue research on waveforms for precision two-way time transfer techniques to mitigate GPS electronic threats.</div> <div>- Continue research into mounted alternative navigation systems for USMC specific platforms to improve operational effectiveness.</div> <div>- Continue research into Low Earth Orbit constellation receivers for naval platforms to improve operational effectiveness.</div> <div>- Continue the development of components and systems to support alternative PNT solutions, e.g., Optical Doppler Velocity Log and Micro-Electromechanical Systems based gyroscopes.</div> <div>- Complete research on miniature fiber optic inertial capability to improve non-Global Positioning System (GPS) navigation.</div> <div>FY 2023 OCO Plans:</div> <div>N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div> <div>There is no significant funding change from FY 2022 to FY 2023.</div>						
Accomplishments/Planned Programs Subtotals		7.786	8.146	8.253	0.000	8.253
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>	Project (Number/Name) 2913 / <i>Electromagnetic Systems Advanced Technology</i>
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>				Project (Number/Name) 9999 / <i>Congressional Adds</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	14.481	4.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.481
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification
 Navy and Marine Corps' sophisticated electronics systems must continually be updated to accommodate increasing information flow, harsh electromagnetic operating conditions, defensive/offensive detection, tracking, and weapon system engagement needs. All Digital Radar Technology, already the core technology to an Air Force advanced threat emulator program, may be fully leveraged via the Electromagnetic Systems Advanced Technology Program to meet additional near term Department of Navy operational needs. With the requested funding, the Office of Naval Research will conduct an All Digital Radar Technology Advanced Technology Demonstration (ATD) and evaluation. The project will expand utilization beyond current advanced threat simulator applications, construct a U.S. prototype demo and evaluation and when appropriate, facilitate technology transfer to the United States..

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
Congressional Add: All Digital Radar Technology	14.481	0.000
FY 2021 Accomplishments: Conducted research supporting All Digital Radar Technology. Planned FY21 activities include contract award and kickoff meeting.		
FY 2022 Plans: N/A		
Congressional Add: Advanced machine learning and artificial intelligence	0.000	4.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct advanced machine learning and artificial intelligence technology development		
Congressional Adds Subtotals	14.481	4.000

C. Other Program Funding Summary (\$ in Millions)
 N/A

Remarks

D. Acquisition Strategy
 N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	242.160	291.183	280.285	-	280.285	254.337	251.529	252.457	249.996	Continuing	Continuing
2223: Marine Corps ATD	0.000	102.250	109.260	118.421	-	118.421	126.171	127.120	131.202	133.826	Continuing	Continuing
2297: Futures Directorate	0.000	89.324	104.071	157.064	-	157.064	123.166	119.310	116.054	110.865	Continuing	Continuing
2958: Cyberspace Activities	0.000	4.635	4.752	4.800	-	4.800	5.000	5.099	5.201	5.305	Continuing	Continuing
9999: Congressional Adds	0.000	45.951	73.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	119.051

A. Mission Description and Budget Item Justification

The United States Navy/Marine Corps team is the most potent naval fighting force in the world. Fundamental to their success are the technologies necessary for effective Distributed Maritime Operations (DMO), Expeditionary Advanced Base Operations (EABO), and Littoral Operations in Contested Environments (LOCE). The Office of Naval Research (ONR) combines knowledge of the naval mission with researchers to select and explore solutions critical to expeditionary warfighting needs. It has become clear the joint force needs a capability that operates persistently and with maximum organic mobility and dispersion to compete and deter in the contact and blunt layers. This Program Element (PE) supports investments in critically needed capabilities as outlined in Force Design 2030, to operate below the threshold of armed conflict by winning the reconnaissance and counter-reconnaissance competition in facilitating deterrence by detection.

These future challenges and portents demand robust technologies for the Marine Corps, but the technology options are constrained. They must have a lightweight deployable character, and the ability to operate in austere conditions with little fixed infrastructure or support while retaining the agility and lethality of an integrated maneuver force. Technology must provide full spectrum capability against robust and complex peer and near-peer adversaries while meeting Size, Weight, Power, Cost limitations, and information availability within Distributed, Intermittent and Limited environments.

The approach within this Program Element (PE) encompasses ideas that support both revolutionary and evolutionary capabilities, and in this way considers and balances both "push" and "pull" aspects of technology projects. This PE matures technologies emerging from PE 0602131M-Marine Corps Landing Force Technology to develop concept prototypes and initial experimentation to confirm feasibility in an environment relevant to operations.

This PE funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRLs) of 4 (component and/or breadboard validation in laboratory environment), 5 (component and/or breadboard validation in relevant environment), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity		R-1 Program Element (Number/Name)				
1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)		PE 0603640M / MC Advanced Technology Demo				
B. Program Change Summary (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		249.340	224.155	0.000	-	0.000
Current President's Budget		242.160	291.183	280.285	-	280.285
Total Adjustments		-7.180	67.028	280.285	-	280.285
• Congressional General Reductions		-	-0.608			
• Congressional Directed Reductions		-	-5.464			
• Congressional Rescissions		-	-			
• Congressional Adds		-	73.100			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-7.181	0.000			
• Rate/Misc Adjustments		0.001	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	280.285	-	280.285
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Expeditionary Process, Exploitation, and Dissemination						
Congressional Add: Adaptive Threat Force Footprint						
Congressional Add: Ensure Defense and Operational Resilience for USMC Tactical Cyber & Spectrum Man						
Congressional Add: USMC Force Design - Closed Classified Wargaming Network and Naval Integration						
Congressional Add: USMC Force Design - Organic Reconnaissance, Surveillance, and Target Acquisition						
Congressional Add: Marine Corps force Design Acceleration - Project Artemis						
Congressional Add: Marine Corps Mission Support Station Demonstration						
Congressional Add: Advanced mission planning system SBIR technology insertion						
Congressional Add: Data analysis and sharing augmentation						
Congressional Add: Low-cost atrittable aircraft technology						
Congressional Add: Adaptive future force						
Congressional Add: AI-powered tactical ISR						
Congressional Add: Expeditionary mission support						
Congressional Add: Platform agnostic weapons system						
Congressional Add: Stand-off security inspection and surveillance system						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)		R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2021	FY 2022
Congressional Add Subtotals for Project: 9999		45.951	73.100
Congressional Add Totals for all Projects		45.951	73.100
Change Summary Explanation Funding: Project 2297: The \$52.993M increase from FY 2022 to FY 2023 supports United States Marine Corps (USMC) service level experimentation and serves as a catalyst for Force Design 2030. The Marine Corps' experimentation plan for Force Design 2030 supports a redefined organizational structure capable of supporting service approved operating concepts such as Expeditionary Advanced Base Operations (EABO), Stand In Forces, all domain Reconnaissance-Counter- Reconnaissance, and Distributed Maritime Operations (DMO). Each of these concepts calls for enabling units with next generation unmanned intelligence, surveillance, and reconnaissance (ISR) and weaponized systems, enhanced situational awareness tools, communication infrastructure, and enhanced prototypes for littoral maneuver. Increase from FY 2022 to FY 2023 will specifically provide a cohesive package of technologies to assess the kill web ecosystem within the future operating environment and properly validate Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities and Policy (DOTMLPF-P) implications across a broad spectrum of warfighting capabilities. Technical: No significant change. Schedule: No significant change. --- FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2223: Marine Corps ATD	0.000	102.250	109.260	118.421	-	118.421	126.171	127.120	131.202	133.826	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project funds technology demonstration, experimentation, and prototyping; and more technologically mature projects within the Future Naval Capability (FNC) process as means to inform, enhance, enable, and invent future concepts and capabilities with new Science and Technology (S&T). This project is organized into ten activities, the core of which is represented by the eight Expeditionary Warfighting Capability Areas.

Emphasized within this project are increased efforts to actively demonstrate advanced technologies and system concepts. These demonstrations and experiments focus on the specific technologies, not necessarily their operational application, and vary based on the technical maturity of the project. This early technology exposure gives Marines a view into the future and enables them to use their imagination and innovation to envision novel employment of the technology and inform the acquisition process.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Command, Control, Communications, Computers (C4)	22.628	24.123	26.572	0.000	26.572
Articles:	-	-	-	-	-
<p>Description: This activity investigates robust, resilient, and secure networked communications pathways and capability that support an expeditionary force's distributed and disaggregated operations. Research supports both networked and local computation for communications that exploits the expeditionary forces close physical proximity to threats while mitigating shortfalls commensurate within Distributed, Intermittent, and Limited environments. Expeditionary forces must operate in the cyber domain and in addition to defending communications networks, vehicles, and weapons systems, are reliant on electronic controllers for basic operations and as such are susceptible to cyberattacks.</p> <p>Technologies addressed within this activity include secure, robust, self-forming, mobile communications networks; distributed computing to support information dissemination to all echelons; improved capabilities in over-the-horizon, beyond line-of-sight, and restricted environment communications and sensors; and software and data processing to support formation of an appropriate common picture. Other efforts include power management, low detectability, conforming to Size, Weight, Power, Cost constraints, and interoperability within the joint environment.</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Further, this activity integrates and demonstrates enhanced communications and situational awareness capabilities in experimental and warfighting environments reflecting USMC operations. Advanced technology resources will be developed and applied to complement commercial, other service, and defense agency investments to produce a technology base addressing identified Marine Corps technology gaps. Focus will be on developing component level prototypes and experimentation in relevant environments.						
FY 2022 Plans: -Continue to emphasize operating in contested and denied electromagnetic spectrum (EMS) environments. The goal of operating ubiquitously in multifunction electronic warfare domains will be achieved by reducing size to handheld form factor focused heavily on the continued development and integration of multiple underlying technologies into systems and subsystems with the purpose of demonstrating the tactical exploitation of information and the EMS. To address resiliency requirements of Command, Control, Communications, Computers (C4) this effort is closely coordinated with the Intelligence, Surveillance, and Reconnaissance and Expeditionary Cyber research portfolio also described herein so as to most efficiently exploit multifunction capabilities in portable reduced Size, Weight, Power, and Cost systems. This integrated rapid co-design, prototyping, and experimentation approach will reduce time needed to provide new capabilities to the US Marine Corps. The following efforts are in collaboration with the CRIT and MuDRaCE FNC activities in this PE/project and leverage experimental discoveries under the MAGTF C4 project to accelerate development of high priority capabilities. -Continue development to demonstrate technologies that include advanced signature management, machine learning, interoperability, spectrum maneuver, damage assessment monitoring, and information dominance for tactical edge systems. -Continue the development to demonstrate portable distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to protect forces in denied and contested EM environments.						
FY 2023 Base Plans: Complete: The following efforts are in collaboration with the Cognitive Radio Frequency Inference Technology (CRIT) and Multi Domain Radar for the Contested Environment (MuDRaCE) FNC activities in this PE/project and leverage experimental discoveries under the MAGTF C4 project to accelerate development of high priority capabilities.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete the development and demonstrate technologies that include advanced signature management, machine learning, interoperability, spectrum maneuver, damage assessment monitoring, and information dominance for tactical edge systems.</p> <p>- Complete the development and demonstrate portable distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to protect forces in denied and contested EM environments.</p> <p>Continue:</p> <p>The following efforts are in collaboration with the Cognitive Radio Frequency Inference Technology (CRIT) and Multi Domain Radar for the Contested Environment (MuDRaCE) FNC activities in this PE/project and leverage experimental discoveries under the MAGTF C4 project to accelerate development of high priority capabilities.</p> <p>- Continue the development of and demonstrate technologies that include advanced signature management, machine learning, interoperability, spectrum maneuver, damage assessment monitoring, and information dominance for tactical edge systems.</p> <p>- Continue the development of and demonstrate distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to protect forces in denied and contested EM environments.</p> <p>Initiate:</p> <p>-Initiate research effort to extend demonstrated analysis capability to classified signal sets and reduce machine learning training time.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>The increase in funding from FY 2022 to FY 2023 is due to (1) the initiation of research efforts to extend demonstrated capability to classified signal sets and reduce machine learning training time and (2) increased investments in signature management, multi-domain sensors and robust communications networks necessary to close high priority capability gaps, and meet the demands of the National Defense Strategy "forward force maneuver and posture resilience." Efforts in these areas directly support Navy and Marine Corps operating concepts Distributed Maritime Operations (DMO), Expeditionary Advanced Base Operations (EABO) and Littoral Operations in a Contested Environment (LOCE).</p>						
Title: Firepower		7.200	6.793	7.500	0.000	7.500

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Articles:		-	-	-	-	-
<p>Description: The activity investigates a large variety of weapons technologies to enhance fires capabilities of Fleet Marine Forces as part of joint maritime campaigns to counter emerging threats and create new opportunities for the joint force to secure operational advantage. Research efforts increase range, lethality, and capacity, while maintaining mobility and tempo to operate inside actively contested maritime domains, to achieve overmatch fires capabilities when operating within the landward portions of the littorals, and to provide weapons system capabilities able to persist when operating within the adversary's intelligence, surveillance, collection, and weapons ranges. Focus on low size, weight, power, and cost of weapons components and weapon systems, having low manpower and cognitive burdens to operate, with low logistics burdens, stresses technical solutions. This activity furthers the maturity of researched technology solutions by also developing the integration required to effectively demonstrate and test emergent capabilities. Weapons system technologies being developed include fire control, launch and propulsion, precision guidance, navigation, and control, seekers, fuzing, and lethality.</p> <p>FY 2022 Plans: Continue development of integrated technologies for low-cost, extended range, precision guided munitions, having improved lethality and special effects payloads for use against various types of stationary and moving targets on land and water, and in satellite and network denied environments. - Complete development of automated fire control technologies enabling automated target classification and prioritization for weaponized unmanned ground vehicles.</p> <p>FY 2023 Base Plans: Continue: - Development of integrated technologies for low-cost, extended range, precision guided munitions, having improved lethality and special effects payloads for use against various types of stationary and moving targets on land and water, and in satellite and network denied environments.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023</p>						
Title: Force Protection		12.275	11.527	13.900	0.000	13.900
Articles:		-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: This activity investigates new ways and means to protect forces and materiel across all operational settings from contested sea-land surface interfaces to complex urban environments. The portfolio protects against adversaries' challenges such as guided-rockets and missiles, mobile coastal artillery, threat Electronic Warfare and Counter Intelligence, and Surveillance and Reconnaissance. Mines and obstacles both in the water and ashore also complicate amphibious landings. The activity invests in vehicle survivability aspects that are exacerbated due to Size, Weight, and Power Cost constraints inherent to Marine Corps operation and the harsh nature of the amphibious environment.</p> <p>Technologies addressed include lightweight armor for ballistic and underbody blast protection, advanced sensors for counter tactical surveillance, active protection, and signature management. This activity also considers technology for payloads, packages and sensors that are needed by amphibious vehicles (both manned and unmanned) including mine counter measures; explosive hazard defeat systems; and obstacle and threat detection systems as well as technologies for improved protection for individuals against blast, ballistic and blunt impact threats.</p> <p>Technologies in this activity enable Marine Corps forces to maintain operational tempo through a range of environments by avoiding or detecting surveillance and targeting capabilities before engagement; counter detection and targeting (e.g. long range sniper, urban shooter, rocket propelled grenades) and delay vehicle detection and identification through signature management/control.</p> <p>FY 2022 Plans:</p> <ul style="list-style-type: none">- Technologies and systems supporting the neutralization of threat unmanned aerial systems via kinetic means will complete- Efforts that emphasize sensors and systems to enable autonomous amphibious assault under mined and obstacle environments will continue. The efforts will focus on multi-domain operations and extending the range at which these unmanned systems are able to perform and execute the assault mission.- Efforts looking at counters to autonomy and sensors/perception will initiate.- Examine technologies for the utility of High Energy Laser (HEL) in Expeditionary operations, including robust, compact, lightweight lasers, with tracking, and optical components to enable Low Altitude Air Defense (LAAD) with non-kinetic weapon hard kill								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Develop disposable heterogeneous multi-domain unmanned vehicles (UxVs), capable of rapid manufacture at scale. The UxVs will operate as swarms, utilizing and mimicking the organizational principles found in social insects/birds/fishes to overwhelm the adversaries' kill chain.</p> <p>- Develop low-cost robotic autonomy systems in support of amphibious operations (e.g., ISR, mine-counter-measure, breaching, fire support, and logistics).</p> <p>- Develop and demonstrate human-machine teaming concepts and appropriate military tactics. The end state will demonstrate swarming multi-domain platforms capable of delivering military capabilities over land and sea.</p> <p>FY 2023 Base Plans:</p> <p>Continue:</p> <p>- Continue efforts looking at counters to autonomy and sensors/perception.</p> <p>- Continue to examine technologies for the utility of High Energy Laser (HEL) in Expeditionary operations, including robust, compact, lightweight lasers, with tracking, and optical components to enable Low Altitude Air Defense (LAAD) with non-kinetic weapon hard kill.</p> <p>- Continue development of low-cost robotic autonomy systems in support of amphibious operations (e.g., ISR, mine-counter-measure, breaching, fire support, and logistics).</p> <p>- Continue development and demonstrate human-machine teaming techniques and procedures appropriate to military tactics. The end state will demonstrate swarming multi-domain platforms capable of delivering military capabilities over land and sea.</p> <p>- Continue efforts that emphasize sensors and systems to enable autonomous amphibious assault under mined and obstacle environments will continue. The efforts will focus on multi-domain operations and extending the range at which these unmanned systems are able to perform and execute the assault mission.</p> <p>- Develop disposable heterogeneous "least-capable" multi-domain unmanned vehicles (UxVs), that can be rapidly manufactured at scale. The UxVs will operate as swarms, utilizing the organizational principles found in social insects/birds/fishes to overwhelm an adversary's kill chain.</p> <p>Initiate:</p> <p>- Initiate force-on-force experimentation for countering heterogeneous multi-domain autonomous swarm attacks in Expeditionary Advanced Basing Operations (EABO) scenarios.</p> <p>- Initiate a follow-on and focused research effort to develop compact rapid analysis and sensing systems to assess expeditionary operational site by detecting battle damages, surface and sub-surface explosive hazards detection and classification.</p> <p>FY 2023 OCO Plans:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A								
FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY 2022 to FY 2023 is due to the initiation of efforts in (1) force-on-force experimentation for countering heterogeneous multi-domain autonomous swarm attacks in Expeditionary Advanced Base Operations (EABO) scenarios and efforts to (2) develop compact rapid analysis and sensing systems to assess expeditionary operational sites by detecting and classifying battle damage, and surface and sub-surface explosive hazards. These efforts will enhance the counter detection and targeting capabilities for Marine Corps forces and directly supports EABO and Force Design 2030.								
Title: Human Performance, Training and Education <div>Articles:</div>				5.107	5.465	6.329	0.000	6.329
Description: This activity investigates several technology investment areas; warrior resilience, and decision-making and expertise development. Warrior resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Decision making and expertise development accelerates development and improves the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. Focus will be on developing component level prototypes for Marine for evaluation and experimentation.				-	-	-	-	-
FY 2022 Plans: Conduct technology development to assess marksmanship lethality via automated capture of shot timing, accuracy, and physical performance. - Conduct technology development focused on human-machine teaming and multi-modal interactions at the small unit level that augment the warfighter and accelerate the Observe, Orient, Decide and Act (OODA) loop to improve decision-making capabilities. - Continue technology demonstrations to increase physical readiness and reduce potential injuries by using wearable physiological monitoring devices, predictive algorithms, health tracking capability, and related technologies that support Marine Corps' Human Performance programs. - Transition 3D terrain visualization, battlefield control measures and effects, and continue technology development with target identification and classification.								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Develop assessment tools and experiential training solutions to train and educate Marines for the right military occupation, and expand research to include adaptive training technologies</div> <div>FY 2023 Base Plans: Continue:<div>- Assess marksmanship lethality via automated capture of shot timing, accuracy, and physical performance; develop and assess new marksmanship training approaches, analysis, and visualizations to improve marksmanship and increase lethality.</div><div>- Improve small unit decision-making capabilities through the use of human-machine teaming and multi-modal interactions</div><div>- Demonstrate ability to increase physical readiness and reduce potential injuries by using wearable physiological monitoring devices, predictive algorithms, health tracking capability, and related technologies that support Marine Corps' Human Performance and Training programs.</div><div>- Develop augmented reality technologies focused on fires applications that improve target identification, classification, and situational awareness.</div><div>- Develop assessment tools and experiential training solutions to train and educate Marines for the right military occupation, and expand research to include adaptive training technologies.</div></div> <div>Complete:<div>- Complete and transition 3-D terrain visualization, battlefield control measures and effects to Marine Corps and other DoD service related activities.</div></div> <div>FY 2023 OCO Plans: N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY2022 to FY2023 reflects an increase in USMC research into AI/ML and augmented reality tools to improve decision making, develop man-machine teaming and fires applications that improve target identification, classification and situational awareness. This research enhances the capability and lethality of small, dispersed units and directly supports Expeditionary Advanced Base Operations (EABO) and Force Design 2030.</div>						
Title: Intelligence, Surveillance, and Reconnaissance (ISR)		8.645	9.059	9.551	0.000	9.551
Articles:		-	-	-	-	-

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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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: This activity investigates enhanced situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes biometric monitoring for expeditionary operations, operational Course of Action development, and autonomous surveillance in support of distributed operations. Conduct advanced development research on the impact of machine learning on mission outcomes. Will investigate the operational relevance of enhanced situational understanding and machine-aided tactical decision-making. This includes presenting actionable information (e.g. support to planning, mission monitoring, and re-planning) to decision makers.</p> <p>Further, 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 3-Dimensional urban battlespace as well as exploiting information (identifying and classifying data) as part of the intelligence preparation of the battlespace in order to facilitate operational maneuver and distributed operations.</p> <p>FY 2022 Plans: Develop and demonstrate new artificial intelligence (AI) systems to automate monitoring and alerting. Research will integrate video analytics with edge processing to create high-throughput detection, classification, and tracking across multiple operational domains.</p> <ul style="list-style-type: none">- Prototype development using recommendation engines to adapt strategies based on adversary actions.- Continue advanced technology development on the operational utility of artificial intelligence/machine learning algorithms, and develop and demonstrate applications to apply these techniques to Marine Corps operations activities.- Continue development to generate synthetic data useful for machine learning while learning how to combine real data from training or operations.- Conduct demonstrations and experimentation with training and operational forces to understand the utility and impact of decision aids on improving and accelerating understanding and information-based decision-making, as well as reductions in operator workload.						

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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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
FY 2022 OCO Plans: FY 2023 Base Plans: Continue: - Develop and demonstrate new artificial intelligence (AI) systems to automate monitoring and alerting. Research will integrate video analytics with edge processing to create high-throughput detection, classification, and tracking across multiple operational domains. - Develop a prototype using recommendation engines to adapt strategies based on adversary actions. - Advanced technology development on the operational utility of Artificial Intelligence and Machine Learning algorithms; develop, demonstrate, and experiment with these techniques during Marine Corps operations exercises and events. - Development to generate synthetic data useful for machine learning while learning how to combine real data from training or operations. - Demonstrations and experimentation with training and operational forces to understand the utility and impact of decision aids on improving and accelerating understanding and information-based decision-making, as well as reductions in operator workload. Initiate: - Develop fused common tactical picture, and tools to support planning, execution, and assessment that will allow commanders the all-domain situation awareness required to make informed and timely decisions. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023						
Title: USMC Future Naval Capabilities		26.056	26.867	27.869	0.000	27.869
Articles:		-	-	-	-	-
Description: This R-2 Activity addresses the advanced technology development associated with the Marine Corps' participation in the Department of the Navy's (DoN) Future Naval Capabilities (FNC) Program. The objective of the work in this Program Element (PE) is to develop promising technologies emerging from the FNC technology candidates funded in PE 0602131M that have been matured to higher Technology Readiness Levels (TRLs). Investments in this activity are coordinated with similar and non-duplicative efforts in PE 0603673N. The FNC Program is structured to accelerate the transition of new technologies to the Fleet and Force. Each effort						

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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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
is assessed for its technology maturity and transition commitment. Funding for FNCs, which have Technology Readiness Levels (TRLs) of 4/5 to 6 and also have transition funding commitments from acquisition Programs of Record, are resourced in this PE 0603640M MC Advanced Technology Demo. Funding for FNC technology candidates at lower TRLs (3 to 4) is resourced in PE 0602131M Marine Corps Landing Force Tech. ONR is working closely with the Resource Sponsors and acquisition stakeholders to develop high priority technological capabilities needed by the operational forces.						
FNC budget activity (BA) 2 investments develop candidate FNC technologies in an agile fashion by exploiting technology advances that respond rapidly to naval needs. This approach facilitates an optimum response when developing and maturing the technology options that can be developed further in this PE 0603640M MC Advanced Technology Demo.						
The FNC Program favors a high level of collaboration. Collaboration with the acquisition stakeholders and their resource sponsors is required. A complete accounting of the technology candidates being developed and a full disposition of each technology development effort funded in this PE is provided annually to the Congressional oversight committees.						
FY 2022 Plans: Cognitive Radio Frequency Inference Technology (CRIT): - In collaboration with Command, Control, Communications, Computers (C4) activity in this PE/project, continue the accelerated development of capabilities to demonstrate small form factor technologies that provide improved signature management of the Marine Air-Ground Task Force (MAGTF) in electromagnetic and information environments. This effort addresses a high priority Marine Corps capability gap and directly supports the National Defense Strategy by providing an 'advanced autonomous system' for 'forward force maneuver and posture resilience.						
Enabling Dynamic Operational RF (ENDOR): - Complete work on ENDOR by finishing fundamental development on its secure tactical computing infrastructure through incorporating the next generation of software cyber practices including a secure Linux operating system, containerization and application orchestration, leading to planned major demonstrations.						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Streamlined Marine After-Action Review Tool- Visualization (SMART-Viz): - Continue development of rapid, automation-assisted Streamlined Marine After-Action Review (AAR) Tools for Visualization that provide the right information, at the right time, at the right place, to the right echelon of command to improve training and lethality.</p> <p>Multi Domain Radar for the Contested Environment (MuDRaCE): - In collaboration with the Command, Control, Communications, Computers (C4) activity in this PE/project, continue the accelerated development of capabilities for a highly mobile multi-domain integrated radar system with improved effectiveness and survivability to support Marine Air-Ground Task Force (MAGTF) units in contested environments. This effort leverages MAGTF C4 networking and sensor development for system of systems capability to ensure key National Defense Strategy requirement for expeditionary 'forward force maneuver and posture resilience' and addresses a high priority Marine Corps capability gap.</p> <p>All Signal Tactical Real-Time Analyzer (ASTRAL) - Continue the development of a sensor receiver module able to detect, identify, and characterize complex signals in contested and congested electromagnetic environments. This program will develop novel topologies that help to address these applications using photonics. Particular emphasis will be given to the use of integrated photonics as a path to reduce overall system cost, size, weight and power (C-SWAP).</p> <p>Maintenance Tools for Operations and Training (MTOT) - Develop software applications (e.g. augmented reality) to improve training availability and accessibility, as well as analytics to support student assessment to address training gaps within the Marine Corps Deliberate Universal Needs</p>					

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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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Statement (D-UNS) on Enterprise Level Maintenance Simulation Training Solution.</p> <p>FY 2023 Base Plans:</p> <p>Continue:</p> <p>Maintenance Tools for Operations and Training (MTOT)</p> <p>- Continue to develop software applications (e.g. augmented reality) and content to improve training availability and accessibility, as well as analytics and algorithms to support student assessment and tailor training to address training gaps within the Marine Corps Deliberate Universal Needs Statement (D-UNS) on Enterprise Level Maintenance Simulation Training Solution.</p> <p>Streamlined Marine After-Action Review Tool- Visualization (SMART-Viz):</p> <p>- Complete development, exit criteria testing, and transition of Streamlined Marine After-Action Review (AAR) Tools for Visualization to Marine Corps Program Manager for Training Systems to support force-on-force and simulation-based training to improve lethality.</p> <p>All Signal Tactical Real-Time Analyzer (ASTRAL):</p> <p>- Complete development of the sensor receiver module to provide full spectral awareness in a contiguous RF range, unifying recent advances in spectral and correlative analysis, signal processing, and monolithic photonics-electronics integration.</p> <p>Cognitive Radio Frequency Inference Technology (CRIT):</p> <p>- Complete development of small form factor technologies that provide organic, easy to understand and use signature management of the Marine Air-Ground Task Force (MAGTF) in electromagnetic and information environments.</p> <p>Multi Domain Radar for the Contested Environment (MuDRaCE):</p> <p>- Complete development of portable, distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to improve effectiveness and survivability in denied and contested electromagnetic environments.</p> <p>Poison Apple (PA)</p>								

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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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate the Poison Apple FNC with two awards to commercial and government performers and begin S&T development by initiating research into establishing a prototype solution that builds upon prior investments that matured earlier versions of the technological capability.</p> <p>- Initiate technology develop planning and documentation leading to a preliminary design review of the proposed prototype solution, and commence development of an initial operational prototype for first year demonstration in a field like setting to receive warfighter feedback of the maturing capability.</p> <p>Ubiquitous Edge (UbE)</p> <p>- Initiate the UbE FNC with five performer awards to begin development by conducting research into a cloud capability orchestration of networked devices to include command and control of networked components.</p> <p>- Initiate technology develop planning to establish a preliminary design for an initial operational prototype, conduct a stakeholder review of the system approach, and commence development of the initial prototype, to include an initial demonstration of the system that obtains warfighter feedback of the maturing capability.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>						
<p>Title: Logistics</p> <p>Articles:</p> <p>Description: This activity investigates the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. 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. This includes efficient and responsive force sustainment, planning and directing logistics operations, logistics demand reduction, fleet maintenance, and expeditionary energy. Expeditionary Energy enhances combat capability of expeditionary warfighters by increasing the efficiency and effectiveness of energy production, storage, distribution and use. Beyond traditional energy efforts, this portfolio also looks at other issues, including energy-efficient behaviors and hybridization of energy sources. These pillars are thoroughly integrated and perpetually related in execution.</p> <p>FY 2022 Plans:</p>		8.751 -	10.067 -	10.800 -	0.000 -	10.800 -

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Advance the broad range of technologies to demonstrate the military utility of enhancing combat capability by increasing energy production, storage, distribution, and curbing energy consumption of the individual Marine and other tactical assets.</div> <div>- Conduct advanced system research into the scaled use of high specific power solar cell for Marine Corps applications ranging from the individual warfighter to augmenting the power and combat endurance unmanned robotic vehicles.</div> <div>- Progress efforts to investigate energy-efficient planning for unmanned aircraft, enabling modular and reconfigurable tactical microgrids and wave energy technologies.</div> <div>FY 2023 Base Plans: Continue:<div>- Advance the broad range of technologies to demonstrate the military utility of enhancing combat capability by increasing energy production, storage, distribution, and curbing energy consumption of the individual Marine and other tactical assets with a particular emphasis on supporting distributed operations.</div><div>- Progress efforts towards energy-aware aerial logistics, modular and reconfigurable tactical microgrids, aluminum-powered expeditionary energy sources and energy-intensive distributed operations.</div></div> <div>Complete:<div>- Complete advanced system research into the scaled use of high specific power solar cell for Marine Corps applications ranging from the individual warfighter to augmenting the power and combat endurance unmanned robotic vehicles.</div></div> <div>Initiate:<div>- Initiate a follow-on and focused research effort developing mission risk-based predictive maintenance technology. Demonstrate in laboratory and progress to field implementation of mission risk-based predictive maintenance technology to allow pre-planning of maintenance and repair requirements sufficiently far in advance to minimize mission interruption and facilitate longer horizon, more energy efficient distribution of Class IX materiel.</div></div> <div>FY 2023 OCO Plans: N/A</div> <div>FY 2022 to FY 2023 Increase/Decrease Statement:</div>						

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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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
There is no significant change from FY 2022 to FY 2023								
Title: Maneuver				11.588	15.359	15.900	0.000	15.900
Articles:				-	-	-	-	-
Description: This activity investigates new ways and means to land forces and material through contested sea-land surface interfaces and then conduct maneuver warfare. In order to enable future Amphibious Operations, research efforts will support autonomous operations across the sea-surf-ground environment, improved fuel efficiency and speed of amphibious vehicles, amphibious vehicle technologies, water performance, and amphibious payloads to change the dynamics of a surface amphibious assault. This includes the emergence of manned-unmanned teaming and autonomous vehicle collaboration.								
The technologies included in this work address areas of mobility, materials, propulsion, signature reduction, modularity, and unmanned systems. This also encompasses navigating the surf zone by a small autonomous vehicle, navigating negative obstacles on land at speed, overcoming adversarial intent, and developing low-cost robotic autonomy kits to support of expeditionary amphibious operations (e.g., ISR, mine-counter-measures, breaching, fire support, and logistics).								
FY 2022 Plans: Continue the development and evaluation of mobility technologies and future concepts for the ground and amphibious fleet to improve maneuverability across a range of challenging terrain environments. Demonstration platforms will continue to be used for further development of technologies to enable enhanced land operations and seamless transition between land and water environments. - Expand efforts on the automation and autonomy systems to include development of low- cost, unmanned swarming amphibious assault capable platforms with a focus on performance in the surf zone and beach environments. Conduct experimentation in increasingly challenging environments to evaluate system performance.								
FY 2023 Base Plans: Continue: - Researching advanced intelligent mobility technologies for ground and amphibious platforms to improve mobility and maneuverability across littoral and inland terrain. Demonstration platforms will continue to be utilized to assess potential future capabilities.								

