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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	0.000	148.923	161.028	152.976	-	152.976	-	-	-	-	-	-
0000: <i>Innovative Naval Prototypes (INP) Applied Res</i>	0.000	109.389	2.474	2.480	-	2.480	-	-	-	-	-	-
2481: <i>EMRG</i>	0.000	7.403	0.000	0.000	-	0.000	-	-	-	-	-	-
2958: <i>Cyberspace Activities</i>	0.000	26.339	28.387	25.988	-	25.988	-	-	-	-	-	-
3416: <i>HIJENKS</i>	0.000	0.000	22.223	9.916	-	9.916	-	-	-	-	-	-
3423: <i>LOCUST</i>	0.000	0.000	21.950	8.031	-	8.031	-	-	-	-	-	-
3450: <i>AMOS</i>	0.000	0.000	8.365	6.446	-	6.446	-	-	-	-	-	-
3451: <i>CLAWS</i>	0.000	0.000	21.353	25.871	-	25.871	-	-	-	-	-	-
3452: <i>ELEKTRA</i>	0.000	0.000	6.006	3.967	-	3.967	-	-	-	-	-	-
3453: <i>Hypersonic Booster</i>	0.000	0.000	9.957	29.915	-	29.915	-	-	-	-	-	-
3454: <i>MDUSV</i>	0.000	0.000	4.829	0.000	-	0.000	-	-	-	-	-	-
3455: <i>MINERVA</i>	0.000	0.000	5.939	3.966	-	3.966	-	-	-	-	-	-
3456: <i>Full Spectrum Undersea Warfare</i>	0.000	0.000	15.545	20.940	-	20.940	-	-	-	-	-	-
3461: <i>MASS</i>	0.000	0.000	0.000	4.487	-	4.487	-	-	-	-	-	-
3462: <i>DEALRS</i>	0.000	0.000	0.000	5.983	-	5.983	-	-	-	-	-	-
3463: <i>MATes</i>	0.000	0.000	0.000	4.986	-	4.986	-	-	-	-	-	-
9999: <i>Congressional Adds</i>	0.000	5.792	14.000	0.000	-	0.000	-	-	-	-	-	-

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

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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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	152.354	160.537	163.711	-	163.711
Current President's Budget	148.923	161.028	152.976	-	152.976
Total Adjustments	-3.431	0.491	-10.735	-	-10.735
• Congressional General Reductions	-	-0.697			
• Congressional Directed Reductions	-	-12.812			
• Congressional Rescissions	-	-			
• Congressional Adds	-	14.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.029	0.000			
• SBIR/STTR Transfer	-3.460	0.000			
• Program Adjustments	0.000	0.000	-10.306	-	-10.306
• Rate/Misc Adjustments	0.000	0.000	-0.429	-	-0.429

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

Project: 9999: *Congressional Adds*

Congressional Add: *Thermoplastic carbon-fiber composite materials research*

Congressional Add: *Thermoplastic tailorable universal feedstock composites*

Congressional Add: *Thermoplastic Composites for Lightweight Naval Applications*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	3.861	0.000
	1.931	10.000
	0.000	4.000
Congressional Add Subtotals for Project: 9999	5.792	14.000
Congressional Add Totals for all Projects	5.792	14.000

Change Summary Explanation

Funding: The FY 2022 funding request in this PE was reduced by \$10.306 million as part of rebalancing adjustment for higher Navy basic and applied research priorities across the S&T portfolio.

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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 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	
Technical: Not applicable.		
Schedule: Not applicable.		

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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>				
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
0000: <i>Innovative Naval Prototypes (INP) Applied Res</i>	0.000	109.389	2.474	2.480	-	2.480	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: Directed Energy / Electric Weapons</p> <p>Description: The FY 2020 Appropriation Act encouraged the Navy to realign Innovative Naval Prototypes (INP) Program research and development efforts into individual projects in order to provide additional clarity and enhanced oversight of INP resources. From this Activity in Project Unit 0000, Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res, INP funding was moved to new stand-alone projects as indicated below starting in FY 2021.</p> <p>- Proj 3416: HIJENKS - Proj 3453: Hypersonic Booster</p> <p>FY 2021 Plans:</p>	28.942	2.474	2.480	0.000	2.480

