Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601103N / *University Research Initiatives*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	137.515	161.433	116.850	-	116.850	116.816	119.141	121.595	124.040	Continuing	Continuing
0000: *University Research Initiatives*	0.000	112.407	119.433	116.850	-	116.850	116.816	119.141	121.595	124.040	Continuing	Continuing
9999: *Congressional Adds*	0.000	25.108	42.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	67.108

A. Mission Description and Budget Item Justification

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

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

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	118.130	119.433	117.552	-	117.552
Current President's Budget	137.515	161.433	116.850	-	116.850
Total Adjustments	19.385	42.000	-0.702	-	-0.702
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	42.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.280	0.000			
• SBIR/STTR Transfer	-5.335	0.000			
• Rate/Misc Adjustments	0.000	0.000	-0.702	-	-0.702
• Congressional Add Adjustments	26.000	-	-	-	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy	Date: March 2019
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601103N *I University Research Initiatives*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	9.657	0.000
Congressional Add: *Defense University Research Instrumentation Program*	9.657	10.000
Congressional Add: *Radar Technology*	5.794	6.000
Congressional Add: *Biocoherent Energy*	0.000	6.000
Congressional Add: *Basic Research*	0.000	10.000
Congressional Add: *Aircraft Fleet Readiness and Sustainment*	0.000	10.000
Congressional Add Subtotals for Project: 9999	25.108	42.000
Congressional Add Totals for all Projects	25.108	42.000

Change Summary Explanation

Change from FY 2019 to FY 2020 includes reduced funding for new MURI projects in FY 2020.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 1	R-1 Program Element (Number/Name) PE 0601103N / *University Research Initiatives*	Project (Number/Name) 0000 / *University Research Initiatives*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
0000: *University Research Initiatives*	0.000	112.407	119.433	116.850	-	116.850	116.816	119.141	121.595	124.040	Continuing	Continuing

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM (DURIP)	21.925	23.774	23.266	0.000	23.266
Description: DURIP funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants. Individual grants range from $50K to $1.5M. Funding for DURIP efforts be awarded after the Office of the Secretary of Defense (OSD) announces the awardees, which typically takes place towards the second half of the fiscal year. In turn, universities need to purchase the instrumentation and take delivery before any billings are generated. It frequently takes several months for delivery and billing to be completed. DURIP is a one-year program. ***FY 2019 Plans:*** Continue to support university research infrastructure essential to high-quality naval-relevant research. ***FY 2020 Base Plans:*** Provide funding for instrumentation to enhance basic research, such as: human-machine interfaces, basic research on communications and networks, basic research on power generation and storage, basic research on high-performance materials, and basic research in the ocean sciences and underwater acoustics. Implement the instrumentation investments made for research efforts, such as: transmission electron microscopy, infrared optoelectronic measurements, an underwater acoustic communication system, basic thermal property					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
measurements, cardiorespiratory physiology phenotyping, and high-speed stereographic imaging for multiphase flows. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no significant change from FY 2019 to FY 2020.					
Title: MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI) ***Description:*** Research efforts include high priority topics that intersect more than one traditional discipline. MURI topics are selected to address Naval Science and Technology (S&T) Framework Priorities as described in the Naval Research and Development Framework. Funding for MURI efforts are awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. Since the MURI program funds academic researchers, execution of the efforts typically ramp up during the summer academic break months. MURI projects make significant contributions to Navy and DoD objectives by speeding up scientific programs, by cross-fertilization of ideas, by hastening the transition of basic research to practical applications, and by training students in cross-disciplinary approaches to science and engineering research of importance to DoD. MURI projects are five year programs. ***FY 2019 Plans:*** Continue to support teams of researchers investigating high priority topics and opportunities thru competition for new MURI awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas that intersect more than one traditional technical discipline. ***FY 2020 Base Plans:*** The MURI program will support multidisciplinary basic research topics, such as: the role of epigenetics in human performance, research on understanding scenes and events through joint parsing, cognitive reasoning and lifelong learning, research on bio-inspired adaptive sonar for classification and guidance in complex environments, research on neural circuits underlying symbolic processing in primate cortex and basal ganglia, and research on chemistry and physics at extreme temperature and pressure: molecules, crystals and microstructures. These investigations support high	82.224	86.706	84.823	0.000	84.823

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
priority topics and scientific opportunities to address strategically important Department of Defense (DoD) research areas that intersect more than one traditional technical discipline. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The MURI funding decrease from FY 2019 to FY 2020 will be reflected in fewer new MURI projects.					
Title: PRESIDENTIAL EARLY CAREER AWARDS (PECASE) ***Description:*** PECASE awards are made to academic scientists early in their research careers for extremely prestigious, single-investigator research in areas of vital importance to the Navy. Awards provide national recognition and research grants of up to $200K per year for five years. OSD, with policy and oversight responsibility for the PECASE program, awards a minimum of four new awards per year. PECASE is a five year program. ***FY 2019 Plans:*** Continue to award four new awards for recognizing and honoring extraordinary achievements of young professionals at the outset of their independent research careers in Science and Technology. ***FY 2020 Base Plans:*** The program will support early career investigators in research areas within the Navy Research and Development (R&D) framework priority objectives, such as: the design of an end-to-end protocol for dynamic spectrum access networks; the determination of multiscale interactions in tropical cyclone structure and intensity changes; the engineering of nonreciprocal acoustic materials and microwave systems through phonon-assisted directional coupling; and the development of therapeutic hydrogel sensors for the monitoring and treatment of wounds. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no significant change from FY 2019 to FY 2020	8.258	8.953	8.761	0.000	8.761
Accomplishments/Planned Programs Subtotals	112.407	119.433	116.850	0.000	116.850