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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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Expand efforts related to the low-cost, unmanned swarming amphibious assault capable platforms to include addition of enhanced autonomy capabilities and utilization and demonstration of advanced payloads for future operations. Conduct experimentation to understand feasibility and utility for military applications.</p> <p>Initiate:</p> <p>- Research advanced drivetrain technologies, system designs, and platforms to assess capability of future military tactical truck systems to improve fuel efficiency, extend range, reduce greenhouse gases, and provide on-board auxiliary power and energy.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no significant change from FY 2022 to FY 2023</p>						
Accomplishments/Planned Programs Subtotals		102.250	109.260	118.421	0.000	118.421
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo				Project (Number/Name) 2297 / Futures Directorate			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2297: Futures Directorate	0.000	89.324	104.071	157.064	-	157.064	123.166	119.310	116.054	110.865	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The mission of the Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) is to generate and examine threat-informed operating concepts and capabilities and provide analytically-supported recommendations to inform subsequent force design and development activities. The Deputy Commandant, Combat Development and Integration (DC, CD&I) is the United States Marine Corps (USMC) advocate for Science and Technology (S&T). MCWL's Commanding General (CG) is the proponent of USMC S&T and serves as the USMC Executive Agent for Marine Corps S&T. The MCWL/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.

As reflected in strategic guidance, expeditionary forces will provide an ever-ready quick strike force to protect United States (US) interests. MCWL/FD pursues concepts, capabilities, and solutions to ensure that Marines of the future force will be effectively organized, trained, and equipped to win across the range of military operations in an uncertain and complex environment. Prioritized investments in S&T are necessary to enable the future Marine Corps and maintain a technological advantage over our adversaries.

This project is organized into 6 activities, the core of which are represented by the Warfighting Capability Areas of the Marine Air-Ground Task Force (MAGTF). The project emphasizes development and demonstration of advanced technology capability concepts, and the examination of their operational application and military utility in the context of formal wargames, Modeling, Simulation, and Analysis (MS&A), and live-force field experimentation with Marines. This operational experimentation directly supports Marine Corps combat development to inform future capability requirements and optimize the acquisition process.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Combat Service Support (CSS) and Force Protection	15.513	34.559	73.324	0.000	73.324
Articles:	-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Combat Service Support and Force Protection experimentation efforts, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training opportunities, and proposed organizational changes associated with enhanced capabilities. This activity develops technology in support of a more distributed technologically advanced force, increasing range, effectiveness, sustainability, and survivability of the Marine Corps Air-Ground Task Force (MAGTF). Most programs listed below are considered major (valued at \$500K or more) or have near					

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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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Expeditionary Logistics, Expeditionary Medical, Force Protection, or Autonomy and Robotics.						
FY 2022 Plans: - Unmanned Logistics and Defense - Continue development and experimentation with highly autonomous and synchronous logistics capabilities in support of expeditionary Marine Air-Ground Task Force (MAGTF) operations. Assess execution of high tempo unmanned sustainment to dispersed and disaggregated forces during joint combined air-ground operations in contested environments including transiting over water from surface vessels to shore and other surface vessels. Continue to utilize autonomous connectors to conduct littoral staging and autonomous resupply. Objectives include providing a landing craft, utility (LCU) with hardened autonomy system that can deploy with Marine Expeditionary Units as part of extended user evaluations (EUEs) to inform requirements for autonomous and unmanned crafts in the littorals. - Sustainment - Continue to sustain and investigate multiple technologies integrated within the MAGTF to experiment with alternate vehicle power, extended mobility, hybrid energy, expeditionary fuel distribution, and small unit water purification to enable logistics demand reduction and provide alternate sustainment to the MAGTF at all levels. Continue experimentation with hybrid power systems, providing the MAGTF with a tactical, highly mobile, transportable, and versatile power generating and power scavenging platform. Design, develop, manufacture, and test an amphibious towable fuel container (unit/system); improving the MAGTFs capability to rapidly transport and distribute fuel to support units maneuvering and conducting operations in a contested environment. Conduct a Limited Technical Assessment (LTA) on the ability to organically construct expeditionary air fields, roadways, and hardened structures. Investigate and leverage existing water purification technologies to enable purification, storage, and distribution to sustain disaggregated units. - Counter UAS - In response to the emergent small UAS (Group I & II) threats, continue to develop an enhanced capability to locate, identify, access, and neutralize small UAS threats. Tasks include exploring/developing autonomous and semi-autonomous counter UAS solutions; developing and demonstrating the capability to execute an end-to-end kill chain in multiple environments; neutralizing targets in an effective, cost efficient manner; and demonstrating the ability to employ counter UAS assets from the seabase to support Marine forces in austere locations. Develop automatic target recognition algorithm for radar optics as well as a library of 3-dimensional imagery to enhance current technology, reduce false positives, and shorten the systematic kill-chain for targeting.						

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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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Explosive Detection/Defeat - Continue to develop an autonomous explosive detection and defeat capability; integrating specialized sensors for enhanced neutralization. Efforts include merging the technologies of detection defeat and autonomy in order to address multiple threats resulting in a robust system that will be markedly more capable over the current single modality systems. The objective is to develop a system capable of detecting 95% of commonly faced explosive hazards and/or defeating them with no more than a 20% false alarm rate in a time period adequate to support Marine Corps ground maneuver elements.</p> <p>- Medical - Continue to experiment with systems to support a smaller, modular, multifunctional medical concept that can support medical care ashore and Marine Littoral Regiments (MLR) by performing studies, integration with unmanned systems, demonstrations, and experimentation. Integrate automated casualty care to provide therapeutic care during movement. Integrate, test, and demonstrate wearable bio-sensors and their applicability to a multifunctional medical team supporting the MLR.</p> <p>- Warfighter Performance - Continue to provide increased lethality and mobility to the warfighter through the integration of technology directly attributable to individual combat equipment. Develop, test, and assess a Radio Agile Integrated Device (RAID) Plate, removing the functional components from multiple handheld radios and consolidating them on the warfighter's back in order to provide a fully integrated communication and power solution designed to interface with the dismounted Marine's end user device.</p> <p>- Littoral Connectors - Expand development and enhancement of capabilities for diversified distribution, providing risk worthy, inexpensive platforms for maneuver and sustainment distribution. Utilize current commercial technology to enhance maneuver to and from seabases and expeditionary advanced bases in the littorals with the ability to deliver directly to the users at shore. Objective is to provide direct logistical support to forces ashore, inform program of record (POR) (Light Amphibious Warship) and acquisition strategy, increase performance ability, survivability, and resiliency of current surface connectors (range, endurance, payload, utility), and mitigate distribution gaps by delivering from the seabase directly to the beach.</p> <p>- Robotic Modernization - Initiate effort to provide ground combat element robotic asset maintenance, repair, and upgrades; ultimately ensuring systems viability for experimentation. Efforts include evaluating and integrating both POR and non-POR payloads, leveraging developed, commercially available technologies, and performing tests, demonstrations, and assessments prior to dedicated live-force experimentation.</p> <p>FY 2023 Base Plans:</p>								

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Unmanned Logistics and Defense: - Continue development and experimentation with highly autonomous and synchronous logistics capabilities in support of expeditionary Marine Air-Ground Task Force (MAGTF) operations. - Continue to assess execution of high tempo unmanned sustainment to dispersed and disaggregated forces during joint combined air-ground operations in contested environments including transiting over water from surface vessels to shore and other surface vessels. - Complete development efforts in support of littoral staging and autonomous resupply, which provides a landing craft, utility (LCU) with hardened autonomy system that can deploy with Marine Expeditionary Units as part of extended user evaluations (EUEs) to inform requirements for autonomous and unmanned crafts in the littorals.						
Sustainment: - Continue to sustain and investigate multiple technologies integrated within the MAGTF to experiment with alternate vehicle power, extended mobility, hybrid energy, expeditionary fuel distribution, and small unit water purification to enable logistics demand reduction and provide alternate sustainment to the MAGTF at all levels. - Complete experimentation with hybrid power systems. - Complete design, development, manufacturing, and testing of an amphibious towable fuel container (unit/ system). - Complete evaluating Limited Technical Assessment (LTA) results on the ability to organically construct expeditionary air fields, roadways, and hardened structures. - Initiate demonstrations with naval logistics information technology integration with low earth orbit and military satellite networks; ultimately reducing reliance on continuous emission systems and leveraging low probability of detection waveforms. - Initiate the research, design, and build of a littoral maneuver enabler prototype.						
Counter Unmanned Aerial System (UAS): - Complete efforts to develop an enhanced capability to locate, identify, access, and neutralize small UAS threats. - Complete development efforts for automatic target recognition algorithms for radar optics as well as a library of 3-dimensional imagery to enhance current technology, reduce false positives, and shorten the systematic kill-chain for targeting.						
Explosive Detection/Defeat:						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to develop an autonomous explosive detection and defeat capability; integrating specialized sensors for enhanced neutralization.</p> <p>- Initiate spiral technology development to produce a mobile explosive hazard in-depth defense.</p> <p>Medical:</p> <p>- Continue to experiment with systems to support a smaller, modular, multifunctional medical concept that can support medical care ashore and Marine Littoral Regiments (MLR) by performing studies, integration with unmanned systems, demonstrations, and experimentation.</p> <p>- Continue to integrate, test, and demonstrate wearable bio-sensors and their applicability to a multifunctional medical team supporting the MLR.</p> <p>- Complete integration of automated casualty care, providing therapeutic care during movement.</p> <p>- Initiate research regarding the constraints of performing medical interventions aboard shallow draft vessels.</p> <p>Warfighter Performance:</p> <p>- Continue to provide increased lethality and mobility to the warfighter through the integration of technology directly attributable to individual combat equipment.</p> <p>- Continue to develop, test, and assess a Radio Agile Integrated Device (RAID) Plate.</p> <p>- Initiate development of common user interface and fully integrate Primary, Alternate, Contingency, Emergency (PACE) plan for dismounted troops.</p> <p>Littoral Connectors:</p> <p>- Continue development and enhancement of capabilities for diversified distribution, providing risk worthy, inexpensive platforms for maneuver and sustainment distribution. Utilize current commercial technology to enhance maneuver to and from seabases and expeditionary advanced bases in the littorals with the ability to deliver directly to the users at shore. Efforts will advance anti-access and area denial capabilities to forward deployed forces.</p> <p>Robotic Modernization:</p> <p>- Continue to provide ground combat element robotic asset maintenance, repair, and upgrades; ultimately ensuring systems viability for experimentation and user evaluation.</p> <p>Camouflage, Concealment, and Detection (CC&D):</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate the development of CC&D capabilities, enabling persistence within enemy's Weapons Engagement Zone (WEZ).</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is directly attributable to the following areas:</p> <p>- Sustainment:</p> <p>- Initiation of demonstrations with naval logistics information technology integration with low earth orbit and military satellite networks.</p> <p>- Continue to manage and experiment with a Stern Landing Vessel (SLV) to assess, evaluate and experiment with a SLV to inform future naval surface vessel requirements, develop tactics, techniques and procedures (TTPs), and refine Distributed Maritime Operations (DMO)/Expeditionary Advanced Base Operations (EABO) concept of operations (CONOPS), pertaining to Force Design 2030. Specifically, additional funds support the execution of a 2nd hull, providing enhanced maneuver to and from seabases and expeditionary advance bases in the littoral with the ability to deliver all classes of supply, up to 38 passengers, directly to the users at shore via a full width (40ft) stern ramp. The SLV has a shallow vee-hull, transits at 14 knots in sea state 5, survivable in seat state 7, possess a 10-ton crane, and has the ability to tow other surface vessels. This effort supports the Navy's program of record Light Amphibious Warship (LAW), PMS-317, and shall serve as a validation of stern-landing vessels vice traditional bow-landing vessels. This package directly supports Naval and Joint Forces by providing Joint Force Maritime Component Commanders and Geographic Combatant Commanders a reliable, survivable, and lethal Marine Corps unit to deploy within the enemy's threat weapon engagement zone (WEZ) in support of joint operating concepts.</p> <p>- Medical:</p> <p>- Initiation of research regarding the constraints of performing medical interventions aboard shallow draft vessels.</p> <p>Camouflage, Concealment, and Detection (CC&D):</p>								

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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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate the development of CC&D capabilities, enabling persistence within enemy's Weapons Engagement Zone (WEZ).						
Title: Fires, Targeting, and Maneuver		5.236	6.499	11.744	0.000	11.744
Articles:		-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) experimentation efforts in the areas of fires, targeting, and maneuver, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced capabilities. This area increases fires, targeting, and maneuver related troop environmental awareness, lethality, and mobility using fused sensors as well as unmanned weaponized and reconnaissance air and ground vehicle platforms to support experimentation. Most programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Marine Air-Ground Task Force (MAGTF) Fires, Maneuver, and Autonomy and Robotics.						
FY 2022 Plans:						
- Unmanned Ground Vehicle (UGV) - Continue to provide a multi-purposed UGV, with modular payload architecture, with specific focus on vehicle sustainment as well as command and control structure. Continue to integrate program of record (POR) and non-POR payloads for the UGV platform that enhance dismounted units across the warfighting functions. Performed tests, demonstrations, and assessments prior to dedicated live-force experimentation. Focus areas include hostile threat detection, route clearance, common launcher integration, and automated target detection. Objective is to integrate a series of kinetic and non-kinetic payload options onto UGVs in order to enhance maneuverability, survivability, and lethality across warfighting communities.						
- Aerial Munitions - Continue to pursue company level precision guided munitions to increase responsiveness, survivability, and lethality to the ground combat element. Continue experimentation with fully autonomous, remotely operated unmanned aerial systems (UASs) that served as a dual electro-optical (day) and infra-red (IR) (night), precision-guided, loitering munition designed to seek, locate, and engage selected targets.						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Multi-Domain Fires - Continue the examination and testing of precision guided munitions. Efforts promote artillery force protection. Initiate investigations into low cost hypersonic technologies as well as multi-Domain Over-the-Horizon (OTH) Targeting.</p> <p>FY 2023 Base Plans: Unmanned Ground Vehicle (UGV):</p> <p>- Continue to provide a multi-purposed UGV, with modular payload architecture, with specific focus on vehicle sustainment as well as command and control structure.</p> <p>- Continue to integrate program of record (POR) and non-POR payloads for the UGV platform that enhance dismounted units across the warfighting functions.</p> <p>- Continue to perform tests, demonstrations, and assessments prior to dedicated live-force experimentation.</p> <p>Aerial Munitions:</p> <p>- Continue to pursue company level precision guided munitions to increase responsiveness, survivability, and lethality to the ground combat element.</p> <p>- Continue experimentation with fully autonomous, remotely operated unmanned aerial systems (UASs) that serves as a dual electro-optical (day) and infra-red (IR) (night), precision-guided, loitering munition designed to seek, locate, and engage selected targets.</p> <p>- Initiate development of a common launcher system that can be integrated onto ultra-light and autonomous vehicles; capable of firing light and medium or medium and heavy precision fires assets.</p> <p>- Initiate tasks to integrate existing weapons technology into a single killer munition.</p> <p>Multi-Domain Fires:</p> <p>- Continue the examination and testing of precision guided munitions. Efforts promote artillery force protection.</p> <p>- Complete investigations into low cost hypersonic technologies as well as multi-domain over-the-horizon (OTH) targeting.</p> <p>- Initiate the incorporation of POR command and control (C2) infrastructure with modified long-range aerial munitions to identify feasibility or recoverable, canister launched, platforms.</p> <p>- Initiate fire coordination cognizance investigations to reduce the cognitive load on fire support officers and commanders as they seek to understand events, make decisions, and take actions during high-stakes operations.</p> <p>- Initiate small unmanned close air support efforts to determine most capable product (platform + weapon + C2); leading to subsequent development and experimentation.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate organic sensor-to-shooter data that expedites the targeting process at the tactical level by integrating national technical means and is interoperable with Joint fires. Funding will be used to conduct a series of Developmental Tests and Limited Technical Assessments that matures the technology and validates USMC service level requirements.</p> <p>- Initiate preliminary design for a hypersonic capability in the 227mm (~9 inch variant) form factor to fit into a M142 High Mobility Artillery Rocket System (HIMARS) Launcher and support an expeditionary concept of operation. Pursuing this size will enable the Marine Corps to leverage existing legacy program of record technologies for both the launcher system (HIMARS) and the command and control software Advanced Field Artillery Tactical Data System (AFATDS).</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to the following efforts:</p> <p>Multi-Domain Fires:</p> <p>- Initiation of small unmanned close air support efforts to determine most capable product (platform + weapon + C2); leading to subsequent development and experimentation.</p> <p>- Initiation of organic sensor-to-shooter data to expedite the targeting process at the tactical level by integrating national technical means and is interoperable with Joint fires.</p> <p>- Initiation of a preliminary design for a hypersonic capability to fit into a M142 High Mobility Artillery Rocket System (HIMARS) Launcher and support an expeditionary concept of operation. Pursuing this size will enable the Marine Corps to leverage existing legacy Program of Record technologies for both the launcher system (HIMARS) and the command and control software Advanced Field Artillery Tactical Data System (AFATDS).</p>						
<p>Title: Marine Air-Ground Task Force (MAGTF) Command, Control, Communications, and Computers (C4)</p> <p>Articles:</p> <p>Description: This activity encompasses all Marine Corps Warfighting Laboratory/Futures Directorate (MCWL/ FD) Command, Control, Communications, and Computers (C4) experimentation efforts, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced C4 capabilities. The area provides cutting edge/enhanced Over-The-Horizon (OTH), Beyond Line of Sight (BLOS), satellite and non-satellite based C4 capabilities to support</p>		8.186 -	9.799 -	15.144 -	0.000 -	15.144 -

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
experimentation. Programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Command, Control, Communications, and Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Cyber/Electronic Warfare (Cyber/EW).						
FY 2022 Plans: - Asymmetric Command and Control (C2) - Continue to improve the stability, reliability, security, and performance of the current Iridium-based, push-to-talk (PTT), and position location information (PLI) system architecture for use in experiments with live-force units across a wide spectrum of ground, air, and surface operations. Continue to expand the use of mini-crypto on a Trellis Ware network and apply the mini-crypto capability to end user devices using the established experimental network/service via the Iridium 9523 modem. - Integrated C2 - Continue experimentation with an MV-22 (aircraft) internally transportable communications platform that receives, processes, and disseminates digital information from organic sensors wirelessly to dismounted users. Tasks include advanced waveform development and integration, advanced track and video processing development, and satellite On-the-Move (OTM) efforts. Initiate development of a persistent satellite communications (SATCOM) point-of-presence to enable Expeditionary Advanced Base (EAB), Distributed Maritime Operations (DMO), and Joint All-Domain C2 (JADC2) experimentation. - Electronic Warfare (EW) / Information Environment Operations - Continue pursuing electronic warfare efforts; to include providing tactical and deployable capabilities to locate, degrade, and/or deny adversaries use of the electromagnetic spectrum (EMS) encompassing elements of EW Support, Electronic Protection, and Electronic Attack measures. Initiatives include: Sensors and Jammers, C2, signal classification, and signal simulation. Initiate the development of a contested environment simulation tool. Initiate efforts to test and assess Tactical Spectrum Warfare Analysis Tools (TSWAT). Continue cyberspace warfare efforts, focusing on integrated cyber-hardening capabilities, external hacking / counterfeit electronics detection, and initiate development, testing, and assessment of combat systems for cyberspace monitoring. - Air Command - Complete development, assessment, and experimentation with tactical and itinerant air C2; specifically supporting a dispersed and disaggregated joint force.						
FY 2023 Base Plans: Asymmetric Command and Control (C2):						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to provide secure "one-to-many" (netted) push-to-talk (PTT) voice and command, control, communications, and computers (C4) data services to disadvantaged users in an easy to use, hand-held radio for both mounted and dismounted operations with no reliance on local ground infrastructure.</p> <p>- Continue mini-crypto development.</p> <p>- Initiate mission play-back capabilities for enhanced analysis and training and continue development and limited technical assessments with an expeditionary transportable communications platform.</p> <p>- Initiate a series of limited technical assessments to provide secure "one-to-many" (netted) push-to-talk (PTT) voice and command, control, communications, and computers (C4) data services to disadvantaged users in an easy to use, hand-held radio for both mounted and dismounted operations with no reliance on local ground infrastructure.</p> <p>Integrated C2:</p> <p>- Continue experimentation with an expeditionary transportable communications platform.</p> <p>- Continue the development of persistent satellite communications (SATCOM) point-of-presence to enable Expeditionary Advanced Base (EAB), Distributed Maritime Operations (DMO), and Joint All-Domain C2 (JADC2) experimentation.</p> <p>- Initiate the integration of a proliferated-Low Earth Orbit (pLEO) satellite constellation capability which will facilitate connectivity to elements of the Family of Integrated Targeting Cells (FITC) and other pLEO enabled platforms and agencies.</p> <p>Electronic Warfare (EW) / Information Environment Operations:</p> <p>- Continue to pursue multiple electronic and cyber-secure warfare efforts.</p> <p>- Complete efforts to test and assess, which provide a ruggedized case for sensing WiFi, Bluetooth, and other electro-magnetic transmissions.</p> <p>- Initiate the development and integration of an airborne EW/Signals Intelligence (SIGINT) radio frequency sensor that is optimized for Group I - III unmanned aerial system (UAS) deployment.</p> <p>- Initiate the integration of a full-spectrum SIGINT and EW capability onto Group V UAS. Effort will provide a modular system architecture with the ability to integrate into multiple platforms.</p> <p>- Initiate experimentation with a cyber application of swarmable, autonomous UASs used to accomplish intelligence, surveillance, and reconnaissance (ISR) and EW operations in a contested environment.</p> <p>- Initiate the development of a resilient, cyber-secure high-performance network within the littorals.</p> <p>Naval Force Tactical Communications:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate experimentation opportunities for high frequency silent transmission over a resilient meshed network. Developed technology will support C2 in heavily contested electro-magnetic environments (EME).</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to the following effort:</p> <p>Asymmetric Command and Control (C2):</p> <p>- Initiation of a series of limited technical assessments to provide secure "one-to-many" (netted) push-to-talk (PTT) voice and command, control, communications, and computers (C4) data services to disadvantaged users in an easy to use, hand-held radio for both mounted and dismounted operations with no reliance on local ground infrastructure.</p> <p>- Integration of a proliferated-Low Earth Orbit (pLEO) satellite constellation capability which will facilitate connectivity to elements of the Family of Integrated Targeting Cells (FITC) and other pLEO enabled platforms and agencies.</p>						
<p>Title: Marine Air-Ground Task Force (MAGTF) Intelligence, Surveillance, and Reconnaissance (ISR)</p> <p>Articles:</p> <p>Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Intelligence, Surveillance and Reconnaissance (ISR) related experimentation efforts, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced ISR capabilities. Using a variety of fused sensors to mesh data, video, and images and incorporating a common tactical controller to operate multiple air and ground ISR platforms, this area enhances small unit situational awareness as well as exploitation and forward engagement ability via experimentation. Programs listed below are considered major (valued at \$500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Autonomy and Robotics.</p> <p>FY 2022 Plans:</p>		22.681 -	24.474 -	25.884 -	0.000 -	25.884 -