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Continue operational analysis and support to inform INP investment decisions in this activity by identifying technologies that will provide scalable lethality through enabling multi-domain, integrated, scalable kinetic and non-kinetic systems for offensive of defensive purposes.</p> <p>FY 2022 Base Plans: Continue operational analysis and support to inform INP investment decisions in this activity by identifying technologies that will provide scalable lethality through enabling multi-domain, integrated, scalable kinetic and non-kinetic systems for offensive of defensive purposes.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: There is no significant funding change from FY 2021 to FY 2022.</p>					
<p>Title: Electromagnetic Maneuver Warfare</p> <p>Description: This R-2 Activity contains all Applied Research Innovative Naval Prototype (INP) investments that are developing new technologies for Electromagnetic Maneuver Warfare (EMW). The electromagnetic spectrum is a key operational maneuver space enabled by continuous, real-time awareness of all spectrum activity. This R-2 Activity supports spectrum dominance, which included efforts that focus on communications, surveillance, EMW and electronics to understand and shape the battle space. The ability to assure access to the full spectrum is essential for battle space awareness and threat surveillance/weapon sensor engagement. Technologies within this activity will provide for integrated and distributed forces capable of dynamic synchronized actions through interoperable forces by incorporation of autonomous/ disaggregated systems to increase flexibility and reach within the electromagnetic spectrum.</p> <p>FY 2021 Plans: N/A</p> <p>FY 2022 Base Plans: N/A</p> <p>FY 2022 OCO Plans: N/A</p>	6.915	0.000	0.000	0.000	0.000
<p>Title: Undersea Warfare</p>	13.766	0.000	0.000	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
FY 2021 Plans: N/A FY 2022 Base Plans: N/A FY 2022 OCO Plans: N/A					
Title: Unmanned and Autonomous Systems FY 2021 Plans: N/A FY 2022 Base Plans: N/A FY 2022 OCO Plans: N/A	48.108	0.000	0.000	0.000	0.000
Title: Artificial Intelligence FY 2021 Plans: N/A FY 2022 Base Plans: N/A FY 2022 OCO Plans: N/A	11.658	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	109.389	2.474	2.480	0.000	2.480

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 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 2481 / EMRG
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2481: EMRG	0.000	7.403	0.000	0.000	-	0.000	-	-	-	-	-	-

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. When released into the railgun, an electric pulse launches the projectile at speeds up to Mach 6. EMRG will bring new capabilities, increased capacity and improved operational economy to fleet operations at sea. With its increased velocity and extended range, the EM Railgun provides multi-mission potential for hypersonic missile defense, anti-air & surface warfare, and naval surface fire support. EMRG is a multi-year effort in various stages of research and development within with the Navy's Innovative Naval Prototypes (INP) family of RDT&E programs. The Activity identified in Project Unit 2481 specifically addresses Applied Research in support of the Electro-Magnetic Railgun (EMRG) high-power, kinetic energy weapon prototype development INP effort.

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

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Electro-Magnetic Railgun (EMRG)	7.403	0.000	0.000	0.000	0.000
Description: Electro-Magnetic Railgun (EMRG) is a high-power, kinetic energy weapon capable of launching precision guided projectiles using electricity instead of chemical propellants. When released into the railgun, an electric pulse launches the projectile at speeds up to Mach 6. EMRG will bring new capabilities, increased capacity and improved operational economy to fleet operations at sea. With its increased velocity and extended range, the EM Railgun provides multi-mission potential for hypersonic missile defense, anti-air & surface warfare, and naval surface fire support.					
FY 2021 Plans: N/A					
FY 2022 Base Plans: N/A					
FY 2022 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	7.403	0.000	0.000	0.000	0.000

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

Line Item	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
• RDTEN/0603801N/2481: EMRG	7.839	9.459	0.000	-	0.000	-	-	-	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 2481 / EMRG

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

<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022</u> <u>Base</u>	<u>FY 2022</u> <u>OCO</u>	<u>FY 2022</u> <u>Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
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Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2958: <i>Cyberspace Activities</i>	0.000	26.339	28.387	25.988	-	25.988	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: Cyber</p> <p>FY 2021 Plans: Continue Applied Research addressing the unique technical challenges required to achieve a systematic reduction of any computing system's attack surface across all its layers of computing. Continue development of tools and techniques enabling powerful tailoring of an end-system computing environment to match the needs of deployed applications and users, removing software bloat and unused features. Develop novel technology for automatically specializing communication protocol features to better match the needs of Naval applications. Deployment of this technology results in a minimal and reshaped cyber attack surface.</p> <p>FY 2022 Base 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.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>	26.339	28.387	25.988	0.000	25.988

