Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy											Date: February 2020	
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*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	151.176	152.354	160.537	-	160.537	163.711	166.933	170.290	173.696	Continuing	Continuing
0000: *Innovative Naval Prototypes (INP) Applied Res*	0.000	151.176	111.453	2.485	-	2.485	54.292	143.529	170.290	173.696	Continuing	Continuing
2481: *EMRG*	0.000	0.000	7.632	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.632
2958: *Cyberspace Activities*	0.000	0.000	27.269	28.511	-	28.511	26.061	0.000	0.000	0.000	0.000	81.841
3416: *HIJENKS*	0.000	0.000	0.000	22.320	-	22.320	9.943	0.000	0.000	0.000	0.000	32.263
3423: *LOCUST*	0.000	0.000	0.000	22.046	-	22.046	5.553	0.000	0.000	0.000	0.000	27.599
3450: *AMOS*	0.000	0.000	0.000	8.401	-	8.401	6.463	8.404	0.000	0.000	0.000	23.268
3451: *CLAWS*	0.000	0.000	0.000	26.456	-	26.456	23.445	0.000	0.000	0.000	0.000	49.901
3452: *ELEKTRA*	0.000	0.000	0.000	6.032	-	6.032	3.977	0.000	0.000	0.000	0.000	10.009
3453: *Hypersonic Booster*	0.000	0.000	0.000	10.000	-	10.000	30.000	15.000	0.000	0.000	0.000	55.000
3454: *MDUSV*	0.000	0.000	0.000	4.850	-	4.850	0.000	0.000	0.000	0.000	0.000	4.850
3455: *MINERVA*	0.000	0.000	0.000	5.965	-	5.965	3.977	0.000	0.000	0.000	0.000	9.942
3456: *Full Spectrum Undersea Warfare*	0.000	0.000	0.000	23.471	-	23.471	0.000	0.000	0.000	0.000	0.000	23.471
9999: *Congressional Adds*	0.000	0.000	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

Note

In FY 2020, the Applied Research Electro-Magnetic Railgun (EMRG) high-power, kinetic energy weapon prototype development effort was realigned from Project Unit 0000 to Project Unit 2481 within this Program Element (PE).

The FY 2017 National Defense Authorization Act directed the services to realign Cyberspace Activity (CA) resources into individual cost codes, projects or program elements (PEs) in order to provide additional clarity and enhanced oversight of cyberspace pure resources. Within this PE, cyber funding was moved from Proj 0000 Innovative Naval Protoypes (INP) Applied Research to Proj 2958 Cyberspace Activities beginning in FY20, which was established to isolate and identify cyberspace activities.

The FY 2020 Appropriation Act directed ONR to establish appropriate projects for prototyping efforts to provide additional acquisition oversight, fiscal clarity and adherence to financial management practices. Within this PE, INP funding has been realigned from Proj 0000 Innovative Naval Protoypes (INP) Applied Research to new stand-alone projects as indicated below starting in FY 2021.

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
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*

- Proj 3416: HIJENKS
- Proj 3423: LOCUST
- Proj 3450: AMOS
- Proj 3451: CLAWS
- Proj 3452: ELEKTRA
- Proj 3453: Hypersonic Booster
- Proj 3454: MDUSV
- Proj 3455: MINERVA
- Proj 3456: Full Spectrum Undersea Warfare

A. Mission Description and Budget Item Justification

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) address the Applied Research associated with the INP Program. These investments define the future of U.S. naval forces. 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 PE, 0603801N Innovative Naval Prototypes Advanced Technology Development. 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.

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.

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).

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
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*

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	154.085	153.062	160.537	-	160.537
Current President's Budget	151.176	152.354	160.537	-	160.537
Total Adjustments	-2.909	-0.708	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-6.708			
• Congressional Rescissions	-	-			
• Congressional Adds	-	6.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.909	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: 9999: *Congressional Adds*		
Congressional Add: *Thermoplastic carbon-fiber composite materials research*	0.000	4.000
Congressional Add: *Thermoplastic tailorable universal feedstock composites*	0.000	2.000
Congressional Add Subtotals for Project: 9999	0.000	6.000
Congressional Add Totals for all Projects	0.000	6.000

Change Summary Explanation

Funding: No significant change.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy											Date: February 2020	
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 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
0000: *Innovative Naval Prototypes (INP) Applied Res*	0.000	151.176	111.453	2.485	-	2.485	54.292	143.529	170.290	173.696	Continuing	Continuing

Note

The FY 2020 Appropriation Act directed ONR to establish appropriate projects for prototyping efforts to provide additional acquisition oversight, fiscal clarity and adherence to financial management practices. Within this PE, INP funding has been realigned from Proj 0000 Innovative Naval Protoypes (INP) Applied Research to new stand-alone projects as indicated below starting in FY 2021.