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Unmanned Aerial Systems (UASs) - Continue to explore, expand mission sets, and exploit the tactical potential of small UASs across multiple Marine Corps domains, focusing on autonomy, innovative applications, and the most advanced small UAS technology. Objectives include increasing ground maneuver force capability with small UASs by integrating critical payloads for immediate use and incorporating new platforms, sensors, and command and control into United States Marine Corps (USMC) UAS operations. Seek to develop Group I long endurance (24+ hour) small UAS. Investigate and assess vertical take-off and landing (VTOL) Group II UAS capabilities. Efforts support providing a small tactical UAS, compatible with the Naval Surface Fleet to align with long-term USMC UAS ship-board requirements. Objectives include integrating, testing, and demonstrating a heavy fuel engine to expand Department of the Navy (DoN) organic ship-board operations; modifying to address other threshold requirements such as Type 1 encryption, electromagnetic interference (EMI) shielding, and global positioning system (GPS) hardening. Initiate efforts using larger UASs to develop shipboard operations using an Electric VTOL (EVTOL), evaluating new power and propulsion technology as well as leveraging the rapidly advancing Urban Air Mobility (UAM) commercial segment. Effort will inform an Analysis of Alternatives (AoA) for an inexpensive next generation helicopter, capable of performing and surviving within an Expeditionary Advanced Base (EAB) construct, reducing maintenance requirements, and dependence on fossil fuels.</p> <p>- Robotic Autonomous Command and Control (C2) - Continue to investigate and experiment with enabling technologies combining sensor and telemetry data from multiple unmanned platforms (ground, surface (water), and air). Incorporate large, medium, and small autonomous as well as C2 (radio and tablet) platforms to integrate, test, and demonstrate fully integrated manned-unmanned teaming concepts with collaborative control between Marines and robotic autonomous assets.</p> <p>- Mapping - Complete investigations into providing a small, lightweight, semi-autonomous system that can self-navigate structure interiors and subterranean environments while simultaneously creating real-time three-dimensional (3D) maps.</p> <p>- Fused Integrated Networking - Continue development and experimentation using an aerial communications gateway platform. Objectives include networking mobile distributed multi-domain sensors, fires, and C2 platforms; supporting high throughput at operationally relevant ranges; leveraging low probability of intercept/ low probability of detection/anti-jam (LPI/LPD/AJ) attributes; reconfiguration to optimize throughput and reduce latency in a given threat environment; and optimized pass fires/C2 information in the form of pre/post-processed information between sensors, shooters, and/or C2 agencies in order to enable a "kill web".</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Air-Launched Reconnaissance - Complete efforts to provide a multi-role, long reach, expeditionary, next generation network of ISR capabilities. Program objective is to demonstrate an unmanned attritable aerial asset arriving at least 5 minutes ahead of a manned assault aircraft, providing threat updates on objective for go/no go landing decision.</p> <p>- Information Operations - Continue to develop and enhance capabilities to increase situational awareness and influence decision making. Integrate capabilities in the information operation environment, to include monitoring, engaging, and producing effects. Conduct limited technical assessments and exercises to evaluate emergent technologies and develop TTPs. Investigate technologies and experimentation opportunities to support the operational utility of artificial intelligence/machine learning algorithms, developing Marine Corps intelligence and logistics applications. Effort seeks to develop tools to improve and accelerate information-based decision-making as well as reductions in operator workload.</p> <p>- Space - Continue to develop capabilities to conduct electronic warfare against UASs in support of MAGTF operations. Provide LPI/LPD C2 link for autonomous surface vessels and demonstrate a communication pathway in a C2 degraded environment. Initiate experimentation efforts to reduce overall cost of distributed, space-based observations. Objective seeks to deploy micro satellites made from semi-conductor fabrication technology. Investigate theory that satellites can be made inexpensively and powerful by leveraging existing high volume design/manufacturing/test infrastructures.</p> <p>FY 2023 Base Plans: Unmanned Aerial Systems (UASs):</p> <p>- Continue to explore, expand mission sets, and exploit the tactical potential of small UASs across multiple Marine Corps domains, focusing on autonomy, innovative applications, and the most advanced small UAS technology.</p> <p>- Continue development of Group I long endurance (24+ hour) small UAS.</p> <p>- Continue to investigate and assess vertical take-off and landing (VTOL) Group II UAS capabilities. Objectives still include integrating, testing, and demonstrating a heavy fuel engine to expand Department of the Navy (DoN) organic ship-board operations.</p> <p>- Continue to explore Group II fixed wing and VTOL payload development.</p> <p>- Continue efforts to provide a highly automated/autonomously operated cargo drone that supports organic resupply via an aerial cargo vehicle; supporting a squad sized element.</p> <p>- Complete efforts using larger UASs to develop shipboard operations using an electric VTOL (EVTOL) asset.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
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, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate specialized payload development for Group 2 and 3 UAS organic to tactical units for extended endurance, increased lethality, and developmental testing.</p> <p>Robotic Autonomous Command and Control (C2):</p> <p>- Continue to investigate and experiment with enabling technologies combining sensor and telemetry data from multiple unmanned platforms (ground, surface (water), and air).</p> <p>Fused Integrated Networking:</p> <p>- Continue development and experimentation using an aerial communications gateway platform. Objectives include developing a podded C4 gateway prototype optimized to be hosted on a Group V Mid-Altitude Long Endurance (MALE) UAS as well as optimizing multi-domain (air, land, and sea) system-to-system interoperability; enabling joint targeting (planned and/or dynamic); and providing a robust capacity to locally hosted applications and services.</p> <p>Information Operations:</p> <p>- Continue to develop and enhance capabilities to increase situational awareness and influence decision making.</p> <p>- Continue to investigate technologies and experimentation opportunities to support the operational utility of artificial intelligence/machine learning algorithms, developing Marine Corps intelligence and logistics applications.</p> <p>- Complete the integration of capabilities in the information operation environment, to include monitoring, engaging, and producing effects.</p> <p>Space:</p> <p>- Continue to develop capabilities to conduct electronic warfare in support of Marine Air-Ground Task Force (MAGTF) operations.</p> <p>- Continue to investigate experimentation opportunities for inexpensive commercial based satellites, leveraging existing high volume design/manufacturing/test infrastructures.</p> <p>- Complete low probability of intercept/low probability of detection (LPI/LPD) C2 link for autonomous surface vessels and demonstrate a communication pathway in a C2 degraded environment.</p> <p>- Complete experimentation efforts to reduce overall cost of distributed, space-based observations.</p> <p>- Initiate the construct and experimentation of integrated targeting cells.</p> <p>- Initiate investigations to search and receive messages transmitted outside standard frequency assignments and forward to deployed forces within the Expeditionary Advanced Base Operations (EABO) construct.</p>								

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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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate Family of Integrated Targeting Cells (FITC) development in order to enhance the tactical-national interfaces that can support the over-the-horizon awareness, identification, and targeting in stressing environments. Prototypes will demonstrate tactical and resilient networking and processing capabilities that can work with national, commercial, and in-theater tactical feeds to increase capabilities operating at the tactical edge.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is due to the following effort:</p> <p>- Unmanned Aerial Systems (UASs): - Initiation of specialized payload development for Group 2 and 3 UAS organic to tactical units for extended endurance, increased lethality, and developmental testing.</p>						
<p>Title: Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Technical, Engineering, and Management Support</p> <p>Articles:</p> <p>Description: Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Technical, Engineering, and Management Support efforts include lab-wide, non-program specific experimentation doctrine, planning, management, and technical/engineering support, as well as technology transition tracking efforts. Tasks listed below are considered major (valued at \$500K or more) or have near real-time operational impact.</p> <p>FY 2022 Plans: - Experimentation Analysis - Efforts now discussed within the Warfighting Excellence area, Modeling, Simulation, and Analysis paragraph.</p> <p>- Commercial Forecasting - Continue to explore new mechanisms to identify long-range commercially available technologies and innovations that may influence future Marine Corps investments. Program goals are to identify commercial innovations which impact future Marine Corps capabilities and leverage commercial dual use investments to preserve military S&T resources. Efforts focus on military focused technologies available in 10 to 20 years.</p>		15.512 -	5.795 -	8.671 -	0.000 -	8.671 -

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Technical Support - Provide a full range of overarching, lab-wide, engineering, analytical, technical, management, and business services; directly related to live-force experimentation. Efforts support the development of new or existing operational concepts, tactics, techniques, procedures, and technologies to prepare Marines for combat. These are critical components to feed into the combat development process. Related, program specific tasks/funding discussed within applicable sections of the exhibit.</p> <p>- Portfolio Analytics - Continue to build a comprehensive visualization tool for Marine Corps Warfighting Laboratory's (MCWL's) portfolio and integrate it with Science and Technology (S&T) efforts across the Department of the Defense's (DoD's) S&T community. Provide strategic portfolio management, simplifying the process of gathering and organizing organizational content into systemized digital frameworks for the automation of data driven reports, road mapping, and strategic planning. Increase awareness of performance and other project metrics due to high-level data analysis and visualization.</p> <p>- Collaboration - Continue to provide critical infrastructure to support the execution of S&T projects. The environment supports S&T development/execution as well as experimentation planning. Effort seeks to facilitate communication, problem solving, risk mitigation, and status reporting in the execution of S&T projects at all classification levels.</p> <p>FY 2023 Base Plans: Commercial Forecasting: - Continue to identify long-range commercially available technologies and innovations that may influence future Marine Corps investments. Efforts provide a means to ensure proactive awareness and leveraging of foreseeable developments in commercial cutting-edge technologies.</p> <p>Technical Support: - Continue to provide a full range of overarching, lab-wide, engineering, analytical, technical, management, and business services; directly related to live-force experimentation.</p> <p>Portfolio Analytics: - Continue to build a comprehensive visualization tool for the Marine Corps Warfighting Laboratory (MCWL) portfolio and integrate it with Science and Technology (S&T) efforts across the Department of Defense's (DoD's) S&T community. Since these efforts are tightly coupled with both Technical Support as well as Collaboration requirements, future discussions will be captured within the Technical Support arena.</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Collaboration: - Continue to provide critical infrastructure to support the execution of S&T projects. The provided laboratory facility co-locates experimentation designers/implementers with project teams and technologists to enhance effectiveness of experimentation design, development, implementation, reporting, prototyping, and outreach of results. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase from FY 2022 to FY 2023 is directly attributable to Technical Support re-alignments to better identify command-level support versus specific project level function. This category did not experience any growth or decline from FY 2022 to FY 2023; however, the requested budget as shown is now better representative of overarching, lab-wide, non-program specific support.							
Title: Warfighting Excellence Articles: Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) 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 MCWL/FD service experimentation (to include planning and analysis) in areas that impact multiple warfighting functions. Programs listed below are considered major (valued at \$500K or more) or have near- real-time operational impact. FY 2022 Plans: - Wargaming - Continue to plan and execute executive agent responsibilities for the Marine Corps Title Ten Wargame, Expeditionary Warrior, as well as other wargames to examine Marine Corps capstone, operating, and functional concepts and explore assigned topics. Efforts include all elements of the Commandant's Planning Guidance and National Defense Strategy. Permit improved wargaming collaboration, quantitative output, and qualitative output by utilizing technical personnel who provide scenario development, database management, simulation training to players, over the shoulder instruction to players, server management, network management, and accreditation of network and system support. This enables an agile wargaming			22.196 -	22.945 -	22.297 -	0.000 -	22.297 -

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
capability, capable of exploring problems, developing insights, expanding assessment and analytical results, and supporting deliberations and excursions.						
- Emerging Threats and Opportunities - Continue to assess and analyze the future security environment; identifying and analyzing emerging threats; and developing and appraising promising concepts, opportunities and technologies. Efforts provide broad-based technological and analytical support for United States Marine Corps (USMC) combat development and experimentation programs at the component, Service, and Joint levels. Support covers the full spectrum of combat development related missions and tasks, to include assessment of the strategic environment, future threats and adversaries, and associated geographic, environmental, economic, and demographic conditions that may influence the development of future warfighting concepts, experimentation, and capabilities.						
- Joint Concept Technology Demonstrations (JCTDs) - Continue to monitor and contribute to approved efforts that address joint and combatant command warfighting needs through the execution and demonstration of prototypes within two to four years. Complete technology development to enable barges/vessels to serve as distributed resupply nodes in support of littoral operations. Initiate efforts to provide kitted solutions to increase the survivability of expeditionary and permanent logistical support networks in an Anti-Access/Area Denial (A2/AD) environment.						
- Exercise Support - Continue multi-year effort to enhance the ability of the Marine Air-Ground Task Force (MAGTF) to conduct operations in the dense urban environment. Focus areas include manned-unmanned teaming functionality.						
- Innovation - Continue to conduct warfighter driven challenges to develop prototypes and foster innovation within the Marine Corps. Continue to reach out to fleet organizations, engage entities and develop required capabilities for further testing and evaluation. Integrate emergent technologies into experimental venues to access feasibility.						
- Modeling, Simulation, and Analysis - Continue to use modeling and simulation (M&S) tools and techniques to provide analysis to support capability development activities. Efforts provide sustained and progressive examination of 21st century warfighting concepts, plans, and capabilities. Force development activities include campaign level and mission/engagement level M&S, systems planning and analysis, model development, table top exercise support, assessment, and product generation for development of Marine Corps and Naval						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
capabilities. Previously reported within the Operations (Support) area (now titled Technical, Engineering, and Management Support), continue to provide unique and comprehensive analytical expertise to facilitate and evaluate experiments in various warfighting areas. Analysts assist in experiment design, data collection during experiments, and performance of reconstruction and analysis of experiments. End products include comprehensive independent experiment analysis reports; detailing results and suggestions to increase effectiveness and efficiency.						
- Experimentation Opposition Force - Continue to demonstrate the abilities of a live adversary force. Force provides a realistic, adaptive, and cohesive adversary as well as civilian environmental characteristics.						
- Autonomous First Wave - Complete campaign to assess an ecosystem of technologies to better understand and advance capabilities to ultimately increase the lethality and effectiveness of the warfighter on tomorrow's battlefield. Conduct limited objective assessments to portray a multi-disciplinary, cross-functional, and intra-branch approach towards the larger foci of the Naval Fleet Experimentation (FLEX) Program and the Marine Corps' Service Level Experimentation Campaign Plan (SLCP), albeit assessing technologies at different phases of ship-to-shore maneuver and combat operations in an urban environment.						
- Joint Assessment Strategies - Complete participation in joint Defense Advanced Research Projects Agency (DARPA)-led initiative to analyze the hardest military challenges facing the United States and our allies. Experimentation efforts seek to inform future warfighting architectures and address/solve identified challenges.						
- Artificial Intelligence (AI) - Continue to leverage joint Component investments to investigate concepts, methods, toolkits, software applications, and ideologies to provide/promote AI support/use for MCWL concept based experimentation. Overall investment amounts decrease due to augmentation and support from joint partners within the Department of Defense (DoD).						
FY 2023 Base Plans:						
Wargaming:						
- Continue to plan and execute executive agent responsibilities for the Marine Corps Title Ten Wargame, Expeditionary Warrior, as well as other wargames to examine Marine Corps capstone, operating, and functional concepts and explore assigned topics. Efforts provide high-level, diverse wargaming support that embrace both the scope of joint wargaming and experimentation. Tasks support the combat development process by helping						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
to develop and refine emerging concepts, conceptualize force design, and identify capabilities and deficiencies within future operating environments. - Continue to enhance on-demand, qualitative, and quantitative modeling capability that executes in a collaborative environment. This is provided by state-of-the-art equipment to improve visualization and allow for seamless collaboration output during wargaming scenarios. Emerging Threats and Opportunities: - Continue to assess and analyze the future security environment; identify and analyze emerging threats; and develop and appraise promising concepts, opportunities and technologies. Efforts include performing as an internal Marine Corps think tank dedicated to developing new ideas and concepts. - Continue to support the full spectrum of combat development-related missions and tasks, to include the assessment of future threats and adversaries and associated geographic, environmental, economic, and demographic conditions that may influence the development of future warfighting concepts, experimentation, and required capabilities in the areas of Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLEPF). Joint Concept Technology Demonstrations (JCTDs): - Continue to monitor and contribute to approved efforts that address joint and combatant command warfighting needs through the execution and demonstration of prototypes within two to four years. - Complete efforts to provide kitted solutions to increase the survivability of expeditionary and permanent logistical support networks in an Anti-Access/Area Denial (A2/AD) environment. - Initiate experimentation and complete efforts to enable barges/vessels to serve as distributed resupply nodes in support of littoral operations. - Initiate explorations into joint efforts that supplement force design initiatives. Exercise Support: - Continue multi-year effort to enhance the ability of the Marine Air-Ground Task Force (MAGTF). Focus areas include demonstrations of an unmanned kill-chain utilizing Group I and II unmanned aerial vehicles (UASs) with Electro-Optic Infrared (EO/IR) payloads and laser target designators, aerial loitering munitions, and unmanned ground vehicles. Innovation:						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to develop/conduct/refine warfighter driven challenges to develop/identify prototypes and foster innovation within the Marine Corps. During this series of exercises industry, academia, and the Naval Research and Development Establishment (NR&NE) are invited to demonstrate emerging technology/engineering innovations that address priority Navy and Marine Corps missions.</p> <p>- Continue to reach out to the fleet and conduct capability wheel workshops in order to identify vital requirements for future development of the Expeditionary Advanced Base Operations (EABO) construct. Where applicable, integrate emergent technologies into experimental venues to access feasibility.</p> <p>Modeling, Simulation, and Analysis:</p> <p>- Continue to investigate/use emerging modeling and simulation (M&S) tools and techniques to provide analysis to support capability development activities. Provide M&S of naval operations with a focus on the Pacific Theater. Efforts include conducting comprehensive kill-chain assessment processes to evaluate current and future offensive capabilities against defensive counter-capabilities between the United States and a range of potential adversaries.</p> <p>- Continue to provide a broad range of independent, unique, and comprehensive analytical expertise to facilitate and evaluate experiments in various warfighting areas. This includes the planning, development, and execution of M&S as well as experimentation events.</p> <p>Experimentation Opposition Force:</p> <p>- Continue to demonstrate/hone the abilities of a live adversary force. Force provides a realistic, adaptive, and cohesive adversary as well as civilian environmental characteristics; thus strengthening experiment hypotheses and objectives.</p> <p>Artificial Intelligence (AI):</p> <p>- Continue to leverage joint Component investments to investigate concepts, methods, toolkits, software applications, and ideologies to provide/promote AI support/use for MCWL concept based experimentation.</p> <p>- Initiate investigations into changing service culture, making it more receptive of AI capabilities, and demonstrating how AI can make missions more effective and efficient. The aim is to reduce human processes and decrease resources and time for administrative tasks as well as demonstrating AI capabilities to garner service-wide acceptance.</p> <p>FY 2023 OCO Plans:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A					
FY 2022 to FY 2023 Increase/Decrease Statement: No significant changes from FY22 to FY23.					
Accomplishments/Planned Programs Subtotals	89.324	104.071	157.064	0.000	157.064
C. Other Program Funding Summary (\$ in Millions) N/A					
Remarks					
D. Acquisition Strategy N/A					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo				Project (Number/Name) 2958 / Cyberspace Activities			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2958: Cyberspace Activities	0.000	4.635	4.752	4.800	-	4.800	5.000	5.099	5.201	5.305	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
This Project activity provides freedom of maneuver and influence in the cyber-electronic warfare domain while simultaneously denying the same to the adversary and protecting critical command systems. Technologies are being developed using a multi-disciplinary approach that combines Radio Frequency electronics, digital signal processing, computer engineering, software engineering, machine learning and data science to support Naval Expeditionary warfighters operating with size, weight and power constrained equipment in Disrupted, Intermittent, Limited environments. Areas of applied research include distributed precision time, predictive software defined radio architectures, coordinated Cyber and Spectrum maneuver to mitigate detection and exploitation, tactical Cyber visualization, discovering and mapping networks in dense urban environments, contextual awareness and blind channel characterization.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Expeditionary Cyber Articles:								4.635	4.752	4.800	0.000	4.800
								-	-	-	-	-
FY 2022 Plans: -Continue cyber related research into mitigation techniques related to USMC systems -Continue research to better identify key cyber terrain at the physical, logical, and cyber persona layers that can be visualized at small unit level -Complete cyber related activities to improve the overall cyber protection strategy for deployed systems at the battalion level and below that feed into the Marine Air-Ground Task Force (MAGTF) Information Group Integrated Command Center -Initiate research to develop of RF enabled EW/cyber networking that will deliver actions at scale through the integration of secure orchestration, cyber secure sensors, distributed beamforming and resilient networking technologies -Initiate research into automating cyber analysis and testing tools to enable software developers and reverse engineers to reduce the time required to conduct vulnerability analysis and software testing tasks.												
FY 2023 Base Plans: Continue: - Continue cyber related research into mitigation techniques related to USMC systems - Continue research to better identify key cyber terrain at the physical, logical, and cyber persona layers that can be visualized at small unit level												

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Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	Project (Number/Name) 2958 / Cyberspace Activities			
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue research to develop of RF enabled EW/cyber networking that will deliver actions at scale through the integration of secure orchestration, cyber secure sensors, and resilient networking technologies - Continue research into automating cyber analysis and testing tools to enable software developers and reverse engineers to reduce the time required to conduct vulnerability analysis and software testing tasks. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023					
Accomplishments/Planned Programs Subtotals	4.635	4.752	4.800	0.000	4.800
C. Other Program Funding Summary (\$ in Millions)					
N/A					
Remarks					
D. Acquisition Strategy					
N/A					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	45.951	73.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	119.051
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Congressional Interest Items not included in other Projects.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Expeditionary Process, Exploitation, and Dissemination								4.827	4.000			
FY 2021 Accomplishments: Conducted advanced technology development in expeditionary process, exploitation, and dissemination.												
FY 2022 Plans: Conduct advanced technology development in expeditionary process, exploitation, and dissemination.												
Congressional Add: Adaptive Threat Force Footprint								5.792	0.000			
FY 2021 Accomplishments: Sustained by the FY 2020 Congressional Enhancement, the Adaptive Threat Force (ATF) has proved itself as a valuable addition to live-force experiments as the Marine Corps moves forward with the concepts of Expeditionary Advanced Base Operations (EABO), Littoral Operations in a Contested Environment (LOCE), and Force Design 2030 (FD 2030). The ATF continues to participate in experiment design to ensure that peer threat capabilities and operational methodologies are incorporated into each experiment. The ATF also continues to train and equip a peer threat adversary force to oppose experiment forces as they develop EABO, LOCE and assess FD 2030. This increases the accuracy and reliability of the data and results obtained. The ATF is central to the ongoing Infantry Battalion 2030 (IBX30) series of experiments that conclude in FY 2022. The ATF will support experiments with the Marine Littoral Regiment (MLR) which will begin in FY 2022 and extend at least until FY 2024. Explorations will inform MLR requirements through imaginative and innovative methods to understand the potential challenges involved in their insertion, command and control viability, sustainment, and survivability. Due to the size of the anticipated forces involved in the MLR experiments, MCWL foresees an increased use of modeling and simulation (M&S) within the experiment plans. To support this the ATF is working to advance a simulation system and incorporate threat force current and												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022	
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	Project (Number/Name) 9999 / Congressional Adds	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022
emerging capabilities to ensure opponents within the simulation truly represent the identified opposition. MCWL envisions expanding the ATF capability in the area of M&S to meet these requirements. FY 2022 Plans: N/A			
Congressional Add: Ensure Defense and Operational Resilience for USMC Tactical Cyber & Spectrum Man FY 2021 Accomplishments: Developed a Reference System Manager. Integrate ENDOR application orchestrator with SOSA reference task manager. Investigate MORA MDM message. Develop distributed mission planning reference tool. Build ENDOR enabled sensor mounted nodes. FY 2022 Plans: N/A		9.654	0.000
Congressional Add: USMC Force Design - Closed Classified Wargaming Network and Naval Integration FY 2021 Accomplishments: The Marine Corps Warfighting Laboratory's (MCWL's) Wargaming Division is establishing a closed, classified wargaming network (WarNet) capability at secret and top secret levels to incorporate new software tools in support of USMC Service wargames. Efforts include further development of a multi-domain/multiplayer software solution to enable player immersion, visualization, and realistic computer assisted adjudication, as well as data generation for post-game analysis. Program leverages emerging cloud capabilities to extend the WarNet architecture to the Marine Expeditionary Forces (MEFs) and Marine Corps Force Pacific (MARFORPAC) to enable collaborative and distributed wargaming. In conjunction, this Congressional Enhancement also accelerates multi-level-security modeling, simulation, and analysis capacity and capability to develop Marine Corps Mission Engineering Threads into Operational Navy (OPNAV) Naval Capabilities Integrated Process (NCIP) efforts. In total, these efforts build necessary analytical and modeling and simulation (M&S) rigor to support Commandant of the Marine Corps (CMC) Force Design programmatic decision-making. FY 2022 Plans: N/A		0.965	0.000
Congressional Add: USMC Force Design - Organic Reconnaissance, Surveillance, and Target Acquisition FY 2021 Accomplishments: Current levels of Marine Expeditionary Forces (MEU)-organic Airborne Intelligence Surveillance, and Reconnaissance (ISR)/Reconnaissance, Surveillance, and Target Acquisition (RSTA) are inadequate to meet demands and inflexible to meet operational constructs like Expeditionary Advanced Base Operations (EABO) and Littoral Operations in a Contested Environment (LOCE). Efforts support MEU operations with an advanced technology vertical take-off-and-landing (VTOL) unmanned aerial system (UAS) ISR platform to inform requirements towards Initial Operating Capability (IOC) of a replacement maritime MEU ISR platform		4.344	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	Project (Number/Name) 9999 / Congressional Adds
B. Accomplishments/Planned Programs (\$ in Millions)		
which will operationalize new Commandant of the Marine Corps (CMC) Force Design capabilities for EABO/ LOCE. FY 2022 Plans: N/A		
Congressional Add: Marine Corps force Design Acceleration - Project Artemis FY 2021 Accomplishments: Using rapid prototyping, Project Artemis outfits the Marine Corps' experimental Marine Littoral Regiment (MLR) with a cohesive set of next generation equipment. Project Artemis modernizes Marine Corps infantry squads with emerging and disruptive technologies in order to develop joint tactics, techniques, and procedures (TTPs) through an extended user evaluation - equipping six Marine Corps Rifle Squads (two rifle platoons) and supporting company headquarters with the latest technological advances in squad lethality. Efforts build the capabilities of "stand-in" forces in accordance with Commandant of the Marine Corps (CMC) Force Design 2030, by developing Manned-Unmanned Teaming (MUM-T) and next generation communication systems TTPs for the infantry squad. Program develops a family of common controllers for current and future weaponized and ISR unmanned ground and air vehicles (UGVs and UAVs), as well as outfits three squads with individual voice mesh network radios and surrogate heads-up displays. FY 2022 Plans: N/A	10.715	0.000
Congressional Add: Marine Corps Mission Support Station Demonstration FY 2021 Accomplishments: Conduct advanced technology development in Marine Corps Mission Support Station Demonstration. FY 2022 Plans: N/A	9.654	0.000
Congressional Add: Advanced mission planning system SBIR technology insertion FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct technology development supporting advanced mission planning system SBIR technology insertion	0.000	5.000
Congressional Add: Data analysis and sharing augmentation FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct data analysis and sharing augmentation technology development	0.000	2.000
Congressional Add: Low-cost atrittable aircraft technology	0.000	25.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	Project (Number/Name) 9999 / Congressional Adds
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Pursue demonstration and experimentation with the tactical and operational alternative uses of highly autonomous, low-cost unmanned aircraft in an operationally representative environment while simultaneously developing the requisite: concepts of employment (CONEMPS), concepts of operation (CONOPS), Tactics, Techniques, Procedures (TTP), and logistics requirements. Pursuits will utilize an unmanned aerial vehicle (UAV) that is runway independent and designed for operations from both austere and improved operations. Efforts are follow-on to an Air Force developmental program.		
Congressional Add: Adaptive future force	0.000	8.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct advance technology development supporting adaptive future force		
Congressional Add: AI-powered tactical ISR	0.000	5.100
FY 2021 Accomplishments: N/A		
FY 2022 Plans: In response to small drones proliferating on the battlefield, pursue the generation of real-time two-dimensional (2D) maps, near-real-time three-dimensional (3D) models, and analytical layers on handheld devices with no network connectivity required. Software development investigations (interoperable with existing Group 1 - 5 unmanned aerial systems (UASs) imaging payloads) are anticipated to drastically improve individual soldier's capabilities without the need to test and field new drone or mobile device hardware. Efforts are in concert with a similar FY 2022 Army Congressional enhancement.		
Congressional Add: Expeditionary mission support	0.000	10.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct technology development supporting expeditionary mission support objectives		
Congressional Add: Platform agnostic weapons system	0.000	5.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Platform agnostic weapons system technology development		
Congressional Add: Stand-off security inspection and surveillance system	0.000	9.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / MC Advanced Technology Demo	Project (Number/Name) 9999 / Congressional Adds

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct stand-off security inspection and surveillance system technology development		
Congressional Adds Subtotals	45.951	73.100

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603651M / <i>JT Non-Lethal Wpns Tech Dev</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	12.882	13.429	14.048	-	14.048	15.556	16.967	17.504	17.855	Continuing	Continuing
3022: <i>Joint Non Lethal Weapons</i>	0.000	12.882	13.429	14.048	-	14.048	15.556	16.967	17.504	17.855	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DoD Non-Lethal Weapons Program was established by the FY96 National Defense Authorization Act. The Office of the Secretary of Defense 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 and Sustainment (A&S) serves as the OSD Principal Staff Assistant and oversees, in consultation with the Under Secretary of Defense for Policy, the DoD NLW Executive Agent.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions 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 requirements and capabilities sought by the Services 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 most relevant 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 National Defense Strategy (NDS) objective of strategic competition by providing options to the joint force in pursuit of national objectives in legal or policy constrained scenarios, as well as complementing the use of lethal effects in complex combat scenarios, for example, in urban environments with large civilian populations. Ongoing NLW studies, analyses and exercise efforts with North Atlantic Treaty Organization (NATO) and Allies also support NDS objectives to strengthen alliances and partnerships. Resulting capabilities will facilitate a fully integrated non-lethal competency as a complement to lethal firepower, providing force application options for below lethal threshold engagements.