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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>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
The decrease in funding from FY 2021 to FY 2022 is due to the planned funding profile and completion of planned INP applied research in this project.					
Accomplishments/Planned Programs Subtotals	26.339	28.387	25.988	0.000	25.988

C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
• RDTEN/0603801N /2958: <i>Cyberspace Activities</i>	13.843	16.417	15.893	-	15.893	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3416: HIJENKS	0.000	0.000	22.223	9.916	-	9.916	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: HIJENKS</p> <p>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.</p> <p>FY 2021 Plans: Continue applied research to enable Joint USAF/USN project development of a compact, multi-pulse High Powered Microwave (HPM) payload through focused Science and Technology (S&T) advancements in prime power, power conditioning, Radio Frequency (RF) sources and antennas, as well as lethality for targets of interest with improved Bomb Damage Assessment (BDA) and weaponizing capabilities. Focus on lethality testing and characterization as well as payload development and build activities.</p> <p>FY 2022 Base 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</p>	0.000	22.223	9.916	0.000	9.916

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

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
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. <i>FY 2022 OCO Plans:</i> N/A <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> The decrease in funding from FY 2021 to FY 2022 is due to the reduction of the need for major test ranges activities (test asset procurement and payload hardware) related to full system demonstration efforts.					
Accomplishments/Planned Programs Subtotals	0.000	22.223	9.916	0.000	9.916

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

<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3416: HIJENKS	0.000	14.402	7.634	-	7.634	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

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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 / LOCUST
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3423: LOCUST	0.000	0.000	21.950	8.031	-	8.031	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: LOCUST	0.000	21.950	8.031	0.000	8.031
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 2021 Plans: Conduct applied research of technologies that support Collaborative, Coordinated, & Cognitive Autonomy (C3A) and large-scale Command and Control (C2) of unmanned swarm air vehicle systems engaging in complex behaviors in degraded environments. In order to further the goals of the C3A research area, the LOCUST					

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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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>program will continue development of autonomy algorithms (such as multi-agent multi-objective optimization, auction processes, and consensus-based particle filters) that optimize the dynamic resources allocation and navigation and implies the determination of how to pose UAVs, task them with missions of fine granularity, and plan their future poses. In the area of C2, LOCUST will continue development of the nominal architecture needed for swarm control (a flying ad-hoc network or FANET) that is subject to dynamic channel adjustment as well as quickly-changing scattering, fading, and multipath effect.</p> <p>FY 2022 Base 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 generation and optimization in multi-target threat scenarios, non-GPS reliant swarm coordination and secure comms architectures that can support operationally relevant environments.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The decrease in FY 2022 is due to the completion of this Project Unit 3423 in FY22.</p>					
Accomplishments/Planned Programs Subtotals	0.000	21.950	8.031	0.000	8.031

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RD TEN/0603801N/3423: <i>LOCUST</i>	0.000	12.695	3.386	-	3.386	-	-	-	-	-	-
• RD TEN/0603382N/3423: <i>LOCUST</i>	2.871	2.208	3.371	-	3.371	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3450: AMOS	0.000	0.000	8.365	6.446	-	6.446	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: AMOS</p> <p>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.</p> <p>FY 2021 Plans: Continue applied research in support of the development of the Arctic Mobile Observing System (AMOS). Specific efforts include the following:</p> <ul style="list-style-type: none"> - Conducting at-sea experimentation to understand limits of two-way communications between AMOS platforms under sea ice in the Arctic maritime environment. - Evaluating the feasibility of Unmanned Underwater Vehicle (UUV) docking and recharge capabilities in the Arctic domain. - Improving the reliability of candidate AMOS nodes, platforms, and sensors for extended duration deployment in Arctic conditions. - Assessing designs of under-ice acoustic navigation systems using results from prior at-sea experiments. 	0.000	8.365	6.446	0.000	6.446