- Proj 3416: HIJENKS
- Proj 3423: LOCUST
- Proj 3450: AMOS
- Proj 3451: CLAWS
- Proj 3452: ELEKTRA
- Proj 3453: Hypersonic Booster
- Proj 3454: MDUSV
- Proj 3455: MINERVA
- Proj 3456: Full Spectrum Undersea Warfare

A. Mission Description and Budget Item Justification

The efforts described in this Project address the Applied Research associated with the INP Program. These investments define the future of U.S. naval forces. 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 PE, 0603801N Innovative Naval Prototypes Advanced Technology Development. 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 Project 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.

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.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Cyber ***FY 2020 Plans:*** N/A ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A	23.135	0.000	0.000	0.000	0.000
Title: Directed Energy / Electric Weapons ***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. - Proj 3416: HIJENKS - Proj 3453: Hypersonic Booster ***FY 2020 Plans:*** Conduct development efforts for a radio frequency effects payload (a joint USAF/USN project) with scalable electromagnetic effects. Conduct the Applied Research supporting initial lab and integration testing. Conduct research to develop a hypersonic cruise missile that is affordable and effective to mature critical technologies. ***FY 2021 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. ***FY 2021 OCO Plans:***	44.779	29.531	2.485	0.000	2.485

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease in FY 2021 is due to the realignment of the Hypersonic Booster and HIJENKS INP efforts from this Activity in Project Unit 0000, Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res, to new stand-alone Project Units as follows: - Proj 3416: HIJENKS - Proj 3453: Hypersonic Booster					
Title: Electromagnetic Maneuver Warfare ***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. ***FY 2020 Plans:*** Develop efforts to enable a strike group to work cooperatively in the electromagnetic spectrum by optimizing electronic warfare, information operations, communications and radar performance. Conduct the Applied Research associated with the final design for a Low-band Radio Frequency Intelligent Distribution Resource (LowRIDR) for the EMC2 prototype. ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:***	10.872	7.056	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Applied Research Innovative Naval Prototype (INP) technologies being developed under this R-2 Activity completed in FY 2020 and will be leveraged starting in FY 2021 under the Advanced Long Range Targeting (ALRT) Activity within this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res.					
Title: Undersea Warfare ***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. - Proj 3450: AMOS - Proj 3456: Full Spectrum Undersea Warfare ***FY 2020 Plans:*** Conduct applied research associated with the development of an Arctic Mobile Observing System (AMOS), a prototype mobile sensing system incorporating Arctic-capable unmanned underwater vehicles that can be deployed anywhere in the Arctic using a central, ice-based buoy node to provide the critical infrastructure (power, communication, navigation, and environmental intelligence). AMOS will provide the Navy with a persistent Arctic presence and environmental Arctic domain awareness at a lower cost and less risk than manned platforms. The combination of Unmanned Underwater Vehicle (UUV) assets included in an AMOS node will determine the range, sensing capability and persistence of each node, and can be chosen based on need and Arctic location. Work under this effort will involve understanding the trade-offs and capabilities for the prototype system. Affordable Mobile ASW Surveillance System (AMASS): Complete Applied Research efforts to verify performance of components to enable next generation Anti-Submarine Warfare (ASW) capability. ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:***	13.602	14.046	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease in FY 2021 is due to the realignment of the AMOS and Full Spectrum Undersea Warfare INP efforts from this Activity in Project Unit 0000, Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res, to new stand-alone Project Units as follows: - Proj 3450: AMOS - Proj 3456: Full Spectrum Undersea Warfare					
Title: Unmanned and Autonomous Systems ***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. - Proj 3451: CLAWS - Proj 3423: LOCUST - Proj 3454: MDUSV ***FY 2020 Plans:*** Conduct development of autonomous payloads for extra-large unmanned undersea vehicles. Conduct development of technologies that continue to support development of a scalable system of inexpensive Unmanned Aerial Vehicles (UAVs) in order to provide a disruptive capability in contested urban environments and against anti-access area denial defenses. Conduct development of technologies that will enable a self-deploying, highly autonomous, multi-mission/multi-payload Unmanned Surface Vehicle (USV) capable of operating with carrier strike groups and surface action groups at a very low operating cost.	58.788	48.925	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Conduct development of an autonomous control system for multiple Unmanned Surface Vehicle (USVs) consisting of cooperative task allocation, cooperative route planning/behaviors, and shared situational awareness. ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease in FY 2021 is due to the realignment of the CLAWS, LOCUST and MDUSV INP efforts from this Activity in Project Unit 0000, Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res, to new stand-alone Project Units as follows: - Proj 3451: CLAWS - Proj 3423: LOCUST - Proj 3454: MDUSV					
Title: Artificial Intelligence ***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. - Proj 3452: ELEKTRA - Proj 3455: MINERVA ***FY 2020 Plans:*** Align Applied Research associated with the development of a prototype multi-domain integrated fires control capability enabled by Artificial Intelligence (AI) allowing for real-time, force-wide electromagnetic maneuver and soft-kill and hard-kill battle management. Thrust areas being explored include distributed combat data systems, AI battle management tools, and embedded machine learning.	0.000	11.895	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Align Applied Research supporting the goal of demonstrating machine speed battle management tools to support continuous analysis and planning at the operational and tactical levels and dynamically synchronizing forces across intelligence, surveillance and reconnaissance, Command and Control and combat systems. Thrust areas being explored include distributed combat data systems, adaptive data analytics and a course of action and intentions assessment AI application. ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease in FY 2021 is due to the realignment of the ELEKTRA and MINERVA INP efforts from this Activity in Project Unit 0000, Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res, to new stand-alone Project Units as follows: - Proj 3452: ELEKTRA - Proj 3455: MINERVA					
Accomplishments/Planned Programs Subtotals	151.176	111.453	2.485	0.000	2.485