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 and Intermediate Force Capabilities (IFCs) 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.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy			Date: April 2022		
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			
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	13.243	13.429	0.000	-	0.000
Current President's Budget	12.882	13.429	14.048	-	14.048
Total Adjustments	-0.361	0.000	14.048	-	14.048
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.361	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	14.048	-	14.048
Change Summary Explanation					
Funding: No significant change.					
Technical: No significant change.					
Schedule: No significant change					

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3022: Joint Non Lethal Weapons	0.000	12.882	13.429	14.048	-	14.048	15.556	16.967	17.504	17.855	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
This project funds the research and development of next-generation Non-Lethal Weapons 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 Non-Lethal Weapons (NLW) 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 Non-Lethal Weapon 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.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Joint Non-Lethal Weapons Articles:								12.882	13.429	14.048	0.000	14.048
								-	-	-	-	-
FY 2022 Plans: - Conduct research and investigation of intermediate force effects and emergent technologies with the potential to further address the Joint Requirements Oversight Council (JROC) approved non lethal counter-personnel and counter-materiel capability gaps. Specifically, explore new non-lethal effects and evaluate alternative innovative applications of existing technologies to address future non-lethal capability needs as escalation of force platforms. Some examples of counter-personnel research include further optimization of non-lethal human effects, and enhanced understanding of human target behavioral effects. -Characterize non-lethal phenomena and to assess target human effects and weapon effectiveness, including the development of dose response and injury correlates for new Non-Lethal Weapons technologies. -Other research includes the assessment and study of new technologies to NLW effectiveness and behavioral response, such as advancing the understanding of Flash Bang effects on humans to support novel non-explosive alternatives to pyrotechnic non-lethal IFC devices. Some examples of counter-materiel research												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
include the investigation of novel intermediate force capabilities for increased delivery and employment options for applications such as vehicle and vessel stopping and the further optimization of intermediate force materials for integration into future escalation of force platforms.						
-Other research includes feasibility and design studies for high peak power radio frequency directed energy sources and other high power microwave directed energy technologies (e.g., lasers, millimeter-waves) with extended range applications an longer duration of effect. Other examples of counter-materiel research include the investigation and conceptual design of high power microwave technologies to reduce overall size, weight, power consumption, thermal cooling requirements, and overall system costs (SWaP-C) performance. Results will support the transition of viable technologies.						
FY 2023 Base Plans:						
Continue:						
- Research and investigation of Non-Lethal Weapons (NLWs) and Intermediate Force Capability (IFC) effects and emergent technologies with the potential to further address the Joint Requirements Oversight Council (JROC) approved non-lethal counter-personnel and counter-materiel capability gaps. Specifically, explore new non-lethal effects and evaluate alternative innovative applications of existing technologies to address future non-lethal capability needs as escalation of force platforms. Examples of counter personnel research include further optimization of non-lethal human effects, and enhanced understanding of human target behavioral effects.						
- Characterize non-lethal phenomena and to assess target human effects and weapon effectiveness, including the development of dose response and injury correlates for new Non-Lethal Weapons technologies.						
- Assess and study of new technologies to NLW effectiveness and behavioral response, such as advancing the understanding of Flash Bang effects on humans to support novel non-explosive alternatives to pyrotechnic non-lethal IFC devices.						
- Counter-materiel research to include the investigation of novel intermediate force capabilities for increased delivery and employment options; for applications such as vehicle and vessel stopping and the further optimization of intermediate force materials for integration into future escalation of force platforms.						
- Perform feasibility and design studies for high peak power radio frequency directed energy sources and other high power microwave directed energy technologies (e.g., lasers, millimeter-waves) with extended range applications and longer duration of effect.						
- Investigation and conceptual design of high power microwave technologies to enable improved performance and reduce overall size, weight, power consumption, thermal cooling requirements, and overall system costs						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>(SWaP-C). Results will support the transition of viable technologies to higher levels of development and demonstration.</p> <p>Complete:</p> <ul style="list-style-type: none"> - Operational tests and support of electric "direct-injection" vehicle stopping prototypes over an extended duration of time in an operationally relevant environment to assess its effectiveness, suitability, maintainability, availability, and other performance indicators. Results from these extended operational tests now prescribe operationally suitable design and performance parameters for future directed energy (DE) vehicle stopping technologies. <p>Initiate:</p> <ul style="list-style-type: none"> - Integrate various human effects(HE) dose response studies into a generalized repel and thermodynamic model of relevant human effects that are safe for operational engagements with Non-lethal Weapon (NLWs) and Intermediate Force Capabilities (IFCs). - Prototype multiple long-range adaptive hardware and software systems; to validate Non-lethal Weapon (NLW) and Intermediate Force Capability (IFC) Directed Energy (DE) emissions are safely aimed on human targets. - Subsystem and component design and development of high peak-power, both for wide-band and for narrow-band Radio Frequencies (RFs), in support of longer range and more compact Non-Lethal Weapon (NLW) and Intermediate Force Capability (IFC) DE effects. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
Accomplishments/Planned Programs Subtotals		12.882	13.429	14.048	0.000	14.048
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	221.954	282.020	251.267	-	251.267	264.700	272.130	277.739	283.237	Continuing	Continuing
3346: <i>Future Naval Capabilities Adv Tech Dev</i>	0.000	211.335	254.020	251.267	-	251.267	264.700	272.130	277.739	283.237	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	10.619	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	38.619

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established to ensure the technological advantage of U.S. Naval forces. ONR manages the Department of the Navy's science and technology (S&T) research portfolio (Basic, Applied and Advanced Technology Development investments). This work includes the Future Naval Capabilities (FNC) program, which delivers technology solutions to known requirements and accelerates innovative technology insertion into Programs of Record (PORs). In close and structured coordination with POR Stakeholders (Combat Capability Development organizations, Operating Forces, and acquisition organizations), FNC efforts create revolutionary technology for PORs. ONR's S&T competencies create substantially higher levels of technology, trade space, and capability gain than acquisition can create within POR programmatic risk constraints. FNC projects create exponential technology improvement substantially cheaper than POR vendors do. The structured FNC process and its specific transition mechanisms manage technical risk and increase the likelihood that technologies systematically deploy to warfighters.

The efforts described in this Program Element (PE) 0603673N for FNC Advanced Technology Development use earlier research conducted in PE 0602750N for FNC Applied Research., and have follow-on transition funding commitments in the receiving acquisition Program of Record PEs. Using a competitive selection process, ONR and POR Stakeholders assess and select each effort in this PE based on its revolutionary technology payoff to the naval warfighter and prioritized operating force requirements. FNC requests from POR Stakeholders exceed funding available in the FNC Program and drive the competitive selection.

Due to the classified efforts in this PE, some have incomplete descriptions. ONR can provide additional information in classified documents.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy I BA 3: Advanced Technology Development (ATD)		PE 0603673N I Future Naval Capabilities Advanced Tech Dev			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	231.061	265.299	0.000	-	0.000
Current President's Budget	221.954	282.020	251.267	-	251.267
Total Adjustments	-9.107	16.721	251.267	-	251.267
• Congressional General Reductions	-	-0.217			
• Congressional Directed Reductions	-	-11.062			
• Congressional Rescissions	-	-			
• Congressional Adds	-	28.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-4.711	0.000			
• SBIR/STTR Transfer	-4.396	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	251.267	-	251.267
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Advanced Energetics Research					
Congressional Add: Development of Submersible Air Revitalization					
Congressional Add: Advanced lidar sensor and data processing					
Congressional Add: Electronic maneuver warfare unmanned sensors					
Congressional Add: Advance machine learning and artificial intelligence					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Funding: Decrease from FY22 to FY23 due to the completion in FY22 of multiple FNCs.					
Technical: not applicable					
Schedule: not applicable					

FY 2021	FY 2022
5.792	3.000
4.827	0.000
0.000	2.000
0.000	14.000
0.000	9.000
10.619	28.000
10.619	28.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
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 Future Naval Capabilities Advanced Tech Dev
FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev				Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3346: Future Naval Capabilities Adv Tech Dev	0.000	211.335	254.020	251.267	-	251.267	264.700	272.130	277.739	283.237	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The Future Naval Capabilities (FNC) Program exploits technology advances and responds quickly to Naval needs. As a result, future Budget Activity (BA) 3 investments supporting the FNC Program are made less than one year before commencing execution. Because FNCs start at higher Technology Readiness Levels (TRL), the typical duration of an FNC is 3-years. The FNC Program favors a high level of collaboration. Program Element R-2 Activities align to warfare areas where the FNC technologies will be integrated into acquisition programs of record.												
A complete accounting of FNC technologies and a full disposition of each technology development effort is provided annually to the Congressional oversight committees.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Capable Manpower (CMP) Articles: Description: The Capable Manpower R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts focus on all aspects of training, including accelerated learning, training environments, ready relevant training, and Live-Virtual-Constructive (LVC) training. FY 2022 Plans: N/A FY 2023 Base Plans: My Navy Foresight (MNF) - Initiate development of a web-based model that describes how changes in manpower, personnel, or training influence quantitative (e.g., retention targets) and qualitative (e.g., process improvements) outcomes. These will result in courses of action to make decision support faster and more precise than current processes. - Survey existing models for common and unique data and metadata, link to OPNAV N1's authoritative data environment and user interface, and develop modelling solutions. FY 2023 OCO Plans:								6.121	0.000	3.000	0.000	3.000
								-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY22 to FY23 is due to a new FNC being started in FY23 that will develop a capability to simultaneously map manpower, personnel, and training dynamics and outcomes, providing a rapid ability to assess a range of policy and operational decisions using a 'what if' scenario generation process.						
Title: Expeditionary Maneuver Warfare (EMW)		31.033	38.626	27.215	0.000	27.215
Articles:		-	-	-	-	-
Description: The Expeditionary Maneuver Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in PE 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. The advanced technologies being developed under this R-2 Activity include innovative naval mine, mine counter measures (MCM), mine delivery methods, and low observable mine neutralization technologies.						
FY 2022 Plans: Low Observable No Collateral Damage - Neutralization (LONCD-N) System: - Complete development and sea testing of charges, autonomy, 3D LiDAR and subsea wireless communications, and integrate with the Remotely Operated Vehicle (ROV). Conduct shallow water ocean experiments, demonstrations, and data collection with a fully integrated ROV system. Conduct end-to-end deep sea tests and demonstrations of autonomous attachment of mock charges to surrogate sea mines or critical infrastructure by the ROV system utilizing the 3D LiDAR and subsea wireless communications. Demonstrate additional explosive ordnance disposal missions with the ROV system.						
Compact Encapsulated Mine (C-ENCAP): - Continue activity on technologies for innovative naval mine and mine delivery methods, and integration of these technologies into integrated minefield planning optimization for mixed and multiple minefields. Specific effort includes subcomponent prototype construction, modelling and simulation of explosive characterization. Additional details are						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev	Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
classified.							
Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS): - Initiate development of a modular, closed-loop, non-towed, high temperature, superconducting magnet, coupled with a low-/non-towed acoustic source for use as a deployable influence mine-sweeping payload aboard any unmanned craft of opportunity.							
FY 2023 Base Plans: Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS): - Continue progress on the MAGNUSS advanced development model with: fabrication of the superconducting magnet and cryogenic cooling system, sub-scale Seneca Lake testing of the acoustic generator, and integration of the magnetic and acoustic payloads with a single command and control system interface to the MCM-USV or any craft of opportunity.							
Low Observable No Collateral Damage - Neutralization (LONCD-N) System: - Complete final demonstrations and sea testing for this FNC, which experienced execution delays in FY22 and needed to be extended into FY23 to finish.							
Compact Encapsulated Mine (C-ENCAP): - Compete design and prototype development for modular payload subcomponent integration, to include energetics characterization. Compete optimized deployment for minefield planning capability.							
Cognitive Router (CR): - Initiate development of the Cognitive Router, which is a clandestine AI-enabled, autonomous, undersea, low-latency cross-domain network. - Initiate development of an Artificial Intelligence / Machine Learning (AI/ML)-based cognitive engine for autonomous in-situ decision making for network discovery, link parameters optimization, link path optimization and supporting Autonomous behaviors for cooperative Unmanned Undersea Vehicle (UUV) autonomy (data exfiltration, path planning, obstacle and threat avoidance, and networking).							
FY 2023 OCO Plans:							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease from FY22 to FY23 is primarily due to the significant wind down of development activities associated with the Low Observable No Collateral Damage - Neutralization (LONCD-N) System and Compact Encapsulated Mine (C-ENCAP) FNCs, which are scheduled to finish in FY23.						
Title: Air Warfare (AW) Articles: Description: The Air Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include human machine interfaces for unmanned platforms and payloads that will assist with delegation of resources from one operator to another, airframe corrosion protection, and a Carrier Air Wing performance assessment tool that uses live, virtual, and constructive data to improve pilot and aircrew performance in near real-time. Different software efforts address unique and specific requirements. FY 2022 Plans: Cross-Domain Unmanned Systems (C-D UxS): - Complete C-D UxS effort by employing software in NAVAIR simulator and at Advanced Naval Technology Exercises (ANTX) to demonstrate, assess and mature software for Transfer of Tactical Control (ToTC) of Unmanned Vehicles (UxVs), payloads or data. Demonstrate the implementation of ToTC through a Human Machine Interface that works through the PMA-281 Command Control System Program of Record. Extend C-D UxS ToTC concepts to specifically address requirements of MQ-25 unmanned air vehicle. Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS): - Complete effort by testing FAM2OUS performance measures in relevant simulation environment to quantify impact on mission effectiveness. Test and evaluate the FAM2OUS software toolkit with Advanced Tactics models implemented in the		50.537 -	53.462 -	44.069 -	0.000 -	44.069 -

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Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Next Generation Threat System (NGTS) at the Integrated Training Facility (ITF) in support of the Integrated Air Defense Course (IADC).						
Solid State Structural Repair (S3R): - Complete development by finalizing special tooling design required to enable in-situ repair, conducting the necessary validation and verification to enable flight clearance approval, demonstrating in-situ repair across multiple platforms (V-22 and F/A-18) and parts, including flight critical components, and conducting flight operations.						
Rapid Adaptive Planning for Time-Sensitive Offensive Responsive Strike (RAPTORS): - Complete development of dynamic tactical mission planning tools. Specific focus on integration into micro service architecture, software delivery and laboratory demonstration.						
Dynamic INtegrated Operations (DINO): - Complete development of software components that work with the Next Generation Naval Mission Planning System (NGNMPS) to enable a decision engagement environment for continuous over-the-horizon (OTH) weapon employment while ensuring targeting chain-of-custody is maintained. Additional details are classified.						
Electromagnetic Maneuver Warfare Resource Allocation Management (EMW RAM): - Complete development and demonstrate prototype algorithms and integrated software technologies for own-platform and multi-platform resource and task management of EW systems that enable autonomous distributed airborne EW operations at naval tactical ranges and timelines.						
Advanced Capability Expansion (ACE): - Complete the development of hardware and software and demonstrate via ground and flight test capabilities that focus on extended range targeting and radar electronic attack protection for the E2-D Advanced Hawkeye APY-9 Radar Sub-System.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev	Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Additional details are classified.							
Enhanced Lethality for Maritime Operations (ELMO): - Continue development of ELMO performing Counter Electronic Attack (CEA)-1/2 build 1 surrogate flight test and analysis. Procure Hardware Processing Bench and Software Development for Advanced CEA Mode Development. Initiate development of CEA-2 Bld-2. Additional details are classified.							
Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS): - Continue development of enhanced, Precise Ship-Relative Navigation (PS-RN) for reliable autonomous ship recovery of Unmanned Aerial Systems (UAS) in all weather, high deck motion environments. Specific focus on preliminary designs, down select to single vendor and prototype laboratory demonstrations. Additional details are classified.							
Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT): - Initiate development of a computational model of the living warfighter that enables prediction of injury risk for both acute traumatic and chronic repetitive operational exposures.							
FY 2023 Base Plans: Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT): - Continue integration of I-PREDICT human digital twin into digital engineering efforts for design of platforms (e.g., future vertical lift helicopter, F-18 and F-35) and equipment (e.g., ejection and crew seats, casualty litter support systems, helmets and body armor). - Continue development of a multi-physics computational model that combines a structural human body model with a dynamic musculoskeletal model that enables prediction of injury risk for both acute traumatic and chronic repetitive operational exposures. The human digital twin will represent both males and females across a range of body sizes and postures.							
Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS): - Complete final testing of the FAM2OUS deliverables, which experienced execution delays in FY22, delaying its completion into FY23.							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Enhanced Lethality for Maritime Operations (ELMO): - Complete development of ELMO Counter Electronic Attack (CEA) builds 1 through 3. Complete laboratory and flight demonstration and analysis of Advanced CEA modes, builds 2 and 3. Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS): - Complete development of enhanced, Precise Ship-Relative Navigation (PS-RN) for reliable autonomous ship recovery of Unmanned Aerial Systems (UAS) in all weather, high deck motion environments with single vendor selected in FY22. Develop prototype to be used in the Joint Precision Approach & Landing System (JPALS) shore based test site with a surrogate aircraft refined by lessons learned from FY22 prototype laboratory bench test results. Execute shore based prototype test with surrogate aircraft and use results to prepare for CVN test as graduation exercise. Digital Expanded Ultra-High Frequency (UHF) Multiple Input, Multiple Output (MIMO) Optimized Radar (DEUMOR): - Initiate development of high-value signal processing, MIMO, Cognitive & Advanced Space-Time-Adaptive Processing (STAP) algorithms, and advanced antenna technologies for airborne surveillance platforms. - Initiate planning for flight-testing of prototype hardware & software. Prediction of Regional Operational Propagation of HF for EMSO Tactics (PROPHET): - Initiate the development of a high frequency communications planning tool to optimize maritime and shore-based distributed communications that accounts for variability and impact of ionospheric conditions. TEDSat: - Initiate development of a low size, weight, power, and cost electronic warfare payload with required on-board processing to provide a persistent capability not currently available to DoD users. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease FY 2022 to FY 2023 is due to the completion in FY22 of the Cross-Domain Unmanned Systems (C-D UxS), Solid State Structural Repair (S3R), Dynamic INtegrated Operations (DINO), RAPTORS,						

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Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Electromagnetic Maneuver Warfare Resource Allocation Management (EMW RAM), and Advanced Capability Expansion (ACE) FNCs.						
Title: Information Warfare (IW)		39.942	55.372	58.402	0.000	58.402
Articles:		-	-	-	-	-
Description: The Information Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts provide Information Warfare capabilities across several disparate uses and environments.						
FY 2022 Plans:						
The increase in Information Warfare funding from FY 2021 to FY 2022 is primarily due to the initiation of three high priority FNCs in FY 2022: MACE, DF-MOTF, and SI^2. The initiation of Multi-Beam Array for Cooperative Engagement (MACE) will provide the first fully digital communications system in the fleet, and the design of this communications system will be adaptable for other shipboard and expeditionary systems. The initiation of a fully informed Data Framework for the Maritime Operations Centers of the Future (DF-MOTF) is a significant Fleet priority for warfighting that can only be discussed in a classified forum. The initiation of the SLQ 32 Signal Identification Improvements (SI^2) FNC will increase the survivability of surface platforms by making urgently needed improvements to the Navy's Electronic Warfare program of record.						
Extended Range - Directional Frequency Analysis and Recording (ER-DIFAR) Sonobuoy: - Complete development and testing of an A-size passive sonobuoy system capable of delivering the required array gain for target detection, localization, and measurement at the required range.						
Advanced Naval Super Wideband Energy Receiver (ANSWER): - Complete development of advanced algorithms and signal processing capabilities for integration with next-generation, super-wide bandwidth recording systems. Demonstrate the capability in the field for rapid technology insertion into naval systems. Additional details are classified.						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Water-space Planning and Execution for Theater Undersea Warfare (WasP-ET):</p> <p>- Continue development of a dynamic and adaptive Prevention of Mutual Interference/Water Space Management (PMI/WSM) application that delivers a new weapons engagement planning capability for Anti-Submarine Warfare (ASW) scenarios. Continue the development of machine learning and optimization algorithms that automatically de-conflicts blue on blue weapon engagements while dynamically assigning blue on red engagements based on exploited intelligence information and tactical contact reporting to generate probabilistic estimates of target location, intended mission, and projected location.</p> <p>Long Endurance Airborne Platform (LEAP) Decoy:</p> <p>- Continue development of LEAP Technologies. Due to FY21 funding cuts, FY22 Plans have been compressed with the CounterMeasure (CM) preliminary design review scheduled in the 1st Quarter, followed by detailed design, which will include the launcher. Planned risk reduction tests will include a chamber test measuring antenna isolation performance. CM component and integration tests will be conducted and test plans will be developed for tethered and untethered flight tests of two prototypes.</p> <p>DECAF:</p> <p>- Continue DECAF by finishing the underlying analysis and continuing development of a new information warfare capability for a field demonstration. Additional details are classified.</p> <p>Data Framework for Maritime Operations Center of the Future (DF-MOTF):</p> <p>- Additional details are classified.</p> <p>Multi-Beam Array for Cooperative Engagement (MACE):</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate development of a new fully digital, multichannel, multi-beam, communications capability for the Navy's Cooperative Engagement Capability (CEC) to enable significantly more targets to be tracked and engaged.</p> <p>SLQ 32 Signal Identification Improvements (SI^2):</p> <p>- Initiate development of new technology that extends existing machine learning based electronic warfare classification systems and expands their capabilities to detect and more accurately characterize modern emitters not accurately captured with existing systems.</p> <p>FY 2023 Base Plans:</p> <p>DECAF:</p> <p>- Continue DECAF development based on underlying analysis done in FY22 to determine effectiveness of a new information warfare capability with test and demonstration events. Initiate transition process into a Program of Record. Additional details are classified.</p> <p>Data Framework for Maritime Operations Center of the Future (DF-MOTF):</p> <p>- Continue to transform Command and Control Decision Making by setting the foundation for artificial intelligence and machine learning big data analytics by consuming data from a single repository with multiple classifications. Continue to develop a multi-level security middleware software tier for Battle Management Aids, Tactical Decision Aids, and Planner applications. Continue to develop middleware containerization software novel solutions to more efficiently use central processing unit and memory resources than typical virtual machine or bare metal deployments that unnecessarily add operating system overhead.</p> <p>Multi-Beam Array for Cooperative Engagement (MACE):</p> <p>- Continue development of a new fully digital, multichannel, multi-beam, communications capability for the Navy's Cooperative Engagement Capability (CEC) to enable significantly more targets to be tracked and engaged.</p> <p>SLQ 32 Signal Identification Improvements (SI^2):</p> <p>- Continue SI2 development and evaluation of new technology to extend machine learning based electronic warfare classification systems in order to improve their capabilities to detect and more accurately characterize modern emitters that are not accurately captured with existing systems.</p> <p>Water-space Planning and Execution for Theater Undersea Warfare (WasP-ET):</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete development of a new capability for Theater Undersea Warfare Commanders to plan and execute theater Anti-Submarine Warfare operations that eliminates all risk of fratricide and collision with known submerged bodies. Complete development of analytic tools to shorten Commander's decision cycle by automatically gathering, synthesizing, and analyzing data; making recommendations for platform and sensor movement and placement to either avoid or locate adversary submarines. Transitioned to Undersea Warfare-Decision Support System program of record.</p> <p>Long Endurance Airborne Platform (LEAP) Decoy:</p> <p>- Complete development of the LEAP prototype countermeasure vehicle and payload to demonstrate a low size, weight and power (SWaP), long endurance, unmanned, expendable EW decoy capability. Finalize integration efforts started in FY22 and conduct tethered and untethered flight tests of the integrated system. Measure detailed antenna and payload performance in a chamber test to verify that the measured technical performance parameters meet system requirements.</p> <p>Data on the Move (DotM):</p> <p>- Initiate the Data on the Move FNC with three awards to commercial and government performers by conducting applied research to efficiently exchange information and integrate large amounts of data in real time among distributed commands.</p> <p>- Initiate technology development planning to establish a preliminary design for an initial operational prototype, conduct a stakeholder review of the system approach, and commence development of the initial prototype to support multiple warfighting domains.</p> <p>MAGICO:</p> <p>- Initiate development of an innovative orchestration application based on modeling and simulation for coordinated employment of information warfare capabilities. Identify technical performance parameters and system requirements through planning and stakeholder engagements to establish a preliminary design of a prototype that provides outputs to shorten decision cycles while meeting operational intent.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The increase from FY 2022 to FY 2023 is due primarily to the initiation in FY23 of the Data on the Move (DotM) and MAGICO FNCs.						
Title: Surface Warfare (SW)		38.927	49.876	55.334	0.000	55.334
Articles:		-	-	-	-	-
Description: The Surface Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include technologies that will provide mission visualization, network analysis, and training for operators in denied and degraded environments.						
FY 2022 Plans: The increase in Surface Warfare from FY 2021 to FY 2022 is primarily due to the initiation of three high priority FNCs in FY22: ASPIRE, Amon Hen and CHAOS. Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE) will improve operations in highly contested and environmentally complex waters by increasing the Navy's capability for distributed maritime operations and long-range targeting. Amon Hen will provide the Fleet with improved situational awareness, increasing the survivability of the High Value Unit while it operates in EMCON. Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS) will increase the lethality of conventional weapon projectiles. Several efforts involving the SPY-6 each involve unique, specific, and needed aspects of the entire system.						
Fleet Training Technologies (FleeT2): - Complete development of FleeT2 by extending simulations and training technologies to include models for theater specific operations in denied/degraded environments (D2E) for Strike Group Warfare Commanders. This includes developing						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
D2E training interventions and adapted models for Strike Group Commanders and additional D2E models that address anticipated adversarial tactics and techniques for strike group training and certification.						
Receive-Only Cooperative Radar (ROCR): - Complete development of a receive-only capability for the SPY-6 product line that improves situational awareness during Emissions Control (EMCON) and improves radar timelines with advanced waveforms for communications and radar operations.						
Hypersonic-threat Dynamic Reassessment and Adaptation (HyDRA): - Complete development of modifications to the AEGIS Weapon System. Additional details are classified.						
Robust Combat Power Control (RCPC): - Continue to develop and implement the control layers of the shipboard Tactical Energy Management as described in the 2019 Electric Ships Technology Development Roadmap, with the FY22 focus being on the controls implementation on a notional ship reference system instantiated using a Power Hardware In-the-Loop (PHIL). This effort will enable shipboard power for future electric weapons.						
Empire: - Continue development of efficient computational techniques for signal processing on SPY-6 for a heterogeneous processing framework, improving resilience and situational awareness in contested electromagnetic environments and increasing the capacity for distributed maritime operations and the survivability of platforms.						
Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE): - Initiate development of new technology that increases the performance and reduces the size, weight, power and cost of						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
the SPY-6 digital receiver and exciter, beam-former and backend signal processor to counter the proliferation of advanced threats and support distributed radar network operations within contested waters.						
Amon Hen: - Initiate development of a low cost portable multi-sensor multi-function C5ISR-T capability that is supports a maneuverable illuminator for unmanned surface vehicles that is compatible with SPY-6 and other radars receiving apertures.						
Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS): - Initiate development of the capability to integrate High Density Reactive Material (HDRM) into conventional ammunition.						
FY 2023 Base Plans: Empire - Continue development of Empire, finalizing and demonstrating a software build leveraging SPY-6 backend signal processing in a simulated environment, which will show distributed functions against simulated targets. - Initiate development of a software build for over-the-air testing with surrogate SPY-6 aperture hardware, which will demonstrate distributed capabilities against surrogate targets.						
Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE): - Continue Iteration 1 hardware design, fabrication and demonstration of next generation SPY-6 digital receiver exciter (DREX) electronics with improved waveform generation capabilities. - Initiate Iteration 2 DREX hardware design, fabrication and demonstration. - Continue fabricating heterogeneous computing (HC) hardware and software design for next generation SPY-6 digital beamformer (DBF). - Initiate DBF subsystem integration and demonstration. - Continue to develop representative functions for HC-based SPY-6 signal processor and adaptive digital beamforming (ADBF) electronics. - Document new DREX and HC design performance and space, weight, and power-cooling (SWaP-C) benefits.						
Amon Hen:						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<div>- Continue Amon Hen development, holding a critical design review of prototype radar illuminator and initiating fabrication of the illuminator aperture and supporting equipment.</div> <div>- Complete the initial build of government-owned backend scheduler software for the illuminator design.</div> <div>- Integrate multi-INT apertures and X-band surface search radar into a modular payload with data fusion processor, then conduct afloat testing on an available surface platform.</div> <div>Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS):</div> <div>- Continue development of HDRM into Navy Conventional Ammunition. Further develop the Damaged State Modeling capability for representative targets engaged by Navy Conventional Ammunition. Include comparative analyses of baseline (kinetic energy only) and HDRM (kinetic & reactive energy) ammunition behavior in the Damaged State Models.</div> <div>Receive-Only Cooperative Radar (ROCR):</div> <div>- Complete development of this FNC, which experienced execution delays in FY22 and needed to be extended into FY23 to complete S&T development and deliver its technology to acquisition.</div> <div>- Complete over-the-air testing of ROCR software build on SPY-6 surrogate apertures.</div> <div>- Demonstrate receive-only functions and radar communication functions against surrogate targets.</div> <div>Hypersonic-threat Dynamic Reassessment and Adaptation (HyDRA):</div> <div>- Complete development of HyDRA, which experienced schedule delays in FY22 and needed to be extended into FY23 to complete S&T development and deliver its technology to the AEGIS Weapon System.</div> <div>Robust Combat Power Control (RCPC):</div> <div>- Complete this FNC with development and implementation of the control layers of the shipboard Tactical Energy Management as described in the 2019 Electric Ships Technology Development Roadmap. The FY23 focus will transition the developmental controls implementation from a notional ship reference system instantiated using a Power Hardware In-the-Loop (PHIL) onto an Integrated Power and Energy System Test Facility (ITF) under development at NSWC PD in support of DDG(X) electrical machinery system testing. The goal would be to confirm FNC exit criteria were met using results of testing conducted.</div> <div>Multi-Spectral High Resolution Targeting Sensor (MUST HITS)</div> <div>- Initiate development of a Digital Read Out Integrated Circuit (DROIC) mated with a high-resolution infrared sensor for detection and tracking of difficult targets.</div>						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Rough Patch III - Initiate development of a counter Intelligence, Surveillance and Reconnaissance (ISR) prototype. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY 2022 to FY 2023 is due primarily to the initiation of the Multi-Spectral High Resolution Targeting Sensor (MUST HITS) and Rough Patch III FNCs in FY23.							
Title: Undersea Warfare (UW) Articles: Description: The Undersea Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include improvements to a broad range of undersea warfare capabilities, including undersea weapons, submarine acoustic sensing and signal processing systems, communications, electro-optics systems, signature management, training, and decision aids. FY 2022 Plans: The increase in Undersea Warfare from FY 2021 to FY 2022 is primarily due to the ramp up of technology development efforts for the VIPB FNC and the initiation in FY 2022 of two high priority FNCs: M2P2 and M&M. The VIRGINIA Improved Propulsion Bearing (VIPB) is a highly important FNC for the submarine program that reduces Risk reduction for the COLUMBIA class submarine. Commencing the manufacturing of a full-scale prototype bearing and starting the fabrication of the scale shaft-line test bed in FY22 are the reasons this FNC's cost went up substantially. The Multi-Material Propeller Prototype (M2P2) will reduce the weight of submarine propellers enabling greater payload fraction/speed and will reduce the cost of Fleet operations as it will be removable and repairable without needing to dry-dock. The MK-48 Acoustic Modifications (M&M) FNC will substantially improve this heavyweight torpedo's probability of kill. Stern Area System (SAS):			44.775 -	56.684 -	63.247 -	0.000 -	63.247 -