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy	Date: May 2021
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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
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>These technologies are a critical component of achieving persistence, and thus feasibility, by unmanned systems operating in harsh environments like the Arctic.</p> <p>FY 2022 Base Plans: Continue applied research in support of the development of the Arctic Mobile Observing System (AMOS). Specific efforts include the following:</p> <ul style="list-style-type: none"> - 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. <p>This applied research is critical to achieving the persistence required for sustained presence in the Arctic.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The decrease in funding from FY 2021 to FY 2022 is due to a decrease in experimentation costs, during which the program will focus on development and adaptation of the system to the lessons learned during FY 2021 field testing.</p>					
Accomplishments/Planned Programs Subtotals	0.000	8.365	6.446	0.000	6.446

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3450: AMOS	0.000	4.504	3.470	-	3.470	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3451 / <i>CLAWS</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3451: <i>CLAWS</i>	0.000	0.000	21.353	25.871	-	25.871	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: CLAWS	0.000	21.353	25.871	0.000	25.871
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 2021 Plans: Continue applied research on 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 & control required for swarm payload from extra-large unmanned undersea vehicle.					
FY 2022 Base Plans:					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3451 / <i>CLAWS</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>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.</p> <p>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.</p> <p>Specific FY 2022 objectives include:</p> <ul style="list-style-type: none"> - 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 <p>Develop autonomy to leverage onboard environmental measurements and C2 reach back to provide mission advantage</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The increase in funding from FY 2021 to FY 2022 is to develop and test precision UUV navigation in GPS denied environments and modular compact UUV combat system. The initial prototype of this technology will be tested in a controlled environment in August of 2022.</p>					
Accomplishments/Planned Programs Subtotals	0.000	21.353	25.871	0.000	25.871

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3451: <i>CLAWS</i>	0.000	15.234	14.298	-	14.298	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3452: ELEKTRA	0.000	0.000	6.006	3.967	-	3.967	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: ELEKTRA</p> <p>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.</p> <p>FY 2021 Plans: Continued applied research associated with the development and expansion of prototype multi-domain integrated fires control capabilities developed in FY2020. Additional research will include more advanced analytics for more complex kinetic/non-kinetic kill chains and battle management. FY2021 Thrust areas include researching additional electromagnetic maneuver warfare concepts, effects coordination techniques, required data analytics, and Human-Machine teaming concepts for AI applications to enable synchronizing forces across</p>	0.000	6.006	3.967	0.000	3.967

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Intelligence, Surveillance and Reconnaissance (ISR), C2 and combat systems at the operational and tactical levels. FY 2022 Base 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 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 2022 OCO Plans: N/A FY 2021 to FY 2022 Increase/Decrease Statement: The decrease in funding from FY 2021 to FY 2022 is due to maturing and completion of the applied research in this program element (PE) and project, and associated migration of efforts and planned increase in advanced technology development investment in PE 0603801N, Project 3452.					
Accomplishments/Planned Programs Subtotals	0.000	6.006	3.967	0.000	3.967

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3452: ELEKTRA	0.000	10.822	12.889	-	12.889	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3453: <i>Hypersonic Booster</i>	0.000	0.000	9.957	29.915	-	29.915	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The Navy currently lacks the ability to demonstrate a ship-launched, DARPA-developed Hypersonic Air-breathing Weapon Concept (HAWC) Cruiser as the original USAF-RAAF air-launch effort did not address naval capabilities. Hypersonic Booster will develop a CVN-capable HAWC All-Up-Round (AUR) for air-launched flight demonstration that will require a 25% reduction in overall length to fit in a CVN weapons elevator. The goal from the outset will be to leverage DARPA-developed HAWC program for naval applications. It will flight test a CVN compliant, HAWC AUR to demonstrate airframe and booster propulsion technologies. The Activity identified in Project Unit 3453 specifically addresses Applied Research in support of the Hypersonic Booster INP effort.