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	Project (Number/Name) 2481 / *EMRG*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
2481: *EMRG*	0.000	0.000	7.632	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.632

Note

Beginning in FY 2020, the Applied Research Electro-Magnetic Railgun (EMRG) high-power, kinetic energy weapon prototype development effort was realigned from Project Unit 0000 to Project Unit 2481 within Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Electro-Magnetic Railgun (EMRG)	0.000	7.632	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 2481 / *EMRG*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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 2020 Plans:*** Conduct applied research addressing the unique technical challenges inherent in the construction, assembly and operation of an Electro-Magnetic (EM) Railgun prototype capable of launching long range projectiles at a tactically relevant muzzle energy and repetition rate. Special materials and compact sub-system components will be developed that are capable of operating in harsh thermal and electromagnetic environments. Advanced modeling tools will be utilized to assess design options, analyze system concepts, and inform experimental hardware design and testing. Develop and test next generation pulsed power components to assess performance and applicability towards future shipboard designs. Develop and refine algorithms for controlling the precision timed electromagnetic pulse used to fire the railgun in the rep-rate mode. Conduct material, physics and thermal property research for long life, rep-rate electromagnetic launch systems and actively monitor performance to understand the high currents, elevated operating temperatures, and cooling of components, so as to improve designs and increase their reliability. Utilize modeling and simulation tools that support simulated operational scenarios to quantify the value of HVP fired from a Railgun. ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The funding decrease from FY 2020 to FY 2021 is due to the completion of Applied Research development efforts under this Activity.					
Accomplishments/Planned Programs Subtotals	0.000	7.632	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 2481 / *EMRG*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/2481: *EMRG*	0.000	7.368	9.500	-	9.500	0.000	0.000	0.000	0.000	0.000	16.868
• RDTEN/0603801N/3400: *Innovative Naval Prototypes (INP) Adv Tech Dev*	156.512	91.137	0.000	-	0.000	8.501	10.482	49.760	50.756	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
2958: *Cyberspace Activities*	0.000	0.000	27.269	28.511	-	28.511	26.061	0.000	0.000	0.000	0.000	81.841

Note

The FY 2017 Appropriation Act directed the services to realign Cyberspace Activity (CA) resources into individual cost codes, projects or Program Elements (PEs) in order to provide additional clarity and enhanced oversight of cyberspace pure resources. Within this PE, cyber funding was moved from Proj 0000 Innovative Naval Protoypes (INP) Applied Research to Proj 2958 Cyberspace Activities, which was established to isolate and identify cyberspace activities.

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.

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.