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022					
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue analysis of FY21's first SAS at-sea trial. Analysis will include the evaluation of SAS system hardware and software performance, and preparations for a full functional SAS demonstration at sea in FY23. Additional details are classified.</p> <p>Diver Augmented Vision Display with Enhanced Communications (DAVD):</p> <p>- Complete development of DAVD by coordinating demonstration and acceptance testing with NAVSEA OOC and Fleet Units as the system migrates to DAVD Gen 3. Working with Fleet and Technical Representatives; develop preventive maintenance plans for the entire DAVD System (topside box, tether and Helmet system to include integrated sonar systems) and integrate procedures into the Navy Preventive Maintenance System (PMS).</p> <p>Avalanche:</p> <p>- Complete this activity on undersea persistence and infrastructure. The prototyping of long endurance autonomy and hardware solutions for fixed and deployable energy sources and heterogeneous communication networks will be complete and a system of systems design package complete.</p> <p>Submarine Propagation Channel Assessment & Prediction (subPCAP):</p> <p>- Complete software integration of the environmental assessment and prediction module within the BLQ-10 and APB programs.</p> <p>Compact Rapid Attack Weapon (CRAW) Upgrade:</p> <p>- Continue this FNC with an in-water demonstration of the Anti-Submarine Warfare (ASW) capability with a submarine launched CRAW.</p> <p>Advanced Broadband Navigation Sonar System (ABNSS):</p>								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev	Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Complete development and transition of new sonar waveforms for the submarine force for employment in the navigation sonar system to improve performance and reduce operational constraints.</p> <p>VIRGINIA Improved Propulsion Bearing (VIPB):</p> <p>- Continue this FNC with the FY22 focus to include the start of manufacturing of the full-scale VIRGINIA prototype bearing and the start of fabrication of components of the scale shaft-line test bed. Additional details are classified.</p> <p>Submarine Tethered Expendable Buoy:</p> <p>- Continue development of buoy prototype by testing sensor payload, fiber deployment, and launcher.</p> <p>Multi-Material Propeller Prototype (M2P2)</p> <p>- Initiate development of techniques for incorporating multi-materials into propeller design to reduce propeller weight, while providing the required thrust. Benefits include greater ship design flexibility and reduced cost to the Fleet for operations and repair. Additional details are classified.</p> <p>MK-48 Acoustic Modifications (M&M)</p> <p>- Initiate development of acoustic modifications to the MK-48 torpedo that will improve the weapon's probability of kill.</p> <p>FY 2023 Base Plans:</p> <p>VIRGINIA Improved Propulsion Bearing (VIPB):</p> <p>- Continue bearing development. Complete bearing detailed design and critical design review. Complete manufacturing and testing of bearing subcomponents. Continue preparation of manufacturing drawings and purchase of long-lead materials. Conduct test planning for land-based test of the full-scale bearing concept (test scheduled 1QFY26).</p> <p>Multi-Material Propeller Prototype (M2P2)</p> <p>- Continue material coupon and building block testing.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev		Project (Number/Name) 3346 / Future Naval Capabilities Adv Tech Dev		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none">- Initiate and complete full scale 688 prototype mechanical concept design.- Initiate full scale 688 prototype mechanical detailed design.- Conduct 1/10th scale testing of full scale 688 prototype hydrodynamic design.- Conduct preliminary design review for full scale 688 prototype design. <p>MK-48 Acoustic Modifications (M&M)</p> <ul style="list-style-type: none">- Continue development of acoustic modification component designs. Down-select components to prototype manufacture. Validate improvements via physics based models and experimental in water measurements. <p>Stern Area System (SAS):</p> <ul style="list-style-type: none">- Complete this FNC with analysis of at-sea trial data, and update systems models and software for second at-sea trial. Prepare and execute full function SAS second at-sea trial events to verify system performance. Conduct and document analysis of full function SAS performance. <p>Compact Rapid Attack Weapon (CRAW) Upgrade:</p> <ul style="list-style-type: none">- Complete this FNC with a final in-water demonstration of a CRAW launch from a submarine. Complete modifications to submarine fire control that are needed for the CRAW launch demonstration. Complete demonstration of CRAW Anti-Submarine Warfare (ASW) capability. <p>Submarine Tethered Expendable Buoy:</p> <ul style="list-style-type: none">- Complete this FNC by completing development of the buoy prototype and conducting final testing of the sensor payload, fiber deployment, and launcher under operational conditions. <p>Own Ship Acoustic Monitoring (OSAM)</p> <ul style="list-style-type: none">- Initiate efforts to execute an FY23 at-sea demo to collect data for software development.- Begin development of prototype vulnerability decision aid and monitoring system. <p>Untethered Goat (U GOAT)</p> <ul style="list-style-type: none">- Initiate development of a multifunction Intelligence, Surveillance and Reconnaissance (ISR) payload for Unmanned Underwater Vehicles to support distributed maritime operations. <p>FY 2023 OCO Plans:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</i>		Project (Number/Name) 3346 / <i>Future Naval Capabilities Adv Tech Dev</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A						
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase from FY 2022 to FY 2023 is primarily due to the initiation of two new Undersea Warfare FNCs that will provide an acoustic monitoring system for the next nuclear submarine class and identify feasible modifications to upgrade the monitoring system of current submarine classes, and develop a new payload and software for the Medium Unmanned Undersea Vehicle (UUV) Program.						
Accomplishments/Planned Programs Subtotals		211.335	254.020	251.267	0.000	251.267
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603673N / Future Naval Capabilities Advanced Tech Dev				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	10.619	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	38.619
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other projects												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Advanced Energetics Research								5.792	3.000			
FY 2021 Accomplishments: FY21 funds will be used toward the advanced demonstration of energetic materials in weapon system applications to include: high performance solid rocket propulsion, advanced liquid fuels for air breathing weapon system propulsion, novel advanced warhead demonstrations focused on advanced ship defeat capabilities, and the demonstration of modeling and simulation capabilities to predict weapon system lethality and effectiveness specifically accounting for non-traditional lethal effects and the quantification of their damage potential on adversary weapon systems.												
FY 2022 Plans: Conduct advanced energetics technology development												
Congressional Add: Development of Submersible Air Revitalization								4.827	0.000			
FY 2021 Accomplishments: Conducted advanced technology development of submersible air revitalization.												
FY 2022 Plans: N/A												
Congressional Add: Advanced lidar sensor and data processing								0.000	2.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct advanced lidar sensor and data processing advanced technology development												
Congressional Add: Electronic maneuver warfare unmanned sensors								0.000	14.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct electronic maneuver warfare unmanned sensors advanced technology development												
Congressional Add: Advance machine learning and artificial intelligence								0.000	9.000			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct advance machine learning and artificial intelligence advanced technology development		
Congressional Adds Subtotals	10.619	28.000

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy **Date:** April 2022

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy I BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603680N / <i>Manufacturing Technology Program</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	58.437	77.236	60.704	-	60.704	61.843	63.115	64.403	65.691	Continuing	Continuing
1050: <i>Manufacturing Tech</i>	0.000	58.437	57.236	60.704	-	60.704	61.843	63.115	64.403	65.691	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	0.000	20.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.000

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to foster scientific research for the advancement of naval power. This work does not stop at the laboratory. Delivery of breakthrough capability often requires new technologies in manufacturing and supply chains of national security. 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)/COLUMBIA Class submarine (CLB); DDG 51 Class destroyer; CVN 78 Class carrier; FFG 62 Class frigate, and F-35 Lightning II aircraft. Office of Naval Research (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. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022		
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 Manufacturing Technology Program				
B. Program Change Summary (\$ in Millions)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		59.861	57.236	0.000	-	0.000
Current President's Budget		58.437	77.236	60.704	-	60.704
Total Adjustments		-1.424	20.000	60.704	-	60.704
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	20.000			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-1.424	0.000			
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	60.704	-	60.704
Congressional Add Details (\$ in Millions, and Includes General Reductions)						
Project: 9999: Congressional Adds						
Congressional Add: Energetics processing						
Congressional Add: Chemical reactor and crystallizer technology						
Congressional Add Subtotals for Project: 9999						
Congressional Add Totals for all Projects						
Change Summary Explanation						
Funding: no significant change						
Technical: Not applicable						
Schedule: Not applicable						

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603680N / <i>Manufacturing Technology Program</i>				Project (Number/Name) 1050 / <i>Manufacturing Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
1050: <i>Manufacturing Tech</i>	0.000	58.437	57.236	60.704	-	60.704	61.843	63.115	64.403	65.691	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to foster scientific research for the advancement of naval power. This work does not stop at the laboratory. Delivery of breakthrough capability often requires new technologies in manufacturing and supply chains of national security. 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)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. Through its affordability efforts, 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. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Composites Processing and Fabrication	7.730	7.932	7.877	0.000	7.877
Articles:	-	-	-	-	-
<p>Description: The primary technical goal of the Composites Processing and Fabrication activity is improving weapon systems affordability, enhancing weapon system effectiveness and improving reliability/warfighter 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)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.</p> <p>Composites processing and fabrication technology areas include but are not limited to fiber-reinforced polymeric (organic) resin composites; ceramic-matrix, metal-matrix, and carbon-carbon composites; composite internal stiffening core materials such as foam, ceramic, balsa wood, polymeric or metallic honeycomb, or other</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program	Project (Number/Name) 1050 / Manufacturing Tech				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>materials; composite external stiffening concepts such as hat and blade stiffeners and methodologies to manufacture them; materials for radomes and other electrical applications; composite manufacturing and similar processes and related equipment technology; and adhesives, adhesive bonding, and related technologies (i.e., surface preparation techniques), as well as mechanical fastening, and other methodologies for joining composites to other composites or metals, and similar assembly technologies.</p> <p>FY 2022 Plans:</p> <p>- Continue to develop and transition composites manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35.</p> <p>- Continue to develop and transition composites manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) transparencies for the F-35 Lightning II aircraft, (2) submarine coatings, (3) flares, and (4) High Energy Laser (HEL) weapon systems.</p> <p>FY 2023 Base Plans:</p> <p>- Continue to develop and transition composites manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG 62 (formerly FFG(X)), and F-35.</p> <p>- Continue to develop and transition composites manufacturing technology improvements that accelerate capability to the fleet. Areas of FY23 concentration include (1) SWARM/unmanned/autonomous vehicle production, (2) advanced submarine fabrication technology, (3) fleet sustainment technology (ships/aircraft), (4) hypersonics production, and (5) other ONR manufacturing acceleration efforts.</p> <p>FY 2023 OCO Plans:</p> <p>N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p> <p>There is no significant funding change from FY 2022 to FY 2023.</p>							
<p>Title: Electronics Processing and Fabrication</p> <p style="text-align: right;">Articles:</p> <p>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.</p>			11.596 -	11.898 -	11.816 -	0.000 -	11.816 -

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program		Project (Number/Name) 1050 / Manufacturing Tech		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Emphasis is on affordability for the following platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.						
Electronics processing and fabrication technology areas include but are not limited to Electronics manufacturing technology (materials, devices, circuits, modules, subsystems); semiconductor devices/vacuum electronics/passive components; compound semiconductors/wide bandgap semiconductors; low-cost, high-throughput manufacturing and assembly techniques; nanoelectronics; electronics packaging technologies (including tamper proof and non-hermetic approaches); optics manufacturing technology (materials devices, circuits, modules, subsystems); optical interconnects; fiber optics and photonics; technologies for electronics and electro-optics testing and evaluation; optical imaging for manufacturing operations; and High Energy Laser (HEL)/directed energy weapons.						
FY 2022 Plans: - Continue to develop and transition electronics and electro-optics manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Continue to develop and transition electronics and electro-optics manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) High Energy Lasers (HEL) weapon systems, (2) Surface Electronic Warfare Improvement Program (SEWIP) for FFG(X) and Large Surface Combatant, and (3) unmanned vehicles.						
FY 2023 Base Plans: - Continue to develop and transition electronics and electro-optics manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG 62 (formerly FFG(X)), and F-35. - Continue to develop and transition electronics and electro-optics manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) SWARM/unmanned/autonomous vehicle production, (2) High Energy Laser (HEL) weapon systems/directed energy, (3) fleet sustainment technology (ships/aircraft), and (4) other ONR manufacturing acceleration efforts.						
FY 2023 OCO Plans:						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program		Project (Number/Name) 1050 / Manufacturing Tech				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A								
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.								
Title: Metals Processing and Fabrication				11.596	11.898	11.816	0.000	11.816
Articles:				-	-	-	-	-
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. Emphasis is on affordability for the following platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.								
This activity also includes the development, optimization, and transition of repair technology for the repair, overhaul, and sustainment of key navy systems. Metals processing and fabrication technology areas include but are not limited to: processing methods; metals additive manufacturing; metallic materials-based systems; casting; joining techniques; machining; surface and heat treatments; coating/cladding; assembly; metal/non-metals interfaces issues; and inspection and compliance verification.								
FY 2022 Plans:								
- Continue to develop and transition metals manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35.								
- Continue to develop and transition metals manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) High Energy Lasers (HEL) weapon systems and (2) unmanned vehicles.								
- Continue Repair Technology (RepTech) Thrust to develop, optimize, and transition repair technology for key naval platforms at depots and logistics centers.								
FY 2023 Base Plans:								
- Continue to develop and transition metals manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG 62 (formerly FFG(X)), and F-35.								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program		Project (Number/Name) 1050 / Manufacturing Tech		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to develop and transition metals manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) SWARM/unmanned/autonomous vehicle production, (2) advanced submarine fabrication technology, (3) fleet sustainment technology (ships/aircraft), and (4) other ONR manufacturing acceleration efforts.</p> <p>- Continue Repair Technology (RepTech) Thrust to develop, optimize, and transition repair technology for key naval platforms at depots and logistics centers.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>						
<p>Title: Manufacturing Enterprise/Other</p> <p>Articles:</p> <p>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) energetics 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)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.</p> <p>Manufacturing enterprise technology areas include, but are not limited to design for easier production/design for manufacturability; development of build/assembly strategies; modeling and simulation technologies; model-based tools and approaches to optimize ease of production; 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; streamlining of outfitting operations; prediction and reduction of welding distortion; advanced automation and</p>		27.515 -	25.508 -	29.195 -	0.000 -	29.195 -

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program	Project (Number/Name) 1050 / Manufacturing Tech				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
robotics for manufacturing; advanced data analytics, artificial intelligence and machine learning for production environments; and inspection technologies such as digital radiography and ultrasonic 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).						
FY 2022 Plans: - Continue at a reduced level to develop and transition advanced manufacturing enterprise technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Continue to develop and transition advanced manufacturing enterprise technology improvements that accelerate capability to the fleet. An area of concentration includes manufacturing improvements for unmanned vehicles. - Continue to develop and transition energetics manufacturing technology improvements that result in cost reduction for Naval Systems. - Continue to develop and transition energetics manufacturing technology improvements that accelerate capability to the fleet. An area of concentration includes manufacturing improvements for flares and energetics.						
FY 2023 Base Plans: - Continue, at an increased level, to develop and transition advanced manufacturing enterprise technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG 62 (formerly FFG(X)), and F-35. - Continue to develop and transition advanced manufacturing enterprise technology improvements that accelerate capability to the fleet. Areas of concentration include (1) SWARM/unmanned/autonomous vehicle production, and (2) fleet sustainment technology (ships/aircraft). - Continue to develop and transition energetics manufacturing technology improvements that result in cost reduction for Naval Systems.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603680N / <i>Manufacturing Technology Program</i>		Project (Number/Name) 1050 / <i>Manufacturing Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Continue to develop and transition energetics manufacturing technology improvements that accelerate capability to the fleet. An area of concentration includes energetics production improvement.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The funding increase from FY 2022 to FY 2023 is due to increased investment and associated research in manufacturing enterprise technology improvements supporting platform affordability initiatives.</p>						
Accomplishments/Planned Programs Subtotals		58.437	57.236	60.704	0.000	60.704
C. Other Program Funding Summary (\$ in Millions)						
N/A						
Remarks						
D. Acquisition Strategy						
<p>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)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, FFG 62 Class frigate, and F-35 Lightning II aircraft. A smaller portion of ManTech's budget (approximately 20%) is directed towards capability acceleration -- manufacturing acceleration of key technologies to enable transition of these technologies to the fleet more quickly.</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603680N / Manufacturing Technology Program				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	0.000	20.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.000
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Energetics processing								0.000	5.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct energetics processing advanced technology development												
Congressional Add: Chemical reactor and crystallizer technology								0.000	15.000			
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct chemical reactor and crystallizer technology advanced technology development												
Congressional Adds Subtotals								0.000	20.000			
C. Other Program Funding Summary (\$ in Millions) N/A												
Remarks												
D. Acquisition Strategy N/A												

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	31.978	40.435	4.999	-	4.999	5.100	5.202	5.306	5.412	Continuing	Continuing
2914: Warfighter Protection Adv Tech	0.000	4.659	4.935	4.999	-	4.999	5.100	5.202	5.306	5.412	Continuing	Continuing
9999: Congressional Adds	0.000	27.319	35.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	62.819

A. Mission Description and Budget Item Justification

This PE supports the advanced development and demonstration of technologies to improve warfighter performance, safety and survivability. Naval investment in these areas is essential in order to improve the ability to enhance, maintain, and sustain Warfighter effectiveness.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of Naval basic and applied research, and advanced technology development investments to ensure Naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	33.120	4.935	0.000	-	0.000
Current President's Budget	31.978	40.435	4.999	-	4.999
Total Adjustments	-1.142	35.500	4.999	-	4.999
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	35.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.142	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy			Date: April 2022	
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		
• Adjustments to Budget Year		-	-	4.999
Congressional Add Details (\$ in Millions, and Includes General Reductions)				
Project: 9999: Congressional Adds				
Congressional Add: Novel Therapeutic Interventions Research		3.8610.000		
Congressional Add: Bone Marrow Registry Program		23.45826.500		
Congressional Add: Warfighter resilience and readiness		0.0004.000		
Congressional Add: Dynamic modular manufacturing		0.0005.000		
Congressional Add Subtotals for Project: 9999		27.31935.500		
Congressional Add Totals for all Projects		27.31935.500		
Change Summary Explanation				
Funding: No significant change.				
Technical: Not applicable.				
Schedule: Not applicable.				

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2914: Warfighter Protection Adv Tech	0.000	4.659	4.935	4.999	-	4.999	5.100	5.202	5.306	5.412	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Program Element supports the advanced development and demonstration of technologies to improve warfighter performance, safety and survivability. Naval investment in these areas is essential in order to improve the ability to enhance, maintain, and sustain Warfighter effectiveness.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Naval Noise-Induced Hearing Loss (NIHL) and Warfighter Performance	4.659	4.935	4.999	0.000	4.999
Articles:	-	-	-	-	-
<p>Description: Improve technologies in Warfighter performance and protection in austere (e.g., high noise, hyperbaric, hypobaric) training and operational environments. Efforts include improvements to warfighter capabilities during exposure to environmental stressors and physiological monitoring of Naval forces during multi-domain training and operational environments.</p> <p>FY 2022 Plans: Auditory Neuroscience and Performance:</p> <ul style="list-style-type: none"> - Continue advanced development and assessment of mitigation strategies to protect Warfighters in high noise environments, including personal protective equipment, advanced communication systems, and equipment/platform quieting measures. <p>Warfighter Performance:</p> <ul style="list-style-type: none"> - Continue advanced technology development and assessment of materials and protective gear to reduce exposures of humans to hazardous levels of electromagnetic energy. - Initiate research on advance physiological and cognitive monitoring technologies that incorporate real-time sensing and observation of individual and team responses to environmental and operational stressors. Enable 					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
artificial intelligence-driven sensors and analytics on operator health and performance prediction to command and leadership for real-time feedback in training and operational scenarios.						
FY 2023 Base Plans: Shaping the Maritime Acoustic Environment (This thrust was previously part of the Auditory Neuroscience and Performance FY22 plan. The name was changed to more accurately describe the research.) Continue: - Advanced development and assessment of mitigation strategies to protect Warfighters with enhanced communication systems (communications interfaces with advanced functionalities, speech to text capabilities) and situational awareness (auditory cuing and alerting for spatial audio, auditory sensor network for decision-aiding), for mission effectiveness. Complete: - Advanced development and assessment of mitigation strategies to protect Warfighters with: (i.) an improved communication systems for divers to dampen equipment noise and minimize hearing loss, (ii.) an impulse noise calculator for assessing exposure from small caliber firearms, and (iii.) a hearing protection device training protocol to mitigate hazardous noise exposures in weapons training environments. Initiate: - Development of acoustic camouflage and decoy technologies to identify and exploit acoustic signatures of Naval platforms and systems. Warfighter Performance and Protection: Continue: - Advanced technology development and assessment of materials and protective gear to reduce exposures of Warfighters to directed energy systems. - Development of advanced physiological and cognitive monitoring technologies that incorporate real-time sensing and observation of individual and team responses to environmental and operational stressors (e.g., hyperbaric, hypobaric, cold, hot, humid). - Advanced development of artificial intelligence-driven physiological and biological monitoring devices that will provide real-time prediction of performance to command and leadership in training and operational scenarios.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603729N / <i>Warfighter Protection Adv Tech</i>		Project (Number/Name) 2914 / <i>Warfighter Protection Adv Tech</i>		
<u>B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)</u>						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Complete: N/A						
Initiate: - Enhance and fuse multiple streams of data from aerial, ground, and physiological on-body sensor sources for asymmetric advantage in operational environments.						
<i>FY 2023 OCO Plans:</i> N/A						
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no significant change from FY 2022 to FY 2023.						
Accomplishments/Planned Programs Subtotals		4.659	4.935	4.999	0.000	4.999
<u>C. Other Program Funding Summary (\$ in Millions)</u> N/A						
<u>Remarks</u>						
<u>D. Acquisition Strategy</u> N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	27.319	35.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	62.819
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Novel Therapeutic Interventions Research								3.861	0.000			
FY 2021 Accomplishments: Developed warfighter centric performance-oriented data-system architecture that permits the use of measures from unobtrusive commercial off the shelf (COTS) and government off the shelf (GOTS) sensors, training data, and other measures of health, wellbeing and psychological status to understand, manage, and optimize the performance and wellbeing, and mitigate musculoskeletal injury risk potential of warfighters. Conducted research efforts to improve survivability and quality of life for service members suffering from poly-traumatic and /or musculoskeletal injuries.												
FY 2022 Plans: N/A												
Congressional Add: Bone Marrow Registry Program								23.458	26.500			
FY 2021 Accomplishments: Developed the scientific, medical and technological advances required to support military contingencies caused by injury to the blood-forming system from toxic substances. Continued to develop, test and mature the ability to address contingency events wherein civilian or military personnel are exposed to marrow toxic agents, primarily ionizing radiation or chemical weapons containing nitrogen mustard in four focus areas: Contingency Preparedness, Development of Science and Technology for Rapid Identification of Matched Donors, Immunogenetic Studies in Transplantation and Clinical Research in Transplantation. Developed an ecosystem around concurrent physiologic and environmental monitoring wearable devices to include new environmental sensors.												
FY 2022 Plans: Develop the scientific, medical and technological advances required to support military contingencies caused by injury to the blood-forming system from toxic substances. Continue to develop, test and mature the ability to address contingency events wherein civilian or military personnel are exposed to marrow toxic agents, primarily ionizing radiation or chemical weapons containing nitrogen mustard in four focus areas: Contingency Preparedness, Development of Science and Technology for Rapid Identification of Matched Donors, Immunogenetic Studies in Transplantation and Clinical Research in Transplantation. Develop												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603729N / <i>Warfighter Protection Adv Tech</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
an ecosystem around concurrent physiologic and environmental monitoring wearable devices to include new environmental sensors.		
Congressional Add: Warfighter resilience and readiness	0.000	4.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct warfighter resilience and readiness advanced technology development		
Congressional Add: Dynamic modular manufacturing	0.000	5.000
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct dynamic modular manufacturing advanced technology development		
Congressional Adds Subtotals	27.319	35.500

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & Demo							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	39.540	60.167	83.137	-	83.137	83.398	85.946	91.960	91.584	Continuing	Continuing
2918: Navy Warfighting Experiments and Demo	0.000	39.540	47.167	83.137	-	83.137	83.398	85.946	91.960	91.584	Continuing	Continuing
9999: Congressional Adds	0.000	0.000	13.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.000

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) guides ongoing research in the pursuit of innovative, decisive capabilities for our Sailors and Marines. ONR manages a broad, but priority-driven investment portfolio of near to long-term basic and applied research. This Program Element (PE) addresses the development of recent Science and Technology (S&T) 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 including Fleet Battle Problems (FBP), Limited Objective Experiments (LOEs) and Fleet/Force exercises. The key aspects of this PE are divided into five areas supporting the continuum of S&T from discovery to delivery: (1) Naval Warfare Experimentation develops rapid prototypes and provides them to the warfighter for experimentation during operational demonstrations and exercises; (2) Operations Analysis provides the Navy and Marine Corps the means to identify capability needs that can be addressed with science and technology solutions and inform future investment; (3) SwampWorks develops and demonstrates newly invented or recently discovered technologies that address emergent and enduring operational problems in an accelerated timeframe; (4) TechSolutions develops rapid response science and technology prototypes addressing Fleet/Force needs identified by Sailors and Marines at the deckplate level; and (5) support for the Naval Precision Strike Operations, providing the Navy capability to quickly locate, target, and strike critical targets.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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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
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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	40.591	47.167	0.000	-	0.000
Current President's Budget	39.540	60.167	83.137	-	83.137
Total Adjustments	-1.051	13.000	83.137	-	83.137
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	13.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.051	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	83.137	-	83.137

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

Project: 9999: Congressional Adds

Congressional Add: *Naval tech bridges*

Congressional Add: *ONR Scout*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

FY 2021	FY 2022
0.000	5.000
0.000	8.000
0.000	13.000
0.000	13.000

Change Summary Explanation

Funding: FY23 increase of \$26,127K supports increased investment in Naval Warfare Experimentation and Swampworks Activities. The increases is the result of the addition of specific international experimentation to support COMPACFLT PACIFIC DRAGON and COMSIXTHFLT FORMIDABLE SHIELD, in addition to the base portfolio of S&T Fleet Experimentation tied to major operational exercises. Additionally, Naval Rapid Innovation establishes advanced technology development funding to provide a means for maturing promising technologies emerging from the Novel Task Force/NOVMOD process.