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

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: Hypersonic Booster</p> <p>Description: The Navy currently lacks the ability to demonstrate a ship-launched, DARPA-developed Hypersonic Air-breathing Weapon Concept (HAWC) Cruiser as the original USAF-RAAF air-launch effort did not address naval capabilities. Hypersonic Booster will develop a CVN-capable HAWC All-Up-Round (AUR) for air-launched flight demonstration that will require a 25% reduction in overall length to fit in a CVN weapons elevator. The goal from the outset will be to leverage DARPA-developed HAWC program for naval applications. It will flight test a CVN compliant, HAWC AUR to demonstrate airframe and booster propulsion technologies.</p> <p>FY 2021 Plans: Continue applied research efforts on vehicle architectural studies in the area of cruiser aerodynamic design to include scramjet engine performance, including alternate forebody shapes, cowl notch configurations, bleed-hole patterns, and diverter leading edge and solid propellant rocket motor booster motor assembly with integral launch attachment and separation assembly concepts.</p> <p>FY 2022 Base 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 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.</p> <p>FY 2022 OCO Plans:</p>	0.000	9.957	29.915	0.000	29.915

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
N/A					
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> The increase in funding from FY 2021 to FY 2022 is due to the planned maturation of the applied research in this activity through the fabrication of hardware and the conduct of multiple test events. Specific hardware to be fabricated includes the vehicle's compressed forebody with the engine inlet assembly for characterizing and tuning the scramjet engine via a series of freejet tests in the NAS Langley wind tunnel.					
Accomplishments/Planned Programs Subtotals	0.000	9.957	29.915	0.000	29.915

C. Other Program Funding Summary (\$ in Millions)											
Line Item	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
• RDTEN/0603801N/3453: <i>Hypersonic Booster</i>	0.000	0.000	0.000	-	0.000	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3454 / MDUSV
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3454: MDUSV	0.000	0.000	4.829	0.000	-	0.000	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: MDUSV	0.000	4.829	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 2021 Plans: Continue applied research of autonomous control for medium displacement unmanned surface systems, focusing on research into common behaviors across multiple missions, additional perception capability and modalities, and methodologies for developing trust in the performance of autonomous systems.					
FY 2022 Base Plans: N/A					
FY 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement:					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3454 / MDUSV

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
The funding decrease from FY 2021 to FY 2022 is due to completion of the Medium Displacement Unmanned Surface Vehicle (MDUSV) INP effort and transition of the platform to the fleet.					
Accomplishments/Planned Programs Subtotals	0.000	4.829	0.000	0.000	0.000

C. Other Program Funding Summary (\$ in Millions)											
	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3454: MDUSV	0.000	1.115	0.000	-	0.000	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3455 / MINERVA
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3455: MINERVA	0.000	0.000	5.939	3.966	-	3.966	-	-	-	-	-	-

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>Title: MINERVA</p> <p>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.</p> <p>FY 2021 Plans: Conduct applied research on emerging artificial intelligence and machine learning methods to: enable a more complete and accurate common intelligence picture; automate the analysis of specific course of action/enemy course of action pairings; and enable blue force assets to collaborate across all warfighting domains. In addition, develop methods that continuously predict the outcome of a large scale war game, recommend a set of future decisions based on desired measures of effectiveness, and monitor mission execution and provide actionable alerts.</p> <p>FY 2022 Base 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</p>	0.000	5.939	3.966	0.000	3.966

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3455 / MINERVA

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
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.					
- 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 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement: The decrease in funding from FY 2021 to FY 2022 is due to maturing of the applied research in this activity and planned increased investment and migration of MINERVA research into the advanced technology development Program Element (PE) 0603801N, Project 3455.					
Accomplishments/Planned Programs Subtotals	0.000	5.939	3.966	0.000	3.966

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3455: MINERVA	0.000	10.889	12.889	-	12.889	-	-	-	-	-	-

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3456: <i>Full Spectrum Undersea Warfare</i>	0.000	0.000	15.545	20.940	-	20.940	-	-	-	-	-	-

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 (MVTADS), 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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Undersea Warfare Efforts	0.000	15.545	20.940	0.000	20.940
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 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>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.</p> <p>FY 2021 Plans: Conduct initial applied research through development and integration of disparate technologies into systems that apply to the unique undersea environment and explore promising concepts (and methods) for achieving desired FSUSW effects (details classified) including, - Physics model and validation of deployable devices and associated Multi-Vehicle Torpedo Tube Deployment System, characterizing forces and allowable margin within which deployed devices are constrained. Characterize the viability of reloading and changing payloads. - Modeling, simulation, breadboard of undersea UAV and undersea launched devices for defined effects to establish technical feasibility and practicality of each concept. - Full scale experimentation with legacy devices to characterize technology performance envelopes to establish technical feasibility and practicality of each concept. - Characterization of sensors, emitters, and command and control constrained by the space, weight, and power of the submarine and system.</p> <p>FY 2022 Base 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.</p>					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- 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 2022 OCO Plans: N/A FY 2021 to FY 2022 Increase/Decrease Statement: The funding increase from FY 2021 to FY 2022 is due to the planned maturation of the Applied Research in this activity through the fabrication of hardware and the conduct of multiple test events.					
Accomplishments/Planned Programs Subtotals	0.000	15.545	20.940	0.000	20.940