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.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Cyber	0.000	27.269	28.511	0.000	28.511
FY 2020 Plans: Conduct 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, resulting in significantly reduced attack surface for both known and unknown vulnerabilities. Specific information on each project will be provided separately to the Congressional oversight committees.					
FY 2021 Base 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.					
FY 2021 OCO Plans: N/A					
FY 2020 to FY 2021 Increase/Decrease Statement: The funding increase from FY 2020 to FY 2021 is due to the ramp-up of Applied Research development efforts in the Total Platform Cyber Protection (TPCP) INP effort under this Activity.					
Accomplishments/Planned Programs Subtotals	0.000	27.269	28.511	0.000	28.511

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3416: *HIJENKS*	0.000	0.000	0.000	22.320	-	22.320	9.943	0.000	0.000	0.000	0.000	32.263

Note

HIgh-power Joint Electromagnetic Non-Kinetic Strike (HIJENKS) plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3416 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: HIJENKS	0.000	0.000	22.320	0.000	22.320
Description: 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					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3416 / *HIJENKS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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. ***FY 2020 Plans:*** N/A ***FY 2021 Base 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 weaponeering capabilities. Focus on lethality testing and characterization as well as payload development and build activities. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the High-power Joint Electromagnetic Non-Kinetic Strike (HIJENKS) effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3416.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	22.320	0.000	22.320

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603382N/3416: *HIJENKS*	0.000	0.000	14.981	-	14.981	16.945	24.690	0.000	0.000	0.000	56.616
• RDTEN/0603801N/3416: *HIJENKS*	0.000	0.000	14.465	-	14.465	7.656	0.000	0.000	0.000	0.000	22.121

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3416 / *HIJENKS*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy										Date: February 2020		
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 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
3423: *LOCUST*	0.000	0.000	0.000	22.046	-	22.046	5.553	0.000	0.000	0.000	0.000	27.599

Note

Low-Cost UAV Swarming Technology (LOCUST) plans and associated resources are realigned from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3423 effective FY 2021. This is not a new start.

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.

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.

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.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3423 / *LOCUST*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: LOCUST	0.000	0.000	22.046	0.000	22.046

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 2020 Plans:
N/A

FY 2021 Base 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 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.

FY 2021 OCO Plans:
N/A

FY 2020 to FY 2021 Increase/Decrease Statement:

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3423 / *LOCUST*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
The increase in FY 2021 is due to the realignment of the Low-Cost UAV Swarming Technology (LOCUST) effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3423.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	22.046	0.000	22.046

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3423: *LOCUST*	0.000	0.000	12.750	-	12.750	3.396	0.000	0.000	0.000	0.000	16.146
• RDTEN/0603382N/3423: *LOCUST*	1.879	2.960	3.561	-	3.561	6.425	5.949	0.000	0.000	0.000	20.787

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3450: *AMOS*	0.000	0.000	0.000	8.401	-	8.401	6.463	8.404	0.000	0.000	0.000	23.268

Note

Arctic Mobile Observing System (AMOS) plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3450 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: AMOS	0.000	0.000	8.401	0.000	8.401

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3450 / *AMOS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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 2020 Plans:*** N/A ***FY 2021 Base Plans:*** Continue applied research in support of the development of the Arctic Mobile Observing System (AMOS). Specific efforts include the following: - 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. These technologies are a critical component of achieving persistence, and thus feasibility, by unmanned systems operating in harsh environments like the Arctic. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the Arctic Mobile Observing System (AMOS) effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3450.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	8.401	0.000	8.401

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3450 / *AMOS*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3450: *AMOS*	0.000	0.000	4.524	-	4.524	3.480	4.525	0.000	0.000	0.000	12.529

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3451: *CLAWS*	0.000	0.000	0.000	26.456	-	26.456	23.445	0.000	0.000	0.000	0.000	49.901

Note

CLAWS plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3451 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: CLAWS	0.000	0.000	26.456	0.000	26.456

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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 2020 Plans:*** N/A ***FY 2021 Base 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 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the CLAWS effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3451.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	26.456	0.000	26.456

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3451: *CLAWS*	0.000	0.000	15.300	-	15.300	14.339	0.000	0.000	0.000	0.000	29.639

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3451 / *CLAWS*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3452: *ELEKTRA*	0.000	0.000	0.000	6.032	-	6.032	3.977	0.000	0.000	0.000	0.000	10.009

Note

ELEKTRA Non-Kinetic and EMW Capability plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3452 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: ELEKTRA	0.000	0.000	6.032	0.000	6.032