Technical: See FY23 Plans and Accomplishments

Schedule: See FY23 Plans and Accomplishments

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2918: Navy Warfighting Experiments and Demo	0.000	39.540	47.167	83.137	-	83.137	83.398	85.946	91.960	91.584	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project focuses on the application of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototypes for warfighter experimentation during laboratory and operational demonstrations, Fleet Battle Problems (FBPs), Limited Objective Experiments (LOEs) and Fleet/Force exercises.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Naval Warfare Experimentation	7.323	8.242	36.711	0.000	36.711
Articles:	-	-	-	-	-
<p>Description: The objective of this activity is to capitalize technology breakthroughs to develop and integrate components including subsystems into prototypes quickly. These technologies are provided to the warfighter for experimentation, field experiments, and/or tests in simulated or actual environments. The use of Navy Warfare Development Command (NWDC) Fleet Experimentation (FLEX) events is encouraged. The net results are knowledge that only an experiment can provide and that will inform future Science and Technology (S&T) development and transition of capabilities.</p> <p>An example of Naval Warfare Experimentation efforts is the Integrated Battle Problem 21 operational experiment in which ONR partnered with Pacific Fleet to insert approximately 29 unmanned systems into a large scale fleet environment and determine their ability to address key operational problems.</p> <p>FY 2022 Plans: Continue to maintain and leverage a Naval Research Enterprise (NRE) Experimentation and Analysis Opportunities catalogue to guide prioritized concept investigations in support of fleet/force needs and strategic S&T initiatives. Invest in operational experimentation such as tests, demonstrations, and large and small scale experimentation that will address emerging operational needs. Manage a NRE experimentation plan which will guide multi-year S&T experimentation efforts in response to emerging concepts and doctrine. Conduct early Technology Readiness Level concept investigations with Fleet and Force input to establish concept potential,</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and inform NRE investment decisions. Leverage experimentation as an excursion to traditional programs to address additional warfighter needs and/or mitigate capability delivery risk. FY 2023 Base Plans: Conduct international experimentation in support of COMPACFLT PACIFIC DRAGON and COMSIXTHFLT, FORMIDABLE SHIELD exercises. Continue to maintain and leverage a Naval Research Enterprise (NRE) experimentation opportunities to guide prioritized concept investigations in support of fleet/force needs and strategic S&T initiatives. Investing in operational experimentation such as tests, demonstrations, and large and small scale experimentation that will address emerging operational needs. Managing a NRE experimentation plan which will guide multi-year S&T experimentation efforts in response to emerging concepts and doctrine. Conduct early Technology Readiness Level concept investigations with Fleet and Force input to establish concept potential, and inform NRE investment decisions. Leverage experimentation as an excursion to traditional programs to address additional warfighter needs and/or mitigate capability delivery risk. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increases from FY22 to FY23 is the result of the addition of specific international experimentation to support COMPACFLT PACIFIC DRAGON and COMSIXTHFLT FORMIDABLE SHIELD, in addition to the base portfolio of S&T Fleet Experimentation tied to major operational exercises. Additionally, Naval Rapid Innovation establishes advanced technology development funding to provide a means for maturing promising technologies emerging from the Novel Task Force/NOVMOD process.						
Title: Operations Analysis		0.783	3.871	4.114	0.000	4.114
Articles:		-	-	-	-	-
Description: The objective of this project is to provide operational analysis through studies, analyses, gaming, modeling and simulation (M&S), and experimentation to identify Navy and Marine Corps capability needs that can be addressed with S&T solutions. The effort includes core analysis of Science and Technology (S&T) programs, military utility/capability gaps analyses, war gaming, structured experimentation events, the articulation of the results of that analysis and war gaming, and the development of innovation strategies and messages resulting from these analyses. An example of an Operations Analysis effort would be conducting the Fast Agile Naval Technology Munitions (FANTOM) Technology Innovation Game (TIG) with the Naval Warfare Development Command and						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & D emo		Project (Number/Name) 2918 / Navy Warfighting Experiments and Demo		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>representatives from the fleet, force, and NRE to determine where application of super-cavitating torpedo technology can have the most significant, near term impact on warfighting capability which allows the NRE to more accurately focus its S&T investments.</p> <p>Tactical Advancement for Next Generation (TANG) solves mission focused, human-centered challenges using innovation and design thinking methods. TANG initiatives tailor the research and solution generation methods to the respective topic and scope.</p> <p>FY 2022 Plans: Continue to conduct new workshops, commission studies, and conduct Concept of Employment and Concept of Operations investigations.</p> <p>Initiate TANG projects that solve mission focused, human-centered challenges using innovation and systems engineering methods for the Navy and United States Marine Corps (USMC).</p> <p>TANG will support discovery of trends, sharing lessons learned, and empowering the workforce to solve problems and build their agility skills by providing high-quality, low-friction training and support to equip commands with warfighter-centered fundamentals.</p> <p>FY 2023 Base Plans: Continue to conduct new workshops, commission studies, and conduct Concept of Employment and Concept of Operations investigations.</p> <p>Continue TANG projects that solve mission focused, human-centered challenges using innovation and systems engineering methods for the Navy and United States Marine Corps (USMC).</p> <p>TANG will support discovery of trends, sharing lessons learned, and empowering the workforce to solve problems and build their agility skills by providing high-quality, low-friction training and support to equip commands with warfighter-centered fundamentals.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
There is no significant funding change from FY 2022 to FY 2023.						
Title: Swampworks		14.500	17.316	24.299	0.000	24.299
Articles:		-	-	-	-	-
Description: Description: The SwampWorks portfolio responds to opportunities for rapid and disruptive technologies to meet urgent warfighter needs, and addresses technology and sailor performance issues identified during experiments, exercises, and demonstrations.						
SwampWorks explores high-risk, disruptive, and innovative technologies and concepts that advance naval warfighter's capabilities. The program has substantial programmatic flexibility and is not limited to any set of technology areas. Ultimately, the goal is to provide a dramatic improvement for the warfighter at a rapid pace. 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 that transitions into the Acquisition Program of Record (POR).						
The Naval Agility Cell (NavalX) group assist in TECHDEV selection within Swampworks. NavalX builds an agile, collaborative, and connected Naval network via regional Technology Bridges (Tech Bridges) to pursue high-risk, disruptive, and innovative technologies and concepts that advance naval warfighter's capabilities.						
Also funded in this activity is the Next System Technology Evaluation Program (NextSTEP), which promotes innovation and entrepreneurial opportunities for naval personnel and student veterans through advanced technology development and demonstration projects at naval facilities and laboratories.						
FY 2022 Plans:						
Complete Digital Twin for USS JOHN F. KENNEDY (CVN 79) Advanced Weapons Elevator.						
Continue development of Quantum Gravimeter Navigation System. The remaining Science and Technology (S&T) projects that started in FY21 was identified during FY21 as emerging warfighters needs are realized.						
Swampworks projects will continue to be aligned with National Defense Strategy, OSD Modernization Priorities and CNO / CMC Guidance.						
FY 2023 Base Plans:						
Complete development of the Quantum Gravimeter Navigation System. The remaining Science and Technology (S&T) projects that start in FY22 will be identified during FY22 as emerging warfighters needs are realized.						
SwampWorks projects will continue to be aligned with National Defense Strategy, OSD Modernization Priorities						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
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, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and CNO / CMC Guidance. Apply the NavalX Innovation pipeline concept to source, curate, scan, incubate, prototype, validate, field and sustain new technologies to accelerate the discovery, development of new technologies and capabilities for naval warfighters.						
NavalX will continue to support discovery of trends, sharing lessons learned, and empowering the workforce to solve problems and build their agility skills by providing high-quality, low-friction training and support to equip commands with warfighter-centered fundamentals.						
Tech Bridge will support regional technology innovation challenges addressing critical Naval mission problems; increase participation of small- and medium-sized business in the defense industrial base; produce and deliver dual-use prototypes in partnership with the local/regional commercial sector, and support regional operational experimentation events. Tech Bridges are an ASN(RDA) initiative under NavalX and sponsored by ONR. Currently, fourteen Tech Bridges have been established across the U.S. plus one in London with the mission to promote regional/local collaborations in support of DON and national security missions. While each Tech Bridge may focus on their specific local/regional challenges and opportunities, they all work together as a Tech Bridge network to share best practices and support each other's mission.						
Next Strategic Technology Evaluation Program (NextSTEP) projects will focus on assessing advanced energy technologies, developing cyber-physical security for energy networks, and utilizing autonomous systems, artificial intelligence and advanced manufacturing to address operational and installation challenges in logistics, readiness, and resilience. NextSTEP (previously Energy Systems Technology Evaluation Program (ESTEP)) is a prototype viability assessment program at naval facilities that promotes adoption, scaling and deployment to the warfighter of defense and dual-use technologies with the following goals: conduct advanced technology demonstrations to evaluate emerging technologies using Navy and Marine Corps operations as test beds; evaluate and de-risk new prototype technologies to help enable their acquisition and adoption; and provide opportunities for professional development for DON personnel and student veteran interns through project participation.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY22 to FY23 of \$6,983K is a result of an increased number of Tech Bridge technology innovation challenges for small- and medium-size businesses; expanded prototyping capabilities at each Tech						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & D emo	Project (Number/Name) 2918 / Navy Warfighting Experiments and Demo				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)			FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Bridge; and the realignment of ESTEP from PE 0603123N Project 2912/Force Protection Advanced Technology to NextSTEP in PE 0603758N Project 2918, while maintaining a constant budget of \$5,000K per year.							
Title: Tech Solutions			4.933	5.151	5.263	0.000	5.263
Articles:			-	-	-	-	-
Description: TechSolutions develops rapid response Science and Technology (S&T) solutions to immediate Fleet/Force needs identified by individual Sailors at the deckplate level and Marines in the field. TechSolutions links warfighters to the science and technology community to develop needed technologies as quickly as possible. Sailors and Marines submit their ideas anytime via the TechSolutions web portal. New projects are initiated annually directly from such requests and a prototype solution is developed collaboratively with the warfighter for delivery within 12 months.							
Examples of technology requests last year included COVID-19 responses for 1) an additively manufactured facemask with reusable/replaceable filtration media to overcome limited supplies of facemasks during the early response to the pandemic, and 2) development of ship husbanding technology to collect and track COVID-19 test results for Naval strike group personnel in order to mitigate the spread of COVID-19 and give strike group commanders situational awareness on the COVID-19 health status of their personnel. Additionally, in response to a request from Marines, TechSolutions delivered an interactive, web-based, serious game that teaches the principles of energy management and logistics so users can gain an understanding and intuition of the trade-offs in energy distribution and logistics planning.							
FY 2022 Plans:							
TechSolutions will continue to conduct new Science and Technology (S&T) developments based on Fleet/Force interactions and expressed warfighter needs. The program will be readily available to support the mission of the fleet by responding to Sailors/Marines need for technology. Developments will be undertaken to deliver rapid response solutions so warfighters can achieve mission success and perform their duties safer, more effectively and more efficiently by leveraging technology that has recently been developed or is emergent. Demonstrations will be conducted with warfighters at the conclusion of developments to assess the utility of the technology and understand what steps remain to achieve transition.							
FY 2023 Base Plans:							

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & D emo		Project (Number/Name) 2918 / Navy Warfighting Experiments and Demo				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)				FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
TechSolutions will continue to conduct new Science and Technology (S&T) developments based on Fleet/Force interactions and expressed warfighter needs. Developments will be undertaken to deliver rapid response solutions so warfighters can achieve mission success and perform their duties more effectively and more efficiently by leveraging new or emergent technology.								
FY 2023 OCO Plans: N/A								
FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.								
Title: Precision Strike Technology				12.001	12.587	12.750	0.000	12.750
Articles:				-	-	-	-	-
Description: Efforts in this area support Naval Precision Strike Operations, providing the Navy capability to quickly locate, target, and strike critical targets. Ongoing efforts include conducting kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives. These studies assess engineering feasibility of various kill-chain options and assess the capability provided. Classified addendum includes further program details.								
FY 2022 Plans: Continue efforts in the area supporting Naval Precision Strike Operations, providing the Navy capability to quickly locate, target, and strike critical targets. Ongoing efforts include conducting kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives. These studies assess engineering feasibility of various kill-chain options and assess the capability provided. Conduct efforts to refine technologies and techniques that fluidly combine surveillance electronic warfare with communications and electronics in support of current and predicted capability requirements to clearly understand and shape the EW battlespace.								
FY 2023 Base Plans: Continue efforts in the area supporting Naval Precision Strike Operations, providing the Navy capability to quickly locate, target, and strike critical targets. Ongoing efforts include conducting kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives.								

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & D emo		Project (Number/Name) 2918 / Navy Warfighting Experiments and Demo	
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO
<p>These studies assess engineering feasibility of various kill-chain options and assess advanced weapon system capabilities.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant change from FY 2022 to FY 2023.</p>					
Accomplishments/Planned Programs Subtotals		39.540	47.167	83.137	0.000
<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p> <p>D. Acquisition Strategy Not applicable.</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603758N / Navy Warfighting Exp & Demo				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	0.000	13.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.000
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.												
B. Accomplishments/Planned Programs (\$ in Millions)									FY 2021	FY 2022		
Congressional Add: Naval tech bridges									0.000	5.000		
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct experiments and demonstrations supporting Naval technology bridges efforts												
Congressional Add: ONR Scout									0.000	8.000		
FY 2021 Accomplishments: N/A												
FY 2022 Plans: Conduct ONR Scout experiments and demonstrations												
Congressional Adds Subtotals									0.000	13.000		
C. Other Program Funding Summary (\$ in Millions) N/A												
Remarks												
D. Acquisition Strategy N/A												

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603782N / Mine and Expeditionary Warfare Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	1.905	1.981	2.007	-	2.007	2.048	2.088	2.130	2.173	Continuing	Continuing
2917: Shallow Water MCM Demos	0.000	1.905	1.981	2.007	-	2.007	2.048	2.088	2.130	2.173	Continuing	Continuing

A. Mission Description and Budget Item Justification

Explosive ordnance disposal is a critical naval mission vital to the safety of service members and civilians. Highly trained Sailors and Marines utilize their knowhow and courage combined with state-of-the-art technology to remove unexploded ordnance, land/sea mines and even chemical, biological and nuclear weapons. The Department of Defense (DoD) Directive 5160.62 "Single Manager Responsibility for Military Explosive Ordnance Disposal Technology and Training (EODT&T)" approved by the DoD Explosive Ordnance Disposal (EOD) Program Board (Sep 2012) guides research in this Program Element (PE). Unique needs and capabilities identified by the Joint Requirements Oversight Council (JROC) and the DoD EOD Program Board are also addressed by this PE, and provide 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).

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy			Date: April 2022			
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				
This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).						
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget		1.940	1.981	0.000	-	0.000
Current President's Budget		1.905	1.981	2.007	-	2.007
Total Adjustments		-0.035	0.000	2.007	-	2.007
• Congressional General Reductions		-	-			
• Congressional Directed Reductions		-	-			
• Congressional Rescissions		-	-			
• Congressional Adds		-	-			
• Congressional Directed Transfers		-	-			
• Reprogrammings		-	-			
• SBIR/STTR Transfer		-0.035	0.000			
• Rate/Misc Adjustments		0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year		-	-	2.007	-	2.007
Change Summary Explanation						
Funding: No significant change.						
Technical: No significant change.						
Schedule: No significant change						

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603782N / Mine and Expeditionary War fare Advanced Technology				Project (Number/Name) 2917 / Shallow Water MCM Demos			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2917: Shallow Water MCM Demos	0.000	1.905	1.981	2.007	-	2.007	2.048	2.088	2.130	2.173	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project 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, throughout the littorals including new generation mines having sophisticated performance characteristics. 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.

This Project 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).

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Joint EOD Demos	1.905	1.981	2.007	0.000	2.007
Articles:	-	-	-	-	-
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, radiographic and advanced 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 and surface 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					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022		
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO
<p>to support precise render safe and neutralization, and neutralization devices containing reactive materials to neutralize devices with low collateral damage. 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.</p> <p>FY 2022 Plans:</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Advanced Technology: Continue advanced technology development and demonstration for JEOD functional areas including detect, access, diagnose, and render safe/neutralize.</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Detection: Continue efforts in the detection functional area. Specific efforts will include development and demonstration of advanced electro-optical and spectroscopic sensors for detection of explosives. The objective is to remotely detect bulk and trace explosives.</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Remote Access: Continue efforts the access functional area. Specific efforts will include robotic manipulators, end effectors and haptics. The objective is to enable remote access to explosive threats and unexploded ordnance.</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Acoustic Sensor: Continue detection of buried explosive threats with seismic- acoustic sensor. Specific effort includes demonstration of a robot mounted seismic acoustic sensor. The objective is to enable standoff detection of buried explosive threats with improved detection and classification statistics.</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Man-Portable Prototypes: Continue efforts in diagnose and render safe/ neutralize functional areas. Specific efforts will include the development and demonstration of man-portable prototypes. The objective is to assess the status of explosive threats and ordnance and render safe/neutralize at standoff.</p> <p>-Joint Explosive Ordnance Disposal (JEOD), Rapid Large Area Clearance advanced technology development for rapid large area clearance of explosive threats. Specific effort includes collective demonstration of multiple prototypes for experimentation. The objective is to enable rapid large area clearance operations including</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
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, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
detection of explosive threats, classification statistics and clearance of munitions from the operational area and render safe/neutralize at standoff.						
FY 2023 Base Plans: - Continue Joint Explosive Ordnance Disposal (JEOD), Advanced Technology: continue development and demonstration for JEOB functional areas including detect, access, diagnose, and render safe/neutralize. - Continue Joint Explosive Ordnance Disposal (JEOD), Detection: continue efforts in the detection functional area. Specific efforts will include development and demonstration of advanced electro-optical and spectroscopic sensors for detection of explosives. The objective is to remotely detect bulk and trace explosives. - Continue Joint Explosive Ordnance Disposal (JEOD), Remote Access: continue efforts the access functional area. Specific efforts will include robotic manipulators, end effectors and haptics. The objective is to enable remote access to explosive threats and unexploded ordnance. - Continue Joint Explosive Ordnance Disposal (JEOD), Acoustic Sensor: continue detection of buried explosive threats with seismic- acoustic sensor. Specific effort includes demonstration of a robot mounted seismic acoustic sensor. The objective is to enable standoff detection of buried explosive threats with improved detection and classification statistics. - Continue Joint Explosive Ordnance Disposal (JEOD), Man-Portable Prototypes: continue efforts in diagnose and render safe/ neutralize functional areas. Specific efforts will include the development and demonstration of man-portable prototypes. The objective is to assess the status of explosive threats and ordnance and render safe/neutralize at standoff. - Continue Joint Explosive Ordnance Disposal (JEOD), Rapid Large Area Clearance advanced technology development for rapid large area clearance of explosive threats. Specific effort includes collective demonstration of multiple prototypes for experimentation. The objective is to enable rapid large area clearance operations including detection of explosive threats, classification statistics and clearance of munitions from the operational area and render safe/neutralize at standoff.						
FY 2023 OCO Plans:						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603782N / <i>Mine and Expeditionary Warfare Advanced Technology</i>		Project (Number/Name) 2917 / <i>Shallow Water MCM Demos</i>	
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
N/A					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no significant funding change from FY 2022 to FY 2023.					
Accomplishments/Planned Programs Subtotals	1.905	1.981	2.007	0.000	2.007
C. Other Program Funding Summary (\$ in Millions) N/A					
Remarks					
D. Acquisition Strategy N/A					

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	154.712	161.444	144.122	-	144.122	125.431	127.939	130.496	133.105	Continuing	Continuing
2481: EMRG	0.000	8.953	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.953
2731: High Energy Laser Counter ASCM Project (HELCAP)	0.000	27.799	13.960	22.460	-	22.460	0.000	0.000	0.000	0.000	0.000	64.219
2958: Cyberspace Activities	0.000	15.537	15.893	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	31.430
3400: Innovative Naval Prototypes (INP) Adv Tech Dev	0.000	0.000	0.000	11.800	-	11.800	9.000	24.694	56.796	85.664	Continuing	Continuing
3416: HIJENKS	0.000	13.630	7.621	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.251
3423: LOCUST	0.000	12.184	3.373	6.000	-	6.000	0.000	0.000	0.000	0.000	0.000	21.557
3450: AMOS	0.000	4.264	3.457	4.480	-	4.480	0.000	0.000	0.000	0.000	0.000	12.201
3451: CLAWS	0.000	14.390	14.285	7.812	-	7.812	0.000	0.000	0.000	0.000	0.000	36.487
3452: ELEKTRA	0.000	10.242	12.876	9.847	-	9.847	4.924	5.022	0.000	0.000	0.000	42.911
3454: MDUSV	0.000	2.514	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.514
3455: MINERVA	0.000	10.307	12.876	11.816	-	11.816	6.894	7.031	0.000	0.000	0.000	48.924
3456: Full Spectrum Undersea Warfare	0.000	0.000	0.000	8.910	-	8.910	9.900	9.900	9.900	10.098	Continuing	Continuing
3457: Long Range Targeting	0.000	7.425	15.941	24.750	-	24.750	44.400	29.300	22.500	0.000	0.000	144.316
3458: Undersea Warfare Efforts	0.000	2.356	6.967	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.323
3459: Super Swarm (SS)	0.000	5.804	9.957	14.850	-	14.850	19.800	19.800	0.000	0.000	0.000	70.211
3461: MASS	0.000	0.000	0.988	3.960	-	3.960	4.950	4.950	0.000	0.000	0.000	14.848
3462: DEALRS	0.000	0.000	0.987	4.950	-	4.950	5.940	5.940	7.920	8.078	Continuing	Continuing
3463: MATes	0.000	0.000	0.987	3.960	-	3.960	4.950	4.950	13.860	14.137	Continuing	Continuing
3464: REDCAT	0.000	0.000	3.976	8.000	-	8.000	6.000	6.000	0.000	0.000	0.000	23.976
5899: Precision Fire Control	0.000	0.000	0.000	0.527	-	0.527	8.673	10.352	19.520	15.128	Continuing	Continuing
9999: Congressional Adds	0.000	19.307	37.300	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.607

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev
A. Mission Description and Budget Item Justification <p>The Office of Naval Research (ONR) portfolio includes efforts that solve problems and respond to mission requirements, as well as, exploratory research for new ideas and breakthrough capabilities. Larger in scope, scale and risk Innovative Naval Prototypes (INP) are selected for their high-payoff and potential to revolutionize operational concepts. The efforts described in this Program Element (PE) continue the Applied Research work in PE 0602792N for promising INPs with Advanced Technology Development activities. INP investments define the future of U.S. naval forces. Due to high technical risk, INPs often have long trial-and-error timeframes to work through challenges, but typically no more than three years between decision points. INP efforts mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require applied and advanced technology development funding to bridge from concept to working prototype. INPs prove technological and capability potential, validate production feasibility, and acquisition potential. ONR demonstrates INPs in relevant environments. Successful experimentation and demonstrations present the Department of the Navy with disruptive capabilities that may lead to a new acquisition programs. INPs are selected by senior leadership in the Department of the Navy.</p> <p>This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).</p> <p>INP investments represent game changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. INPs do not develop hardware for service use, rather they prove technological and production feasibility, and show naval utility and acquisition potential. The Office of Naval Research (ONR) demonstrates INPs in relevant environments. Successful experimentation and demonstrations present the Department of the Navy with disruptive capabilities that may lead to the obsolescence of existing capabilities and acquisition programs. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.</p> <p>Information security concerns preclude fully detailed descriptions of project efforts, research activities, and technology development plans. Specific information on each project and activity will be provided separately to the Congressional oversight committees.</p>		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
1319: Research, Development, Test & Evaluation, Navy I BA 3: Advanced Technology Development (ATD)		PE 0603801N I Innovative Naval Prototypes (INP) Adv Tec Dev			
B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	159.338	133.779	0.000	-	0.000
Current President's Budget	154.712	161.444	144.122	-	144.122
Total Adjustments	-4.626	27.665	144.122	-	144.122
• Congressional General Reductions	-	-0.169			
• Congressional Directed Reductions	-	-9.466			
• Congressional Rescissions	-	-			
• Congressional Adds	-	37.300			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.847	0.000			
• SBIR/STTR Transfer	-6.471	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments	-0.002	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	144.122	-	144.122
Congressional Add Details (\$ in Millions, and Includes General Reductions)					
Project: 9999: Congressional Adds					
Congressional Add: Electromagnetic Railgun					
Congressional Add: High speed laser cooling systems					
Congressional Add: Advanced ATRT SBIR enterprise capabilities					
Congressional Add: Energetics renaissance					
Congressional Add: Group 3 advanced autonomous					
Congressional Add Subtotals for Project: 9999					
Congressional Add Totals for all Projects					
Change Summary Explanation					
Funding: not applicable.					
Schedule: not applicable.					
Technical: not applicable					

FY 2021	FY 2022
19.307	0.000
0.000	6.000
0.000	16.300
0.000	10.000
0.000	5.000
19.307	37.300
19.307	37.300

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev
FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev				Project (Number/Name) 2481 / EMRG			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2481: EMRG	0.000	8.953	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.953
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Electro-Magnetic Railgun (EMRG) is a high-power, kinetic energy weapon capable of launching precision guided projectiles using electricity instead of chemical propellants. This multi-year effort will build a Railgun Weapon System (RGWS) by designing, fabricating and integrating EMRG subsystems and components into a weapon system that brings new capabilities, increased capacity and improved operational economy to fleet operations at sea. With its increased velocity and extended range, EMRG provides multi-mission potential for hypersonic missile defense, anti-air & surface warfare, and naval surface fire support. The Activity identified in Project Unit 2481 specifically addresses Advanced Technology Development in support of the EMRG high-power, kinetic energy weapon prototype development Innovative Naval Prototype (INP) effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Electro-Magnetic Railgun (EMRG) Articles: Description: The Electro-Magnetic Railgun (EMRG) is a high-power, kinetic energy weapon capable of launching precision guided projectiles using electricity instead of chemical propellants. This multi-year effort will build a Railgun Weapon System (RGWS) by designing, fabricating and integrating EMRG subsystems and components into a weapon system that brings new capabilities, increased capacity and improved operational economy to fleet operations at sea. With its increased velocity and extended range, EMRG provides multi-mission potential for hypersonic missile defense, anti-air & surface warfare, and naval surface fire support. FY 2022 Plans: N/A FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A								8.953	0.000	0.000	0.000	0.000
								-	-	-	-	-
Accomplishments/Planned Programs Subtotals								8.953	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev	Project (Number/Name) 2481 / EMRG
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev				Project (Number/Name) 2731 / High Energy Laser Counter ASCM Project (HELCAP)			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2731: High Energy Laser Counter ASCM Project (HELCAP)	0.000	27.799	13.960	22.460	-	22.460	0.000	0.000	0.000	0.000	0.000	64.219
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The High Energy Laser Counter ASCM Project (HELCAP) will expedite the development, experimentation, integration and demonstration of critical technologies to defeat crossing Anti-Ship Cruise Missiles (ASCM) by addressing the remaining technical challenges, e.g.: atmospheric turbulence, automatic target identification and aim point selection, precision target tracking with low jitter in high clutter conditions, advanced beam control, and higher power HEL development. HELCAP will assess, develop, experiment, and demonstrate the various laser weapon system technologies and methods of implementation required to defeat ASCMs in a crossing engagement.

HELCAP activities in this project (0603801N) include technology assessments, laser lethality investigations, and advanced beam control. Component and Subsystem level operability is being conducted under this project specifically the Beam Control subsystem including active tracking and advanced atmospheric compensation using Adaptive Optics. The Beam Director subsystem testing will occur in a simulated environment (land based) against surrogate ASCM targets. Other subsystems being developed and tested under this project include the automated engagement sequencing, HEL targets and diagnostics subsystems, and an HEL interface compatible with a range of competing HEL source technologies. This project passes technology to follow on HELCAP activities under Program Element (PE) 0603925N Directed Energy and Electric Weapon Systems.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: HELCAP	27.799	13.960	22.460	0.000	22.460
Articles:	-	-	-	-	-
Description: The High Energy Laser Counter ASCM Project (HELCAP) expedites the development, experimentation, integration and demonstration of critical technologies to defeat crossing Anti-Ship Cruise Missiles (ASCM) by addressing the remaining technical challenges, e.g.: atmospheric turbulence, automatic target identification and aim point selection, precision target tracking with low jitter in high clutter conditions, advanced beam control, and higher power HEL development. HELCAP will assess, develop, experiment, and demonstrate various laser weapon system technologies and methods of implementation required to defeat ASCMs in a crossing engagement.					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev	Project (Number/Name) 2731 / High Energy Laser Counter ASCM Project (HELCAP)				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>HELCAP activities conducted in this project (0603801N) include technology assessments, laser lethality investigations, and advanced beam control. Component and Subsystem level operability is being conducted under this project specifically the Beam Control subsystem including active tracking and advanced atmospheric compensation using Adaptive Optics. The Beam Director subsystem tested will occur in a simulated environment (land based) against surrogate ASCM targets. Other subsystems being developed and tested under this project include the automated engagement sequencing, HEL targets and diagnostics subsystems, and an HEL interface compatible with a range of competing HEL source technologies. This project passes technology to follow on HELCAP activities conducted under Program Element (PE) 0603925N Directed Energy and Electric Weapon Systems.</p> <p>FY 2022 Plans: Continue in the integration phase of an overall multi-year effort whose objective is to conduct development, experimentation, and demonstration of critical technologies to defeat crossing Anti-Ship Cruise Missiles (ASCM) including laser lethality, advanced beam control, and high energy laser sources.</p> <p>Continue ASCM defeat analysis and assessments including lethality, engagement modeling, atmospheric propagation characterization, and beam control.</p> <p>Continue to design and develop critical beam control testbed technology. Continue laser/materiel component interaction testing and support beam control tracker and adaptive optics verification experimentation.</p> <p>FY 2023 Base Plans: Continue: - Integration phase of an overall multi-year effort whose objective is to conduct development, experimentation, and demonstration of critical technologies to defeat crossing Anti-Ship Cruise Missiles (ASCM) including laser lethality, advanced beam control, and high energy laser sources.</p> <p>Continue: - Integration phase of an overall multi-year effort whose objective is to conduct development, experimentation, and demonstration of critical technologies to defeat crossing Anti-Ship Cruise Missiles (ASCM) including laser lethality, advanced beam control, and high energy laser sources.</p> <p>Complete:</p>						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototype s (INP) Adv Tec Dev</i>		Project (Number/Name) 2731 / <i>High Energy Laser Counter ASCM Project (HELCAP)</i>							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
<p>- Laser/materiel component interaction testing and support beam control tracker and adaptive optics verification experimentation.</p> <p>- ASCM defeat analysis and assessments including lethality, engagement modeling, atmospheric propagation characterization, and beam control.</p> <p>Continue:</p> <p>- High Power System Integration and Anti-Ship Cruise Missile Detect to Defeat Demonstration preparations</p> <p>- High power system integration demonstration (Demo 2) at White Sands Missile Range (WSMR). Demo 2 serves to prove the technological feasibility and assessments of subsystem and component operability in a simulated land-based environment.</p> <p>Demo 2 will demonstrate subsystem operability to receive and process target tracking, adherence to range safety protocols and user control, and demonstrate laser deconfliction against space assets in user-defined regions. Testing planned includes static and dynamic ground and air-based targets.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The FY22 to FY23 increase in funding is due to planned HELCAP high power system integration and maritime ASCM detect to defeat demonstrations to include surrogate subsonic ASCM targets engaged over land as well as simulated open ocean environments.</p>											
Accomplishments/Planned Programs Subtotals		27.799	13.960	22.460	0.000	22.460					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/ 0603925N/2731: <i>High Energy Laser Counter ASCM Project</i>	29.847	25.964	6.598	-	6.598	6.853	3.611	3.647	3.270	Continuing	Continuing
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 2958 / Cyberspace Activities			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2958: Cyberspace Activities	0.000	15.537	15.893	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	31.430
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project contains all Advanced Technology Development Innovative Naval Prototype (INP) investments that are developing new technologies for cyber warfare. Potential adversaries are investing in advanced technologies that will challenge our advantages in the critical information domain. Nation states and non-state actors seek to degrade our command and control capabilities, networks and computer systems. Cyber threats continue to grow and rapidly proliferate. Technologies developed in this Project will enable the warfighter to take immediate, appropriate action at any time against any desired adversary, target or network by assuring that autonomous, continuous analyses of intelligence, persistent surveillance and open information sources have, at all times, optimized the possible courses of action based on commander's guidance. Technologies within this activity will foster operational endurance and enable sustained operations and resiliency for warfighters and platforms through enhanced cyber security/protection.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Cyber	15.537	15.893	0.000	0.000	0.000
Articles:	-	-	-	-	-
<p>Description: This R2 Activity contains all Advanced Technology Development Innovative Naval Prototype (INP) investments that are developing new technologies for cyber warfare. Potential adversaries are investing in advanced technologies that will challenge our advantages in the critical information domain. Nation states and non-state actors seek to degrade our command and control capabilities, networks and computer systems. Cyber threats continue to grow and rapidly proliferate. Technologies developed in this R2 Activity will enable the warfighter to take immediate, appropriate action at any time against any desired adversary, target or network by assuring that autonomous, continuous analyses of intelligence, persistent surveillance and open information sources have, at all times, optimized the possible courses of action based on commander's guidance. Technologies within this activity will foster operational endurance and enable sustained operations and resiliency for warfighters and platforms through enhanced cyber security/protection.</p> <p>FY 2022 Plans:</p> <p>- Complete Advanced Technology Development of tools and techniques that enable compelling new cyber capabilities for automated, systematic reduction and dynamic reshaping of any computing system's attack surface. Continue conducting rapid demonstrations of the technologies in multiple Naval combat and C4I</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 2958 / <i>Cyberspace Activities</i>							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
<p>systems to evaluate tool efficacy, study system integration and workflow techniques, and to demonstrate inventive new capabilities for acquisition programs.</p> <ul style="list-style-type: none"> - Complete advanced capability analysis of software debloat projects for Java, compiled C/C++, and low-level system firmware. This task is necessary to study system integration techniques for the tooling and to demonstrate capabilities for acquisition programs. - Complete development of communications protocol subsetting and automated dialect generation to reshape cyber attack surface. - Complete development of non-destructive microelectronics inspection methods that would provide a critical new capability for scalable cyber supply chain protection. <p>stem integration and workflow techniques, and to demonstrate inventive new capabilities for acquisition programs.</p> <p>FY 2023 Base Plans: N/A</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding is due to program completion.</p>											
Accomplishments/Planned Programs Subtotals		15.537	15.893	0.000	0.000	0.000					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0602792N/2958: CYBERSPACE ACTIVITIES	26.867	25.988	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	52.855
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3400 / Innovative Naval Prototypes (INP) Adv Tech Dev			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3400: Innovative Naval Prototypes (INP) Adv Tech Dev	0.000	0.000	0.000	11.800	-	11.800	9.000	24.694	56.796	85.664	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The efforts described in this Project address the Advanced Technology Development associated with the Innovative Naval Prototypes (INP) Program. These investments represent game-changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both Budget Activity (BA) 2 and BA3 funding. The BA3 INP funds are specified in a separate Program Element (PE), 0603801N Innovative Naval Prototypes (INP) Adv Tec Dev. INPs do not develop hardware for service use; rather they provide feeder technology that can be demonstrated in prototypes in the 6.3 portion of the INP program. Developing INPs requires a systematic expansion and application of knowledge to develop useful materials, devices, and systems oriented toward the design and development of prototypes applicable to specific mission area requirements. The efforts funded within this PE is focuses on continuing the technology development from the BA2 efforts in order to develop full-scale technology/operational demonstrations. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Innovative Naval Prototypes (INP) Adv Tech Dev	0.000	0.000	11.800	0.000	11.800
Articles:	-	-	-	-	-
Description: The efforts described in this Project address the Advanced Technology Development associated with the Innovative Naval Prototypes (INP) Program. These investments represent game-changing technologies with the potential to revolutionize operational concepts. They are disruptive in nature, as they would dramatically change the way naval forces fight. Due to high technical risk, INPs typically have long duration but have no more than three years between decision points. They mature technologies from a Technology Readiness Level (TRL) of 2 or 3 to a TRL of 6. As such, INPs require both Budget Activity (BA) 2 and BA3 funding. The BA3 INP funds are specified in a separate Program Element (PE), 0603801N Innovative Naval Prototypes (INP) Adv Tec Dev. INPs do not develop hardware for service use; rather they provide feeder technology that can be demonstrated in prototypes in the 6.3 portion of the INP program. Developing INPs requires a systematic expansion and application of knowledge to develop useful materials, devices, and systems oriented toward the design and development of prototypes applicable to specific mission area requirements. The efforts funded within this PE is focuses on continuing the technology development from the BA2 efforts in order to develop full-scale technology/					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022																																												
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>	Project (Number/Name) 3400 / <i>Innovative Naval Prototypes (INP) Adv Tech Dev</i>																																													
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)																																															
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 65%;"></th> <th style="width: 10%;">FY 2021</th> <th style="width: 10%;">FY 2022</th> <th style="width: 10%;">FY 2023 Base</th> <th style="width: 10%;">FY 2023 OCO</th> <th style="width: 10%;">FY 2023 Total</th> </tr> </thead> <tbody> <tr> <td>operational demonstrations. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><i>FY 2022 Plans:</i> N/A</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><i>FY 2023 Base Plans:</i> Continue to explore promising advanced technology development efforts and identify the best candidates capable of resulting in full-scale technology/operational demonstrations which will inform future INP investment decisions in this activity. This includes identifying technologies that will provide scalable lethality through enabling multi-domain, integrated, scalable kinetic and non-kinetic systems for offensive of defensive purposes.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><i>FY 2023 OCO Plans:</i> N/A</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY 2022 to FY 2023 in Proj: 3400 INP Adv Tech Dev is to provide increased opportunities to identify promising advanced technology concepts for further development as INPs.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: right;">Accomplishments/Planned Programs Subtotals</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">11.800</td> <td style="text-align: center;">0.000</td> <td style="text-align: center;">11.800</td> </tr> </tbody> </table>							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	operational demonstrations. The Department of the Navy would have to make significant acquisition decisions to integrate the new technological capabilities into naval warfighting systems. INPs are selected by a process that involves senior leadership in the Department of the Navy.						<i>FY 2022 Plans:</i> N/A						<i>FY 2023 Base Plans:</i> Continue to explore promising advanced technology development efforts and identify the best candidates capable of resulting in full-scale technology/operational demonstrations which will inform future INP investment decisions in this activity. This includes identifying technologies that will provide scalable lethality through enabling multi-domain, integrated, scalable kinetic and non-kinetic systems for offensive of defensive purposes.						<i>FY 2023 OCO Plans:</i> N/A						<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY 2022 to FY 2023 in Proj: 3400 INP Adv Tech Dev is to provide increased opportunities to identify promising advanced technology concepts for further development as INPs.						Accomplishments/Planned Programs Subtotals	0.000	0.000	11.800	0.000	11.800
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C. Other Program Funding Summary (\$ in Millions) N/A																																															
Remarks																																															
D. Acquisition Strategy N/A																																															