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 2022 Navy **Date:** May 2021

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
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3461: MASS	0.000	0.000	0.000	4.487	-	4.487	-	-	-	-	-	-

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. This is not a new start.

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Manufacture of Autonomous Systems at Scale (MASS)	0.000	0.000	4.487	0.000	4.487
FY 2021 Plans: N/A					
FY 2022 Base 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 2022 OCO Plans:					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
N/A					
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i>					
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 BA2 level. Efforts focused on increasing the scale (both quantities and size) at which forward deployable advanced manufacturing techniques can produce unmanned and autonomous systems will continue and include examining non-polymer materials processes as well as electronics. Additionally, conduct efforts taking an approach to understand how platforms intended to be disposable or attriteable are designed and manufactured differently than their conventional manned counterparts. This represents a new approach to the design of unmanned and autonomous platforms.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	4.487	0.000	4.487

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTEN/0603801N/3461: mASS	0.000	0.000	3.491	-	3.491	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

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 / DEALRS
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3462: <i>DEALRS</i>	0.000	0.000	0.000	5.983	-	5.983	-	-	-	-	-	-

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. This is not a new start.

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)

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: DEALRS	0.000	0.000	5.983	0.000	5.983
FY 2021 Plans: N/A					
FY 2022 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.					
FY 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement: 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 BA2 level. Efforts focused on technologies allowing for greatly					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
increasing the range of unmanned systems and/or marsupial concepts where large numbers of platforms can be transported and deployed will continue. A significant component of the technical challenge is the mission focused employment with only minimal and virtual operator interaction prior to deployment requiring automated start-up, programming, health checks, and deployment on scales not seen before. Robotizing the deployment and employment components across platforms in all domains is a significant aspect.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	5.983	0.000	5.983

C. Other Program Funding Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
• RDTEN/0603801N/3462: <i>DEALRS</i>	0.000	0.000	4.986	-	4.986	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3463 / MATes
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3463: MATes	0.000	0.000	0.000	4.986	-	4.986	-	-	-	-	-	-

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. This is not a new start.

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Manned and Autonomous Teams	0.000	0.000	4.986	0.000	4.986
FY 2021 Plans: N/A					
FY 2022 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.					
FY 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement:					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 3463 / MATes

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

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
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 BA2 level. Efforts focused on multiple autonomy architectures and their optimization to a changing mission based on perception data and human operator connectivity will continue. The validation of this approach will be done through repeated small-scale experimentation established under Project Unit 3459: Super Swarm - Overwhelming Swarm Effects to gain understanding and trust of autonomy modes under increasingly difficult, changing, or uncertain operating conditions.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	4.986	0.000	4.986

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

<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RD TEN/0603801N/3463: MATes	0.000	0.000	3.989	-	3.989	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / <i>Innovative Naval Prototypes (INP) Applied Res</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	5.792	14.000	0.000	-	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

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

	FY 2020	FY 2021
<i>Congressional Add:</i> Thermoplastic carbon-fiber composite materials research <i>FY 2020 Accomplishments:</i> N/A <i>FY 2021 Plans:</i> N/A	3.861	0.000
<i>Congressional Add:</i> Thermoplastic tailorable universal feedstock composites <i>FY 2020 Accomplishments:</i> N/A <i>FY 2021 Plans:</i> Conduct 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.	1.931	10.000
<i>Congressional Add:</i> Thermoplastic Composites for Lightweight Naval Applications <i>FY 2020 Accomplishments:</i> N/A <i>FY 2021 Plans:</i> Conduct applied research in Thermoplastic Composites for Lightweight Naval Applications.	0.000	4.000
Congressional Adds Subtotals	5.792	14.000

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

N/A

Remarks

D. Acquisition Strategy

N/A