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3452 / *ELEKTRA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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 2020 Plans:*** N/A ***FY 2021 Base 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 Intelligence, Surveillance and Reconnaissance (ISR), C2 and combat systems at the operational and tactical levels. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the ELEKTRA Non-Kinetic and EMW Capability effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3452.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	6.032	0.000	6.032

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3452 / *ELEKTRA*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3452: *ELEKTRA*	0.000	0.000	10.869	-	10.869	12.926	9.946	4.973	5.072	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3453: *Hypersonic Booster*	0.000	0.000	0.000	10.000	-	10.000	30.000	15.000	0.000	0.000	0.000	55.000

Note

Hypersonic Booster plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3453 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Hypersonic Booster	0.000	0.000	10.000	0.000	10.000
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					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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. ***FY 2020 Plans:*** N/A ***FY 2021 Base 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. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the Hypersonic Booster effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3453.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	10.000	0.000	10.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3453: *Hypersonic Booster*	0.000	0.000	0.000	-	0.000	0.000	20.000	30.000	30.600	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3454: *MDUSV*	0.000	0.000	0.000	4.850	-	4.850	0.000	0.000	0.000	0.000	0.000	4.850

Note

Medium Displacement Unmanned Surface Vehicle (MDUSV) plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3454 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: MDUSV	0.000	0.000	4.850	0.000	4.850
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					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3454 / *MDUSV*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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 2020 Plans:*** N/A ***FY 2021 Base 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 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the Medium Displacement Unmanned Surface Vehicle (MDUSV) effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3454.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	4.850	0.000	4.850

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3454: *MDUSV*	0.000	0.000	1.115	-	1.115	0.000	0.000	0.000	0.000	0.000	1.115

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3455: *MINERVA*	0.000	0.000	0.000	5.965	-	5.965	3.977	0.000	0.000	0.000	0.000	9.942

Note

MINERVA - Artificial Intelligence (AI) Enhanced Warfighter Decision Superiority Capability plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3455 effective FY 2021. This is not a new start.

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.

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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: MINERVA	0.000	0.000	5.965	0.000	5.965
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					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
(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 2020 Plans:*** N/A ***FY 2021 Base 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. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the MINERVA - ai Enhanced Warfighter Decision Superiority Capability effort from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3455.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	5.965	0.000	5.965

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTEN/0603801N/3455: *MINERVA*	0.000	0.000	10.936	-	10.936	12.926	11.935	6.963	7.102	Continuing	Continuing

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602792N / *Innovative Naval Prototypes (INP) Applied Res*	**Project (Number/Name)** 3455 / *MINERVA*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3456: *Full Spectrum Undersea Warfare*	0.000	0.000	0.000	23.471	-	23.471	0.000	0.000	0.000	0.000	0.000	23.471

Note

Full Spectrum Undersea Warfare plans and associated resources are realigned from Project Unit 0000 in Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3456 effective FY 2021. This is not a new start.

A. Mission Description and Budget Item Justification

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 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. The Activity identified in Project Unit 3456 specifically addresses Applied Research in support of the FSUW INP effort.

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.

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.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Undersea Warfare Efforts	0.000	0.000	23.471	0.000	23.471
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 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 2020 Plans:*** N/A ***FY 2021 Base Plans:*** Initiate high performance component development for active ASW surveillance concepts. These components will be distributed, deployable, and affordable with long endurance station keeping. Initiate follow on research using results from the successful completion of the Affordable Mobile ASW Surveillance System (AMASS) phenomenology demonstration. Initiate research in other FSUSW mission areas. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase in FY 2021 is due to the realignment of the Full Spectrum Undersea Warfare, Undersea Warfare efforts from Project Unit 0000 in this Program Element (PE) 0602792N Innovative Naval Prototypes (INP) Applied Res into this new Project Unit 3456.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	23.471	0.000	23.471

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
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*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	6.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020
Congressional Add: Thermoplastic carbon-fiber composite materials research ***FY 2019 Accomplishments:*** N/A ***FY 2020 Plans:*** Conduct Applied Research in Thermoplastic carbon-fiber composite materials research.	0.000	4.000
Congressional Add: Thermoplastic tailorable universal feedstock composites ***FY 2019 Accomplishments:*** N/A ***FY 2020 Plans:*** Conduct Applied Research in Thermoplastic tailorable universal feedstock composites.	0.000	2.000
Congressional Adds Subtotals	0.000	6.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A