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy									Date: April 2022			
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3416 / HIJENKS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3416: HIJENKS	0.000	13.630	7.621	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.251
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The High-power Joint Electromagnetic Non-Kinetic Strike (HIJENKS) INP effort is a non-kinetic High Power Microwave (HPM) payload integrated on an airborne platform will enable the prosecution of multiple targets with area coverage across each target and open targets previously restricted due to collateral damage. HIJENKS increases operational access by disrupting land-based infrastructure facilities tied to adversary systems, decreases cost exchange ratios through non-kinetic engagement, and addresses targets previously restricted due to collateral damage concerns/moral hardening. It expands the competitive space in the electromagnetic spectrum to disrupt, degrade, and destroy critical electronic targets. The Activity identified in Project Unit 3416 specifically addresses Advanced Technology Development in support of the HIJENKS INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: HIJENKS								13.630	7.621	0.000	0.000	0.000
Articles:								-	-	-	-	-
Description: The High Power Joint Electromagnetic Non-Kinetic Strike (HIJENKS) program is a proof-of-concept demonstration of a multi-target, advanced airborne High Power Microwave (HPM) payload capable of disrupting electronic targets non-kinetically. HIJENKS is capable of disrupting land-based electronic system infrastructure and engaging multiple targets with a single airborne weapon, increasing operational access/decreasing cost exchange ratios, providing area lethality with increased pulse rate, providing options to address limitations on collateral damage, increasing standoff range and expanding magazine depth. HIJENKS will advance the current state-of-the-art in HPM technology and demonstrate the near-term operational benefits of integrating HPM-based Electronic Warfare/Electronic Attack (EW/EA) into the current force structure.												
FY 2022 Plans:												
- Complete effort to develop an integration-ready HPM payload and TDP to enable future platform integration. Continue development of HPM payload adaptable to multiple airborne systems, including system design studies and modeling of alternative HPM payload technologies. Develop and deliver two duplicate payload pods for use by both Navy and AF in static and emulated dynamic flight testing. Complete full payload system integration and multiple test events to demonstration functionality of first payload unit. Complete system level test with builds of additional payload units. Complete environmental testing, shock and vibration testing, Electromagnetic Interference (EMI), and Weapon Effectiveness testing. Validate payload performance requirements including												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022				
Appropriation/Budget Activity 1319 / 3				R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>			Project (Number/Name) 3416 / HIJENKS				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Effective Radiated Power (ERP), number of pulses-per-engagement, number of engagements, and Electronic Damage Battle Indication (EDBI). Complete static demonstration of the world's most advanced HPM payload - highest power level achieved for aperture size and system volume. FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding is due to program completion.											
							Accomplishments/Planned Programs Subtotals				
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RD TEN/0602792N/3416: HIJENKS	21.033	9.916	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.949
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3423 / LOCUST			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3423: LOCUST	0.000	12.184	3.373	6.000	-	6.000	0.000	0.000	0.000	0.000	0.000	21.557
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Adversary military modernization and increasing contested domains require a shift in approach "...to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This will include capabilities to enhance close combat lethality in complex terrain." LOCUST will develop and deliver autonomy, C2 architecture, and a series of modular payloads on a robust, scalable, flexible, multifunctional UAV system; employable from surface, sub-surface, airborne, and ground manned and un-manned systems to provide a dispersed, resilient, and adaptive capability to gain a competitive military advantage. LOCUST will provide ISR and precision loitering munitions capable of being launched from air, surface, ground, and sub-surface platforms to conduct both singular and swarm operations across battlespace in conjunction with Joint and manned operations. It will demonstrate multi-domain launch and strike operations, heterogeneous air platform payloads, unmanned from unmanned operations, distributed control of the strike mission, and refined cost elements for critical technologies that have supply chain assurance addressed. The Activity identified in Project Unit 3423 specifically addresses Advanced Technology Development in support of the LOCUST INP effort.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: LOCUST	12.184	3.373	6.000	0.000	6.000
Articles:	-	-	-	-	-
Description: Adversary military modernization and increasing contested domains require a shift in approach "...to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This will include capabilities to enhance close combat lethality in complex terrain." LOCUST will develop and deliver autonomy, C2 architecture, and a series of modular payloads on a robust, scalable, flexible, multifunctional UAV system; employable from surface, sub-surface, airborne, and ground manned and un-manned systems to provide a dispersed, resilient, and adaptive capability to gain a competitive military advantage. LOCUST will provide ISR and precision loitering munitions capable of being launched from air, surface, ground, and sub-surface platforms to conduct both singular and swarm operations across battlespace in conjunction with Joint and manned operations. It will demonstrate multi-domain launch and strike operations, heterogeneous air platform payloads, unmanned from unmanned operations, distributed control of the strike mission, and refined cost elements for critical technologies that have supply chain assurance addressed.					
FY 2022 Plans: Complete advanced technology development efforts associated with development and flight testing of mission-oriented payloads in which cost, size, weight, and power reductions play a significant role in their utility will					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022				
Appropriation/Budget Activity 1319 / 3			R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>			Project (Number/Name) 3423 / <i>LOCUST</i>					
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>complete. The primary focus of the efforts will be on conducting field swarm demonstration in an operationally relevant environment. This activity represents a significant component needed for the air element under the associated Super Swarm multi-domain activity.</p> <p><i>FY 2023 Base Plans:</i> Continue advanced technology development in support of the LOCUST INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Continue Advanced Technology Development activities to support participation live-fire Fleet experimentation venues. - Initiate payload development that is specific to a Fleet requested operational scenario. This payload is being adapted from applied research conducted under a non-LOCUST activity. The utilization of this technology in the LOCUST concept introduces additional technical risk that will be addressed. - Initiate platform design modifications to increase payload capacity, integrate mission specific payload, and conduct live flight testing. <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY 2022 to FY 2023 in Proj: 3423 LOCUST is due to the need to address a critical technology element for a Fleet requested operational scenario.</p>											
Accomplishments/Planned Programs Subtotals							12.184	3.373	6.000	0.000	6.000
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0602792N/3423: <i>LOCUST</i>	20.776	8.031	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	28.807
• RDTEN/0603382N/3423: <i>LOCUST</i>	2.123	3.371	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.257
Remarks											
D. Acquisition Strategy											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3450 / AMOS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3450: AMOS	0.000	4.264	3.457	4.480	-	4.480	0.000	0.000	0.000	0.000	0.000	12.201
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The Arctic Mobile Observing System (AMOS) INP effort will develop a prototype mobile sensing system that can be deployed anywhere in the Arctic via the development of a sea ice-based buoy node that will enable the critical infrastructure (power, communication, environmental intelligence) to provide the Navy with a persistent Arctic presence at lower cost than manned platforms. AMOS is a mobile observing system of systems node that enables 2-way communications, under-ice vehicle navigation, and extended-duration autonomy in the complex Arctic environment. AMOS will provide a persistent, mobile, autonomous capability to monitor the operational environment and maritime operations of potential adversaries in the Arctic Ocean. The Activity identified in Project Unit 3450 specifically addresses Advanced Technology Development in support of the AMOS INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: AMOS								4.264	3.457	4.480	0.000	4.480
								Articles: -	-	-	-	-
Description: The Arctic Mobile Observing System (AMOS) INP effort will develop a prototype mobile sensing system that can be deployed anywhere in the Arctic via the development of a sea ice-based buoy node that will enable the critical infrastructure (power, communication, environmental intelligence) to provide the Navy with a persistent Arctic presence at lower cost than manned platforms. AMOS is a mobile observing system of systems node that enables 2-way communications, under-ice vehicle navigation, and extended-duration autonomy in the complex Arctic environment. AMOS will provide a persistent, mobile, autonomous capability to monitor the operational environment and maritime operations of potential adversaries in the Arctic Ocean.												
FY 2022 Plans:												
Continue advanced technology development efforts associated with the following:												
- Constructing instrumented AMOS gliders and float prototypes for deployments												
- Constructing prototype nodes with meteorological sensors and command and for deployment in Arctic experiments.												
- Testing extended-duration of AMOS nodes and platforms through year-long Arctic deployments.												
- Demonstrating navigation and 2-way communications of AMOS platforms and vehicles												
FY 2023 Base Plans:												
Continue advanced technology development efforts:												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3450 / AMOS							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total						
<p>- Demonstration of navigation and 2-way communications of AMOS platforms and vehicles.</p> <p>Complete All AMOS prototype system and subsystem builds in preparation for end of FY23 deployment. This includes:</p> <ul style="list-style-type: none"> - Complete construction of all ice tethered buoys, navigation buoys, floats, gliders and UUVs that meet the AMOS prototype requirements and operational concept. - Complete construction of prototype AMOS communication node with final meteorological sensors. - Complete the situational awareness/command and control system to monitor prototype performance during final test and evaluation period. <p>- Initiate final Arctic deployment of full AMOS prototype for test and evaluation</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding from FY22 to FY23 is to support logistic costs related to the final deployment of prototype observing system components for test and evaluation in the Arctic Ocean.</p>											
Accomplishments/Planned Programs Subtotals		4.264	3.457	4.480	0.000	4.480					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0602792N/3450: AMOS	7.918	6.446	8.320	-	8.320	0.000	0.000	0.000	0.000	0.000	22.684
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3451 / CLAWS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3451: CLAWS	0.000	14.390	14.285	7.812	-	7.812	0.000	0.000	0.000	0.000	0.000	36.487
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The CLAWS INP effort will develop an autonomous unmanned undersea weapon system capable of providing offensive effects to the Combatant Commanders beyond Phase 0 inside the first island chain. It will clandestinely extend the reach of large UUVs and increase the mission areas into kinetic effects. CLAWS will deliver algorithms to enable all families of UUVs to operate in complex, dynamic and degraded environments. CLAWS will demonstrate autonomous missions in denied waters, develop and demonstrate autonomous technologies for survivability of large UUVs, and develop autonomy and launch capabilities for special mission payloads. CLAWS will be able to complete missions 1&2 against near peer adversary defenses, maintain critical communication with Navy C2/Fires and provide critical ISR information. The Activity identified in Project Unit 3451 specifically addresses Advanced Technology Development in support of the CLAWS INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: CLAWS Articles: Description: The CLAWS INP effort will develop an autonomous unmanned undersea weapon system capable of providing offensive effects to the Combatant Commanders beyond Phase 0 inside the first island chain. It will clandestinely extend the reach of large UUVs and increase the mission areas into kinetic effects. CLAWS will deliver algorithms to enable all families of UUVs to operate in complex, dynamic and degraded environments. CLAWS will demonstrate autonomous missions in denied waters, develop and demonstrate autonomous technologies for survivability of large UUVs, and develop autonomy and launch capabilities for special mission payloads. CLAWS will be able to complete missions 1&2 against near peer adversary defenses, maintain critical communication with Navy C2/Fires and provide critical ISR information. FY 2022 Plans: Continue the advanced development of autonomy for classified payload 2. Develop adaptive mission planning for swarm of payload to create kinetic effects. Complete Advanced Technology Development effort in autonomy development for classified payload 1: - Conduct final demonstration with OSD Hydra JCTD - Develop and mature the autonomy for classified payload 1 FY 2023 Base Plans:								14.390	14.285	7.812	0.000	7.812
								-	-	-	-	-

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Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3451 / <i>CLAWS</i>							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
Continue: Continue the advanced development of autonomy for classified payload 2. Develop adaptive mission planning for swarm of payload to create kinetic effects. In FY 23, technical demonstrations for Payload 2 will be completed before final demonstration.											
Complete: Final report and knowledge transfer of technology to navy acquisition											
<i>FY 2023 OCO Plans:</i> N/A											
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The decrease in funding from FY22 to FY23 is due to the completion of the Advanced Technology Development effort in autonomy development for classified payload 1.											
Accomplishments/Planned Programs Subtotals		14.390	14.285	7.812	0.000	7.812					
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0602792N/3451: <i>CLAWS</i>	19.943	25.871	2.475	-	2.475	0.000	0.000	0.000	0.000	0.000	48.289
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3452 / ELEKTRA			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3452: ELEKTRA	0.000	10.242	12.876	9.847	-	9.847	4.924	5.022	0.000	0.000	0.000	42.911
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Complex multi-domain threats can overwhelm the operator and individual platforms ability to defend the force. The ELEKTRA INP effort is developing "Human on the Loop" Artificial Intelligence (AI) enabled algorithms to perform force level kinetic/non-kinetic kill chain optimization and coordination across multiple domains at machine to machine speeds to increase the lethality and survivability of the Force. ELEKTRA will demonstrate AI/ML ability to coordinate kinetic/non kinetic effects autonomously with heterogeneous platforms, the ability to operate in degraded environments for hours and the ability to coordinate and execute domain kill chains simultaneously. It will deploy artificial intelligent (AI) and machine learning (ML) architecture, neural networked computing and large data handling to enable real time, force level effects assignment, coordination and resource management. The Activity identified in Project Unit 3452 specifically addresses Advanced Technology Development in support of the ELEKTRA INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: ELEKTRA Articles: Description: Complex multi-domain threats can overwhelm the operator and individual platforms ability to defend the force. The ELEKTRA INP effort is developing "Human on the Loop" Artificial Intelligence (AI) enabled algorithms to perform force level kinetic/non-kinetic kill chain optimization and coordination across multiple domains at machine to machine speeds to increase the lethality and survivability of the Force. ELEKTRA will demonstrate AI/ML ability to coordinate kinetic/non kinetic effects autonomously with heterogeneous platforms, the ability to operate in degraded environments for hours and the ability to coordinate and execute domain kill chains simultaneously. It will deploy artificial intelligent (AI) and machine learning (ML) architecture, neural networked computing and large data handling to enable real time, force level effects assignment, coordination and resource management. FY 2022 Plans: Continuing efforts will focus on advanced technology development and experimentation. This experimentation will include incorporation of new analytics and decision support functionality, additional non-kinetic and kinetic kill chains, new functionality with airborne platforms, and experimentation with tactical systems on surface and airborne platforms during a large scale exercise. FY 2023 Base Plans:								10.242	12.876	9.847	0.000	9.847
								-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022				
Appropriation/Budget Activity 1319 / 3				R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev			Project (Number/Name) 3452 / ELEKTRA				
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Continue:</p> <p>- Development and implementation of artificial intelligence/machine learning functionality for surface and air platforms to include commander's intent, threat evaluation, engage ability and effector management.</p> <p>- Implementation of distributed maritime operations warfare concepts, effects coordination techniques and human-machine teaming concepts.</p> <p>- Demonstrations of complex kinetic/non-kinetic kill chains and battle management functionality in a multi-platform live virtual construct/live experiment.</p> <p>Initiate:</p> <p>- Integration of feedback from FY22 experimentation and identify new analytics and decision support functionality based on results.</p> <p>- Development and demonstration of new human machine interface and effector coordination functionality into airborne platforms.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding from FY 2022 to FY 2023 is due to maturation and completion of advanced technology development efforts to include: completion of prototype modifications to a surface combat system to enable the use of Elektra functionality in live/live virtual construct environments; completion of a live virtual construct/test environment to allow for persistent testing of Elektra functionality; and completion of at-sea experimentation for evaluation of current functionality.</p>											
Accomplishments/Planned Programs Subtotals							10.242	12.876	9.847	0.000	9.847
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0602792N/3452: ELEKTRA	5.686	3.967	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.653

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022	
Appropriation/Budget Activity 1319 / 3				R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3452 / ELEKTRA			
C. Other Program Funding Summary (\$ in Millions)											
	<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023</u> <u>Base</u>	<u>FY 2023</u> <u>OCO</u>	<u>FY 2023</u> <u>Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To</u> <u>Complete</u> <u>Total Cost</u>
<u>Remarks</u>											
D. Acquisition Strategy											
N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy									Date: April 2022			
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3454 / MDUSV			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3454: MDUSV	0.000	2.514	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.514
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The Medium Displacement Unmanned Surface Vehicle (MDUSV) Project will develop and test a 132 ft. unmanned surface vehicle with ocean-spanning range, months of endurance, good seakeeping, and substantial payload. The vessel will have a high level of autonomy for independent operations under sparse supervisory control and have utility for a variety of Navy missions. MDUSVs capable of deployed blue-water operations with operator trust in safe, reliable operation, long-range and endurance autonomous operations. This will create a new paradigm for Navy surface force, a hybrid manned/unmanned force, and enable new tactics in performing naval missions. The Activity identified in Project Unit 3454 specifically addresses Advanced Technology Development in support of the MDUSV INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: MDUSV Articles: Description: The Medium Displacement Unmanned Surface Vehicle (MDUSV) Project will develop and test a 132 ft. unmanned surface vehicle with ocean-spanning range, months of endurance, good seakeeping, and substantial payload. The vessel will have a high level of autonomy for independent operations under sparse supervisory control and have utility for a variety of Navy missions. MDUSVs capable of deployed blue-water operations with operator trust in safe, reliable operation, long-range and endurance autonomous operations. This will create a new paradigm for Navy surface force, a hybrid manned/unmanned force, and enable new tactics in performing naval missions. FY 2022 Plans: N/A FY 2023 Base Plans: N/A FY 2023 OCO Plans: N/A								2.514	0.000	0.000	0.000	0.000
								-	-	-	-	-
Accomplishments/Planned Programs Subtotals								2.514	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy							Date: April 2022		
Appropriation/Budget Activity 1319 / 3				R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev			Project (Number/Name) 3454 / MDUSV		

C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0602792N/3454: MDUSV	4.570	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.570

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3455 / MINERVA			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3455: MINERVA	0.000	10.307	12.876	11.816	-	11.816	6.894	7.031	0.000	0.000	0.000	48.924
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The need to operate in a multiple domain environment against highly capable peers requires improved decision quality and reduced decision timelines. MINERVA will develop AI and Machine-Learning (ML) capabilities to improve mission planning, intelligence gathering, execution and assessment. Minerva will deliver next-generation decision aids by combining operations research with emerging AI capabilities to create learning, self-adaptive automation that supports Composite Warfare Commander's (CWC) and their staffs at the Fleet, Force and Group echelons. It will establish a DevOps environment that includes warfighter staffs in the development and integration of new capabilities. The Activity identified in Project Unit 3455 specifically addresses Advanced Technology Development in support of the MINERVA INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: MINERVA Articles: Description: The need to operate in a multiple domain environment against highly capable peers requires improved decision quality and reduced decision timelines. MINERVA will develop AI and Machine-Learning (ML) capabilities to improve mission planning, intelligence gathering, execution and assessment. Minerva will deliver next-generation decision aids by combining operations research with emerging AI capabilities to create learning, self-adaptive automation that supports Composite Warfare Commander's (CWC) and their staffs at the Fleet, Force and Group echelons. It will establish a DevOps environment that includes warfighter staffs in the development and integration of new capabilities. FY 2022 Plans: Continue research on Artificial Intelligence and Machine Learning (AI/ML) methods to infer an enemy course of action and predict enemy locations. In addition, measure mission planning services, mission execution and adjustment services; and human acceptance of AI/ML decision aid services. Develop methods to test and validate AI/ML enabled decision aiding services. Specific FY22 focused development efforts include: negative search feedback to the Common Operational Picture; dynamic adaptive waterspace management; operational level of war planning that accounts for adversary constraints; maneuver planning capability combined with a weapon-sensor-effect-target assignment algorithms; machine learning algorithms to predict and make inferences about enemy intended actions; multi-domain battle management automation planner; demonstration of current								10.307	12.876	11.816	0.000	11.816
								-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022				
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev		Project (Number/Name) 3455 / MINERVA		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>and predicted evaluation of composability of operational systems and force packages; and continue to mature, test, and demonstrate best practices of artificial intelligence and machine learning methods to improve mission planning efficiency.</p> <p>FY 2023 Base Plans:</p> <p>Continue:</p> <ul style="list-style-type: none">- to develop models that exploit intelligence information and tactical contact reporting to generate probabilistic estimates of target location, intended mission, and projected future location even in face of large time gaps between contacts reports and high degrees of uncertainty over intended target mission.- to develop a multi-objective planner (time scale of days, not hours) that optimizes the limited number of Navy and Marine Corps platforms/assets based on an adversary's order of battle.- to develop a dynamic waterspace "area" planner that enables staff planners to evaluate developing plans across the seven joint operational functions (command and control, information, intelligence, fires, movement and maneuver, protection, and sustainment).- to develop advanced analytics and prototyping for operational level of war staff planners to optimize Navy and Marine- to develop mixed linear integer program model that assigns air, surface, and undersea effects to a grouping of moving defended targets that can shoot down incoming salvos that can't be targeted until, say, a sensor window on day three.- to develop reinforcement learning models that learn from in-situ and historical data in predicting the next location of the adversary platform location.- to develop a multi-objective multi-warfare domain planner for Future Operations (FOPS) planners to generate and share products used to convey operational and tactical plans.- to experiment and test in real world events and training exercises to improve Minerva's analytic tools. Measure effectiveness of mission planning services, mission execution and adjustment services; and human acceptance of artificial intelligence / machine learning decision aid services. <p>Complete:</p> <ul style="list-style-type: none">- integration of unit readiness data into Minerva applications. Up-to-date readiness data combined with Minerva's planning analytic algorithms will help staff planners evaluate Risk to Force / Risk to Mission.- optimized negative search algorithm to aid Maritime Operations Center staff in understanding tradeoff between sensor placement and risk of missing threat.						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototype s (INP) Adv Tec Dev</i>		Project (Number/Name) 3455 / MINERVA							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
<p>- automated analytics tool to monitor, ingest, parse, and exploit naval chat message traffic in real-time with little to no human intervention. The tool extracts and associates events with their arguments and locations from chat messages. The tool monitors chatrooms to answer questions of who/what/when/where from unstructured text (e.g., naval 9-line reports).</p> <p>Initiate: - mission planning tools for Maritime Operations Center (MOC) logistics planning.</p> <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The decrease in funding from FY2022 to FY2023 is due to automated analytics tools and sensor tradeoff algorithm development.</p>											
Accomplishments/Planned Programs Subtotals		10.307	12.876	11.816	0.000	11.816					
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RD TEN/0602792N/3455: MINERVA	5.710	3.966	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.676
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev				Project (Number/Name) 3456 / Full Spectrum Undersea Warfare			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3456: Full Spectrum Undersea Warfare	0.000	0.000	0.000	8.910	-	8.910	9.900	9.900	9.900	10.098	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Full Spectrum Undersea Warfare (FSUW) Project will develop new technology for offensive and defensive warfare conducted on the seabed, in the sea (i.e. subsea), and from the sea. This INP focuses on Theatre Undersea Warfare (TUSW), Joint Targeting and Strike, and Subsea and Seabed Warfare (SSW). There are five thrust areas of the FSUW INP that are key to enabling Chief of Naval Operations Guidance (CNOG), Distributed Maritime Operations (DMO), and the Commandant's Stand in Force with manned and unmanned warfighting capability. These thrust areas were specifically chosen in direct collaboration with STRATCOM, INDO-PACOM, Fleet and Undersea Warfare Commanders and validated with regular Flag engagements. These advanced technology developments will enable future undersea weapon systems (e.g., Maritime Strike Tomahawk and ADCAP variants), COCOM campaign, and operational plans. FSUW thrust areas include 1) Undersea effectors, 2) Integrated expeditionary subsea system of systems, 3) Multi-Vehicle Torpedo Tube Development System (MVTDS) for payload A, 4) Undersea UAV for Over-The-Horizon (OTH) effects and 5) Undersea Launched Devices to enable Commanding Officers and Regional Combatant Commander effects. The thrust areas are technically an operational interconnected. Selected concepts from advanced research will be integrated into viable representative prototypes for field experimentation in a relevant environment. Lessons learned from field experimentation will inform continued applied research spirals to remedy technical shortcomings, expand capability, or define an alternate approach. The Activity identified in Full Spectrum Undersea Warfare, Project 3458, specifically addresses Advanced Technology Development in support of the Full Spectrum Undersea Warfare INP effort. The Applied Research Budget Activity (BA) 2 funding is in a separate Program Element (PE) 0602792N FSUW INP, Project 3456.