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 0000 / *University Research Initiatives*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319 / 1					R-1 Program Element (Number/Name) PE 0601103N / *University Research Initiatives*				Project (Number/Name) 9999 / *Congressional Adds*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
9999: *Congressional Adds*	0.000	25.108	42.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	67.108

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Program Increase	9.657	0.000
FY 2018 Accomplishments: This increase furthered the U. S. Navy's efforts to support multidisciplinary basic research in a wide range of scientific and engineering disciplines that enable the U.S. Navy to maintain its technological superiority. Through this increase, additional Multidisciplinary University Research Initiative (MURI) awards, and Presidential Early Career Awards for Scientists and Engineers (PECASE) were selected and funded. These new MURI topics draw from the most critical Naval R&D priorities to translate future force attributes into research objectives. Outstanding young PECASE scientists and engineers were be funded to address shared Naval R&D priorities. These research objectives include improving human-machine interfaces, increasing the flexibility and reach of the naval force through the incorporation of autonomous systems, enabling maneuverability, efficiency and resiliency for sustained operations, transforming vast data into timely knowledge; and enabling offensive and defensive actions that are multi-domain, integrated, and cost-effective.		
FY 2019 Plans: N/A		
Congressional Add: Defense University Research Instrumentation Program	9.657	10.000
FY 2018 Accomplishments: Through this increase, additional Defense University Research Instrumentation Program (DURIP) awards were selected and funded enabling the performers to take advantage of the evolving technological advances in scientific instrumentation to study the physical, chemical, geological, and geophysical processes of the oceans, so that research can continue to keep pace with the Science and Technology (S&T) Community. The oceans are the primary Navy-relevant operational environment and ocean research requires specialized sea-going, resilient marine equipment.		
FY 2019 Plans: Through this increase, additional Defense University Research Instrumentation Program (DURIP) awards will be selected and funded enabling the performers to take advantage of the evolving technological advances in scientific instrumentation to study the physical, chemical, geological, and geophysical processes of the oceans, so that research can continue to keep pace with the Science and Technology (S&T)		

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601103N / *University Research Initiatives*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Community. The oceans are the primary Navy-relevant operational environment and ocean research requires specialized sea-going, resilient marine equipment.		
Congressional Add: Radar Technology ***FY 2018 Accomplishments:*** Conducted efforts that seek to leverage advances in the field of radar development with respect to incorporating both polarimetric and phased array radar technology in an all-digital design for new technology to assist the Navy with improved weather forecasting. ***FY 2019 Plans:*** Conduct efforts for the design, construction and testing of a mobile, ground-based, active aperture array (active electronically scanned antenna - AESA) utilizing cutting-edge science and technology for critical aperture components (receiver and transmitter).	5.794	6.000
Congressional Add: Biocoherent Energy ***FY 2018 Accomplishments:*** N/A ***FY 2019 Plans:*** Basic science research to identify mechanisms to enhance coherent energy transfer between photoactive molecules attached to nucleic acid nanostructures for application to synthetic light harvesting systems, optoelectronic devices, information processing systems, and possibly quantum computing. - AIM 1: Conduct and develop computational and experimental approaches to identify the best structures of photoactive molecules and their nucleic acid nanostructures that can efficiently transfer energy coherently. - AIM2: Assemble the superior photoactive molecules into structures using nucleic acid self-assembly and assess performance.	0.000	6.000
Congressional Add: Basic Research ***FY 2018 Accomplishments:*** N/A ***FY 2019 Plans:*** This increase furthers the U. S. Navy's efforts to support multidisciplinary basic research in a wide range of scientific and engineering disciplines that enable the U.S. Navy to maintain its technological superiority. Through this increase, additional Multidisciplinary University Research Initiative (MURI) awards, and Presidential Early Career Awards for Scientists and Engineers (PECASE) will be selected and funded. These new MURI topics draw from the most critical Naval R&D priorities to translate future force attributes into research objectives. Outstanding young PECASE scientists and engineers were be funded to address shared Naval R&D priorities. These research objectives include improving human-machine interfaces, increasing the flexibility and reach of the naval force through the incorporation of autonomous systems, enabling maneuverability,	0.000	10.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
efficiency and resiliency for sustained operations, transforming vast data into timely knowledge; and enabling offensive and defensive actions that are multi-domain, integrated, and cost-effective.		
Congressional Add: Aircraft Fleet Readiness and Sustainment ***FY 2018 Accomplishments:*** N/A ***FY 2019 Plans:*** Basic research focus on advanced laboratory equipment and capabilities in support of Aviation Structures.	0.000	10.000
Congressional Adds Subtotals	25.108	42.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Interest Items not included in other Projects.