Information security concerns preclude fully detailed descriptions of project efforts, research activities, and technology development plans. Specific information on each project and activity will be provided separately to the Congressional oversight committees.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Full Spectrum Undersea Warfare (FSUW)	0.000	0.000	8.910	0.000	8.910
Articles:	-	-	-	-	-
FY 2022 Plans: N/A					
FY 2023 Base Plans: Continue: Advanced Technology Development associated with the Multi-Vehicle Torpedo Tube Deployment System prototype for Virginia Class submarines including - Prototype construction					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3456 / <i>Full Spectrum Undersea Warfare</i>		
<u>B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)</u>						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none"> - Full scale prototype testing - Reload scaled testing <p>Complete: Design Multi-Vehicle Torpedo Tube Deployment System (MVTADS) prototype for Virginia Class submarines.</p> <p>Initiate:</p> <ul style="list-style-type: none"> - Reload viability and features of the MVTADS (Reloader) - Joint undersea surveillance and targeting UUV sensors for autonomously conducting specific undersea tasks - Small autonomous undersea launched devices. <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase in funding in Proj: 3456 FSUW is due to placing the Full Spectrum Undersea Warfare (FSUW) INP in a Project Number that complements its BA2 Project number like all other INPs. All funds from Project 3458 Undersea Warfare Efforts are now in this corrected Project, which is now properly named. Funding growth from FY 2022 to FY 2023 is due to the maturing of the Applied Research phase and the planned ramp-up in Advanced Technology Development which will focus on concept and technology demonstrations.</p>						
Accomplishments/Planned Programs Subtotals		0.000	0.000	8.910	0.000	8.910
<u>C. Other Program Funding Summary (\$ in Millions)</u> N/A						
<u>Remarks</u>						
<u>D. Acquisition Strategy</u> N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3457 / Long Range Targeting			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3457: Long Range Targeting	0.000	7.425	15.941	24.750	-	24.750	44.400	29.300	22.500	0.000	0.000	144.316
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Long Range Targeting emphasizes the specific naval use of HF Over the Horizon Radar (OTHR) on maritime platforms and forward-based positive identification technologies to fill gaps in long-range fires kill chains. Technologies within this activity will enable integrated long range naval fires. Investments include technologies for OTH radar antennas, HF antenna arrays, signal processing, and electronic surveillance. Activity identified in Project Unit 3457 specifically addresses Advanced Technology Development in support of the LRT INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
Title: Long Range Targeting							7.425	15.941	24.750	0.000	24.750	
Articles:							-	-	-	-	-	
Description: Long Range Targeting emphasizes the specific naval use of HF Over the Horizon Radar (OTHR) on maritime platforms and forward-based positive identification technologies to fill gaps in long-range fires kill chains. Technologies within this activity will enable integrated long range naval fires. Investments include technologies for OTH radar antennas, HF antenna arrays, signal processing, and electronic surveillance. Activity identified in Project Unit 3457 specifically addresses Advanced Technology Development in support of the LRT INP effort.												
FY 2022 Plans:												
Continue to refine the Long Range Targeting framework/architecture. Continue development efforts to incorporate methods and develop technology for beyond-line-of-sight communications and exploit Over-the-Horizon (OTH) sensors, In-Scene aids, and sense making phenomenology to refine BLOS target detection, track and positive identification. Continue planning for test, integration, demonstration and experiment activities for Long Range Targeting. Begin development of technologies to integrate track data with other sources to feed Battle Management Command and Control (BMC2) kill chain algorithms with the objective of supporting live missions.												
FY 2023 Base Plans:												
- Continue development efforts to incorporate methods and develop technology to exploit Over-the-Horizon (OTH) sensors, In-Scene aids, and sense making phenomenology to refine BLOS target detection, track and positive identification.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3457 / <i>Long Range Targeting</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none"> - Continue planning for test, integration, demonstration and experiment activities for Long Range Targeting. - Continue development of technologies to integrate track data with other sources to feed Battle Management Command and Control (BMC2) kill chain algorithms with the objective of supporting live missions. Continue MOTHER software development; Analyze data from recent HF demonstrations. - Complete the refinement of LRT framework/architecture; Initial increment of MOTHER software; and Test planning for In-Scene Aids data collection #2. - Initiate At-sea HF phenomenology data collection. <p><i>FY 2023 OCO Plans:</i> N/A</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Increase in funding from FY 2022 to FY 2023 is due to development of an Afloat Mobile/Maritime Over the Horizon Radar (MOTHER) to support long range sensing and targeting.</p>						
Accomplishments/Planned Programs Subtotals		7.425	15.941	24.750	0.000	24.750
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev				Project (Number/Name) 3458 / Undersea Warfare Efforts			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3458: Undersea Warfare Efforts	0.000	2.356	6.967	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.323
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Undersea Warfare Efforts Project will develop new technology for offensive and defensive warfare conducted on the seabed, in the sea (i.e. subsea), and from the sea. Undersea Warfare Efforts as part of Full Spectrum Undersea Warfare (FSUSW) focuses on Theatre Undersea Warfare (TUSW), Joint Targeting and Strike, and Subsea and Seabed Warfare (SSW). There are five thrust areas of the Undersea Warfare Efforts that are key to enabling Chief of Naval Operations Guidance (CNOG), Distributed Maritime Operations (DMO), and the Commandant's Stand in Force with manned and unmanned warfighting capability. These thrust areas were specifically chosen in direct collaboration with STRATCOM, INDO-PACOM, Fleet and Undersea Warfare Commanders and validated with regular Flag engagements. These advanced technology developments will enable future undersea weapon systems (e.g., Maritime Strike Tomahawk and ADCAP variants), COCOM campaign, and operational plans. Undersea Warfare Efforts thrust areas include 1) Undersea effectors, 2) Integrated expeditionary subsea system of systems, 3) Multi-Vehicle Torpedo Tube Development System (MVTDS) for payload A, 4) Undersea UAV for Over-The-Horizon (OTH) effects and 5) Undersea Launched Devices to enable Commanding Officers and Regional Combatant Commander effects. The thrust areas are technically an operational interconnected. Selected concepts from advanced research will be integrated into viable representative prototypes for field experimentation in a relevant environment. Lessons learned from field experimentation will inform continued applied research spirals to remedy technical shortcomings, expand capability, or define an alternate approach. The Activity identified in the Undersea Warfare Efforts, Project 3458, specifically addresses Advanced Technology Development in support of the Full Spectrum Undersea Warfare INP effort. The Applied Research Budget Activity (BA) 2 funding is in a separate Program Element (PE) 060279N FSUSW INP, Project 3456.

Information security concerns preclude fully detailed descriptions of project efforts, research activities, and technology development plans. Specific information on each project and activity will be provided separately to the Congressional oversight committees.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Undersea Warfare Efforts	2.356	6.967	0.000	0.000	0.000
Articles:	-	-	-	-	-
Description: The Undersea Warfare Efforts Project will develop new technology for offensive and defensive warfare conducted on the seabed, in the sea (i.e. subsea), and from the sea. Undersea Warfare Efforts as part of Full Spectrum Undersea Warfare (FSUSW) focuses on Theatre Undersea Warfare (TUSW), Joint Targeting and Strike, and Subsea and Seabed Warfare (SSW). There are five thrust areas of the Undersea Warfare Efforts that are key to enabling Chief of Naval Operations Guidance (CNOG), Distributed Maritime Operations (DMO), and the Commandant's Stand in Force with manned and unmanned warfighting capability. These thrust areas were specifically chosen in direct collaboration with STRATCOM, INDO-PACOM, Fleet and Undersea Warfare					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022			
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev		Project (Number/Name) 3458 / Undersea Warfare Efforts		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Commanders and validated with regular Flag engagements. These advanced technology developments will enable future undersea weapon systems (e.g., Maritime Strike Tomahawk and ADCAP variants), COCOM campaign, and operational plans. Undersea Warfare Efforts thrust areas include 1) Undersea effectors, 2) Integrated expeditionary subsea system of systems, 3) Multi-Vehicle Torpedo Tube Development System (MVTADS) for payload A, 4) Undersea UAV for Over-The-Horizon (OTH) effects and 5) Undersea Launched Devices to enable Commanding Officers and Regional Combatant Commander effects. The thrust areas are technically an operational interconnected. Selected concepts from advanced research will be integrated into viable representative prototypes for field experimentation in a relevant environment. Lessons learned from field experimentation will inform continued applied research spirals to remedy technical shortcomings, expand capability, or define an alternate approach. The Activity identified in the Undersea Warfare Efforts, Project 3458, specifically addresses Advanced Technology Development in support of the Full Spectrum Undersea Warfare INP effort. The Applied Research Budget Activity (BA) 2 funding is in a separate Program Element (PE) 060279N FSUSW INP, Project 3456.						
Information security concerns preclude fully detailed descriptions of project efforts, research activities, and technology development plans. Specific information on each project and activity will be provided separately to the Congressional oversight committees.						
FY 2022 Plans: Continued Advanced Technology Development associated with the Multi-Vehicle Torpedo Tube Deployment System prototype for Virginia Class submarines using including - Prototype component tank testing - Assessment of reload viability and features						
FY 2023 Base Plans: N/A						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The decrease in funding in FY 2022 to FY 2023 is due to placing all funds from Project 3458 Undersea Warfare Efforts, which were all associated with the Full Spectrum Undersea Warfare (FSUW) INP, into a new Project						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022	
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3458 / <i>Undersea Warfare Efforts</i>	
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
3456 Full Spectrum Undersea Warfare, that complements the Full Spectrum Undersea Warfare BA2 Project number like all other INPs.					
Accomplishments/Planned Programs Subtotals	2.356	6.967	0.000	0.000	0.000
C. Other Program Funding Summary (\$ in Millions) N/A					
Remarks					
D. Acquisition Strategy N/A					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3459 / Super Swarm (SS)			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3459: Super Swarm (SS)	0.000	5.804	9.957	14.850	-	14.850	19.800	19.800	0.000	0.000	0.000	70.211
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
Swarming is a concept that allows for multi-domain, heterogeneous swarms of unmanned systems capable of rendering the counter's ability to scale either inadequate or irrelevant and includes offensive and defensive operations, own and adversarial employment, and a physical battlespace ranging from open ocean to ashore. The Super Swarm (SS) INP effort will develop an autonomous control system for multiple USV's consisting of cooperative task allocation, cooperative route planning/behaviors and shared situational awareness. The Swarm autonomy technology is leveraged by other programs including the Medium Displacement Unmanned Surface Vehicle (MDUSV) and the Autonomous USV FNC program. It will consist of the employment of sustainable large-scale robotic swarm warfare across all domains ahead of our adversaries to obviate costly and vulnerable legacy platforms and to gain a competitive advantage. The Activity identified in Project Unit 3459 specifically addresses Advanced Technology Development in support of the Super Swarm INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Super Swarm (SS) Articles: Description: Swarming is a concept that allows for multi-domain, heterogeneous swarms of unmanned systems capable of rendering the counter's ability to scale either inadequate or irrelevant and includes offensive and defensive operations, own and adversarial employment, and a physical battlespace ranging from open ocean to ashore. The Super Swarm (SS) INP effort will develop an autonomous control system for multiple USV's consisting of cooperative task allocation, cooperative route planning/behaviors and shared situational awareness. The Swarm autonomy technology is leveraged by other programs including the Medium Displacement Unmanned Surface Vehicle (MDUSV) and the Autonomous USV FNC program. It will consist of the employment of sustainable large-scale robotic swarm warfare across all domains ahead of our adversaries to obviate costly and vulnerable legacy platforms and to gain a competitive advantage. FY 2022 Plans: Continue efforts focused on interaction of multiple autonomy architectures across multiple domains and platforms to generate coordinated and optimized behaviors for the delivery of effects on target. Due to increase needed on several technology discovery areas associated with the overarching Super Swarm concept, three activities established to support overall program goals and are addressed separately. FY 2023 Base Plans:								5.804	9.957	14.850	0.000	14.850
								-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3459 / <i>Super Swarm (SS)</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Continue efforts focused on interaction of multiple autonomy architectures across multiple domains and platforms to generate coordinated and optimized behaviors for the delivery of effects on target.						
Initiate efforts in dynamic and reactive swarm optimization for complex, highly defended target scenarios.						
Initiate efforts for heterogeneous platform launch integration onto objective Deployment and Employment of Autonomous Long Range Systems (DEALRS) (Project 3462) swarm delivery marsupial host platform.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 is due to the planned increase in both small-scale and full-scale platform development and experimentation.						
Accomplishments/Planned Programs Subtotals		5.804	9.957	14.850	0.000	14.850
C. Other Program Funding Summary (\$ in Millions) N/A						
Remarks						
D. Acquisition Strategy N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototype s (INP) Adv Tec Dev				Project (Number/Name) 3461 / MASS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3461: MASS	0.000	0.000	0.988	3.960	-	3.960	4.950	4.950	0.000	0.000	0.000	14.848
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
Note This activity is being broken out from Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA3 level.												
A. Mission Description and Budget Item Justification The rising use of air, surface, and sub-surface unmanned and autonomous systems requires a paradigm shift in the development, production, and life-cycle management of these systems in order to gain a competitive advantage against adversarial capabilities as well as allow for fielding of significant numbers (1000's to 10,000's) in an increasingly budget-constrained acquisition environment. The growth in rapid prototyping and additive manufacturing technologies presents an opportunity to capitalize on these advances though technical development and demonstration efforts focused on scale-up both in terms of rapid production of relevant quantities as well as greatly increasing the physical size of platforms produced far beyond what is currently achievable. Manufacturing of Autonomous Systems at Scale (MASS) efforts will utilize wide range of advanced manufacturing methods combined with adaptive digital design processes with "Design for Low-Cost Platform Attriteability" as a major attribute to avoid the platform cost growths normally associated with exquisite systems development. This also represents the ability to rapidly modify platform attributes based on evolving operational needs and quickly insert into build process without costly retooling. Secondary goals focus on increasing commonality of critical components across platforms and design of these in modular fashion in order to manage supply chain vulnerability. Lastly, the project will look at ability to place manufacturing capability as far forward/afloat as possible to reduce the logistics tail and speed delivery of capability at-scale into the fleet. The activity identified in Project Unit 3461 MASS specifically addresses Advanced Technology Development in support of the MASS effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
Title: Manufacture of Autonomous Systems at Scale (MASS) Articles: FY 2022 Plans: Continue Manufacturing of Autonomous Systems at Scale (MASS) experimentation and demonstration efforts to build and employ the use of advanced manufacturing methods combined with Designed for Attriteability platforms as the enablers for Project Unit 3459 - Super Swarm - Overwhelming Swarm Effects. FY 2023 Base Plans: Continue Manufacturing of Autonomous Systems at Scale (MASS) efforts to utilize wide range of advanced manufacturing methods based on design for affordable attritability.							0.000	0.988	3.960	0.000	3.960	
							-	-	-	-	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3461 / MASS							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
Continue MASS digital design efforts to couple rapid adaptive processes focused on large scale (both size and quantity) Super Swarm (Project 3459) and Deployment and Employment of Autonomous Long Range Systems (DEALRS) (Project 3462) platforms of interest.											
Complete MASS experimentation and demonstration efforts of sub/small scale platform concept demonstrators.											
Initiate rapidly reconfigurable tooling for large scale structures to enable rapid design iteration / evolution in response to threats.											
Initiate low-rate batch manufacturing of small-scale platforms in field environments.											
Initiate initial exploration of application of methodologies to larger-scale structures, components, and platforms across all domains.											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The increase in FY 2023 is due to increasing research of manufacturing methods as applied to various types of platforms in order to achieve the goals of the program and an FY22 congressional mark.											
Accomplishments/Planned Programs Subtotals		0.000	0.988	3.960	0.000	3.960					
C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDTEN/0602792N/3461: MASS	0.000	4.487	4.950	-	4.950	7.920	0.000	0.000	0.000	0.000	17.357
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3462 / DEALRS			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3462: DEALRS	0.000	0.000	0.987	4.950	-	4.950	5.940	5.940	7.920	8.078	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

Note

This activity is being broken out from Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA3 level.

A. Mission Description and Budget Item Justification

Adversary Anti-Access and Area Denial (A2/AD) capabilities continue to improve but remain focused on targeting specific US and joint force capabilities. The Deployment and Employment of Autonomous Long Range Systems (DEALRS) project will develop technologies that sidestep, operate below the threshold, or deplete adversary A2/AD capabilities. DEALRS will specifically develop technologies to enable low-cost unmanned systems that can maneuver across theater-level ranges to penetrate, operate within, and launch strikes from within adversary A2/AD system coverage. This project will develop technologies to increase the range and endurance of autonomous systems while maintaining tactically relevant speeds, loiter times, and signatures with low cost. It will also address technologies that enable the marsupial launch of terminal engagement autonomous unmanned systems across all domains from larger and/or longer-range host systems that bring them to the launch area and the associated technologies needed to ensure roboticized and autonomous startup and launch of the marsupial systems without human intervention. The Activity identified in Project Unit 3462 DEALRS specifically addresses Advanced Technology Development in support of the INP effort.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Deployment & Employment of Autonomous Long Range Systems (DEALRS)	0.000	0.987	4.950	0.000	4.950
Articles:	-	-	-	-	-
Description: Adversary Anti-Access and Area Denial (A2/AD) capabilities continue to improve but remain focused on targeting specific US and joint force capabilities. The Deployment and Employment of Autonomous Long Range Systems (DEALRS) project will develop technologies that sidestep, operate below the threshold, or deplete adversary A2/AD capabilities. DEALRS will specifically develop technologies to enable low-cost unmanned systems that can maneuver across theater-level ranges to penetrate, operate within, and launch strikes from within adversary A2/AD system coverage. This project will develop technologies to increase the range and endurance of autonomous systems while maintaining tactically relevant speeds, loiter times, and signatures with low cost. It will also address technologies that enable the marsupial launch of terminal engagement autonomous unmanned systems across all domains from larger and/or longer-range host systems that bring them to the launch area and the associated technologies needed to ensure roboticized and autonomous startup and launch of the marsupial systems without human intervention. The Activity identified in					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev		Project (Number/Name) 3462 / DEALRS		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Project Unit 3462 DEALRS specifically addresses Advanced Technology Development in support of the INP effort.						
FY 2022 Plans: Continue efforts to demonstrate concepts for the Deployment and Employment of Autonomous Long Range Systems (DEALRS) across all domains. Efforts will focus on scaling up promising concepts to demonstrate trans-Oceanic deployment and employment of large numbers of unmanned systems to deliver desired effects in the areas of operation.						
FY 2023 Base Plans: - Continue efforts to explore concepts for the Deployment and Employment of Autonomous Long Range Systems (DEALRS) across all domains. Efforts will focus on platforms enhancements as well as marsupial concepts to allow extremely large numbers of systems to traverse long distances with minimal human intervention to bring them into the operations area. - Continue efforts to demonstrate concepts for DEALRS across all domains. Efforts will focus on scaling up promising concepts to demonstrate trans-Oceanic deployment and employment of large numbers of unmanned systems to deliver desired effects in the areas of operation. - Initiate efforts on scaling up promising concepts to demonstrate trans-Oceanic deployment of low-cost attritable swarm agents and platforms. This will be informed by FY22 and early FY23 Super Swarm (Project 3459), Manufacture of Autonomous Systems at Scale (MASS) (Project 3461) and Manned / Autonomous Teams (MATes) (Project 3463) activities. BA3 efforts will focus on swarm agent range/ endurance enhancements and swarm delivery marsupial host platform development beyond the BA2 level.						
FY 2023 OCO Plans: N/A						
FY 2022 to FY 2023 Increase/Decrease Statement: FY2022 to FY2023 increase associated with initiating efforts on scaling up promising concepts to demonstrate trans-Oceanic deployment of low-cost attritable swarm agents and platforms. Efforts will focus on swarm agent range/ endurance enhancements and swarm delivery marsupial host platform development.						
Accomplishments/Planned Programs Subtotals		0.000	0.987	4.950	0.000	4.950

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022	
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev	Project (Number/Name) 3462 / DEALRS	

C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RD TEN/0602792N/3462: DEALRS	0.000	5.983	6.930	-	6.930	10.890	6.930	0.000	0.000	0.000	30.733

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3463 / MATes			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3463: MATes	0.000	0.000	0.987	3.960	-	3.960	4.950	4.950	13.860	14.137	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
Note This activity is being broken out from Project Unit 3459 Super Swarm to provide increased visibility and focus on this technical challenge area at the BA3 level.												
A. Mission Description and Budget Item Justification Traditionally, the utilization of autonomous systems is either operationally segregated from manned operations or requires a significant amount of human oversight when operating in conjunction with manned assets, which mitigates some of the advantage from using them. The goal of the Manned and Autonomous Teams (MATes) project is to develop autonomic robotic technology and collaborative autonomous behaviors that seamlessly operate across all domains in conjunction with manned units, allowing for real-time adaptation and optimization in a manner that streamlines the element of human interaction needed to share mission goals. This technology will monitor human or manned system teammate state, behavior, mission, and adversary threat status to anticipate and act in a tactically appropriate manner that is predictable, communicable, and trusted by the human/manned teammates and which enables autonomous system optimization in coordination with the human/manned teammate and mission objectives. Intuitive human/autonomous system interfaces will be developed to allow focus on higher-order decision-making tasks by the operators allowing for large numbers of autonomous systems (100's or 1000's) to be managed in support of manned operations. The activity identified in Project Unit 3463 MATes specifically addresses Advanced Technology Development in support of the MATes effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)												
							FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
Title: Manned and Autonomous Teams (MATes)							0.000	0.987	3.960	0.000	3.960	
Articles:							-	-	-	-	-	
FY 2022 Plans: Continue efforts to explore autonomy, perception, and command and control (C2) concepts for Manned and Autonomous Teams (MATES) conducting complex multi-domain operations in proximity to each other along a spectrum of missions. Missions range from fully autonomous to highly supervised requiring an agile optimization as real-world factors change.												
FY 2023 Base Plans: Continue efforts to explore autonomy, perception, and command and control (C2) concepts for Manned and Autonomous Teams (MATES) conducting complex multi-domain operations in proximity to each other along a spectrum of missions. Missions range from fully autonomous to highly supervised requiring an agile optimization as real-world factors change.												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022							
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototype s (INP) Adv Tec Dev</i>		Project (Number/Name) 3463 / MATes							
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)											
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total					
Continue efforts to explore autonomy, perception, and command and control (C2) concepts for MATES conducting complex multi-domain operations in proximity to each other along a spectrum of missions.											
Initiate demonstration of multiple autonomy architectures across multiple domains conducting re-optimizing behaviors based on changing mission parameters and perception data. Agents will be Super Swarm (Project 3459) agents, and efforts will mutually inform tactical behavior, perception, and autonomy schemas.											
Initiate experiments to validate command and control with different levels of human oversight and trust.											
FY 2023 OCO Plans: N/A											
FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY2022 and FY2023 is due to initiation of demonstrations of multiple autonomy architectures across multiple domains conducting re-optimizing behaviors based on changing mission parameters and perception data. Funding increase also support experiments to validate command and control with different levels of human oversight and trust.											
Accomplishments/Planned Programs Subtotals		0.000	0.987	3.960	0.000	3.960					
C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0602792N/3463: MATes	0.000	4.986	6.435	-	6.435	9.900	9.900	4.950	5.049	Continuing	Continuing
Remarks											
D. Acquisition Strategy N/A											

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 3464 / REDCAT			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3464: REDCAT	0.000	0.000	3.976	8.000	-	8.000	6.000	6.000	0.000	0.000	0.000	23.976
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Remote Electromagnetic Disruption of Critical Advanced Threats (REDCAT) will demonstrate High Power Microwave (HPM) integration onto Naval platforms for air defense missions. The objective of the REDCAT rapid prototyping effort is to demonstrate that the REDCAT system is able to detect, track, engage, defeat and assess advanced threats to the ship in a maritime environment. This HPM payload capability will supplement and conserve the ships kinetic defensive weapons. In addition to advancing the HPM source and antenna technologies, this program will also enhance sensor systems well as common weapon console with ongoing laser programs. REDCAT will also develop novel Radio Frequency (RF) waveforms to improve HPM effectiveness. When combined with other non-kinetic capabilities and integrated with the ship's command and control (C2), REDCAT will provide a low cost-per-shot, deep magazine capability for significantly expanding the self-defense capabilities of US Navy platforms. Rapid engagement of targets for large threat raid defeat is a major feature of the system. The system will demonstrate full kill chain integration from find to assess. The payoffs for the REDCAT program include integrated non-kinetic air defense systems to improve the layered defense, optimized use of defensive kinetic weapons and improved sensor and control systems.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: REDCAT HPM Test Bed	0.000	3.976	8.000	0.000	8.000
Articles:	-	-	-	-	-
Description: Remote Electromagnetic Disruption of Critical Advanced Threats (REDCAT) will demonstrate High Power Microwave (HPM) integration onto Naval platforms for air defense missions. The objective of the REDCAT rapid prototyping effort is to demonstrate that the REDCAT system is able to detect, track, engage, defeat and assess advanced threats to the ship in a maritime environment. This HPM payload capability will supplement and conserve the ships kinetic defensive weapons. In addition to advancing the HPM source and antenna technologies, this program will also enhance sensor systems well as common weapon console with ongoing laser programs. REDCAT will also develop novel Radio Frequency (RF) waveforms to improve HPM effectiveness. When combined with other non-kinetic capabilities and integrated with the ship's command and control (C2), REDCAT will provide a low cost-per-shot, deep magazine capability for significantly expanding the self-defense capabilities of US Navy platforms. Rapid engagement of targets for large threat raid defeat is a major feature of the system. The system will demonstrate full kill chain integration from find to assess. The payoffs for the REDCAT program include integrated non-kinetic air defense systems to improve the layered defense, optimized use of defensive kinetic weapons and improved sensor and control systems. This effort will also develop and HPM test bed and perform capability demonstrations to fill gaps in effects and mission					

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy				Date: April 2022		
Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603801N / <i>Innovative Naval Prototypes (INP) Adv Tec Dev</i>		Project (Number/Name) 3464 / REDCAT		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)						
		FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>modeling of HPM weapons. This includes providing specific measurable data to inform the Terminal Defense NIF gap assessment & closure plans. The goal of the government-developed HPM test bed is to:</p> <ul style="list-style-type: none"> - Evaluate existing REDCAT prototype hardware for performance and suitability evaluation - Develop detailed effects understanding of HPM lethality capability and thresholds - Inform HPM system requirements and a ship deployable HPM system design <p>FY 2022 Plans: Complete HPM payload build, system level performance analysis and mission level modeling. Complete full HPM, sensor and control console system integration. Complete full system land based testing as a risk reduction to at sea testing. Perform capability demonstration in operationally relevant maritime environment against representative threat surrogates. Demonstrate full kill chain integration from find to assess.</p> <p>FY 2023 Base Plans: Continue advanced technology development in support of the REDCAT INP. Specific efforts include the following:</p> <ul style="list-style-type: none"> - Complete the HPM test bed - Begin integration testing for HPM/EW effects based requirements development. - Contract for antenna completion. - Effects testing initiation and analysis across Navy labs, JHU-APL, and Raytheon. <p>Key Deliverables: Test bed hardware and drawings, Pulsed power assessment test report, EW techniques test report, Mission modeling analysis report, Effects based modeling framework</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY 2022 to FY 2023 in Proj: 3464 REDCAT is to complete the test bed and begin integration testing for HPM/EW effects-based requirements development.</p>						
Accomplishments/Planned Programs Subtotals		0.000	3.976	8.000	0.000	8.000
C. Other Program Funding Summary (\$ in Millions)						
N/A						

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev	Project (Number/Name) 3464 / REDCAT
C. Other Program Funding Summary (\$ in Millions)		
Remarks		
D. Acquisition Strategy		
N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 5899 / Precision Fire Control			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5899: Precision Fire Control	0.000	0.000	0.000	0.527	-	0.527	8.673	10.352	19.520	15.128	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification												
The Precision Fire Control (PFC) effort will develop a fire control architecture that delivers high precision, high update rate guidance solutions to enable cruise missile defense with small, low-cost interceptors and dramatically increase number of interceptors per ship or Expeditionary Advanced Base. It will develop fire control capability for multiple interceptors (missiles and gun projectiles) that contribute to layered defense of surface combatants, expeditionary forces, and homeland protection. Develop PFC-enabled low-cost missile (LCM) based on existing 2.75" rocket components.												
The Activity identified in Proj: 5899 Precision Fire Control (PFC) specifically addresses Advanced Technology Development in support of the PFC INP effort.												
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)								FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Precision Fire Control Articles: FY 2022 Plans: N/A FY 2023 Base Plans: Initiate Advanced Technology Development in support of the Precision Fire Control (PFC)INP. Specific efforts include the following: - Begin prototyping of PFC fire control elements and Hyper Velocity Projectile (HPV) flight test units. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase in funding from FY22 to FY23 in Proj: 5899 Precision Fire Control (PFC) is due to the initiation of this Project.								0.000	0.000	0.527	0.000	0.527
								-	-	-	-	-
Accomplishments/Planned Programs Subtotals								0.000	0.000	0.527	0.000	0.527
C. Other Program Funding Summary (\$ in Millions)												
N/A												

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev	Project (Number/Name) 5899 / Precision Fire Control
C. Other Program Funding Summary (\$ in Millions)		
Remarks		
D. Acquisition Strategy		
N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy										Date: April 2022		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev				Project (Number/Name) 9999 / Congressional Adds			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
9999: Congressional Adds	0.000	19.307	37.300	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.607
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		
A. Mission Description and Budget Item Justification Congressional Interest Items not included in other Projects.												
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2021	FY 2022			
Congressional Add: Electromagnetic Railgun FY 2021 Accomplishments: FY21 Congressional Add funds were used to complete Railgun INP final demonstrations and continue demonstrating Railgun and Hypervelocity Projectile (HVP) capabilities. Funding also advanced HVP development with tests to demonstrate HVP survivability and maneuverability, alternative fire control techniques, and Naval Surface Fire Support. Railgun technology and knowledge attained was documented and preserved. Railgun hardware was realigned to maximize its sustainability to facilitate potential future use. FY 2022 Plans: N/A								19.307	0.000			
Congressional Add: High speed laser cooling systems FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct high speed laser cooling systems advanced technology development								0.000	6.000			
Congressional Add: Advanced ATRT SBIR enterprise capabilities FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct advanced ATRT SBIR enterprise capabilities advanced technology development								0.000	16.300			
Congressional Add: Energetics renaissance FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct energetics renaissance advanced technology development								0.000	10.000			
Congressional Add: Group 3 advanced autonomous								0.000	5.000			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603801N / Innovative Naval Prototypes (INP) Adv Tec Dev	Project (Number/Name) 9999 / Congressional Adds

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: N/A		
FY 2022 Plans: Conduct advanced technology development supporting group 3 advanced autonomous efforts		
Congressional Adds Subtotals	19.307	37.300

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
N/A