Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy											Date: May 2017	

Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*						R-1 Program Element (Number/Name) PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology*						

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	0.000	3.349	15.167	15.164	-	15.164	13.172	13.415	1.959	1.998	Continuing	Continuing
2917: *Shallow Water MCM Demos*	0.000	1.901	15.167	15.164	-	15.164	13.172	13.415	1.959	1.998	Continuing	Continuing
9999: *Congressional Adds*	0.000	1.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.448

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015) and investment directions as defined by Department of Defense (DoD) Directive 5160.62 "Single Manager Responsibility for Military Explosive Ordnance Disposal Technology and Training (EODT&T)" and approved by the DoD Explosive Ordnance Disposal (EOD) Program Board (Sep 2012). This strategy is based on needs and capabilities from Navy and Marine Corps guidance, input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). The strategy is also based on the unique needs and capabilities identified by the Joint Requirements Oversight Council (JROC) and the DoD EOD Program Board. It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval and Joint EOD forces in the 21st century. The strategy focuses and aligns Naval S&T with Naval missions, DoD EOD S&T with Joint EOD missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE primarily develops and demonstrates prototype Mine Countermeasures (MCM), Expeditionary Warfare and Joint EOD system components that support capabilities enabling Naval and Joint EOD Forces to influence operations ashore. Adversarial nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littorals. They also have the capability to develop or modify explosive devices such as mines and unexploded ordnance to construct Improvised Explosive Devices (IEDs) for the purpose of targeting Joint Forces. Real world operations have demonstrated the requirement to quickly counter the mine threat. Current operations have also demonstrated the requirement to quickly counter the threat from explosive hazards and IEDs during DoD operations. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. Advanced technologies must enable Joint EOD forces to detect/locate, gain access, diagnose, render safe, neutralize, recover, exploit and dispose of a broad spectrum of explosive hazards including unexploded ordnance and IEDs. This program supports the advanced development and integration of sensors, processing, warheads, and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the advanced development and integration of sensors and tools for standoff capabilities such as detection and location of IEDs (particularly in dismounted operations), dismounted diagnosis of buried munitions and other explosive hazards, precision render safe and neutralization of surface munitions and other explosive hazards, and enhanced access to IEDs. It supports the MCM-related FNC Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship To Objective Maneuver (STOM) key transformational capability within Sea Strike.

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

Exhibit R-2, **RDT&E Budget Item Justification:** FY 2018 Navy				**Date:** May 2017	

Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology*

B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	3.491	15.167	15.470	-	15.470
Current President's Budget	3.349	15.167	15.164	-	15.164
Total Adjustments	-0.142	0.000	-0.306	-	-0.306
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.047	0.000			
• SBIR/STTR Transfer	-0.095	0.000			
• Program Adjustments	0.000	0.000	-0.306	-	-0.306
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	**FY 2016**	**FY 2017**
Project: 9999: *Congressional Adds*		
Congressional Add: *Program Increase*	1.448	0.000
Congressional Add Subtotals for Project: 9999	1.448	0.000
Congressional Add Totals for all Projects	1.448	0.000

Change Summary Explanation

The increase in FY 2017 is due to the transfer of research efforts and activities previously conducted in the Advanced Sea Mines Future Naval Capability (FNC) effort (SHD-FY16-OSD Modular Undersea Effectors (MUSE)) from PE 0603673N Future Naval Capabilities Advanced Technology Development to PE 0603782N Mine and Expeditionary Warfare Advanced Technology.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, **RDT&E Project Justification:** FY 2018 Navy										**Date:** May 2017	

Appropriation/Budget Activity 1319 I 3	**R-1 Program Element (Number/Name)** PE 0603782N I *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 I *Shallow Water MCM Demos*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
2917: *Shallow Water MCM Demos*	0.000	1.901	15.167	15.164	-	15.164	13.172	13.415	1.959	1.998	Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE develops and demonstrates prototype technology for Mine Countermeasures (MCM), US Naval sea mining, and Expeditionary Warfare and Joint EOD system components that support capabilities enabling Naval and Joint EOD Forces to influence operations ashore. Adversarial nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littorals. They also have the capability to develop or modify explosive devices such as mines and unexploded ordnance to construct Improvised Explosive Devices (IEDs) for the purpose of targeting Joint Forces. Real world operations have demonstrated the requirement to quickly counter the mine threat. Current operations have also demonstrated the requirement to quickly counter the threat from explosive hazards and IEDs during DoD operations. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. Advanced technologies must enable Joint EOD forces to detect/locate, gain access, diagnose, render safe, neutralize, recover, exploit and dispose of a broad spectrum of explosive hazards including unexploded ordnance and IEDs. This program supports the advanced development and integration of sensors, processing, warheads, and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the advanced development and integration of sensors and tools for standoff capabilities such as detection and location of IEDs (particularly in dismounted operations), dismounted diagnosis of buried munitions and other explosive hazards, precision render safe and neutralization of surface munitions and other explosive hazards, and enhanced access to IEDs. It supports advanced development for battlespace shaping weapons including advanced undersea weapons. It supports the MCM related FNC Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship To Objective Maneuver (STOM) key transformational capability within Sea Strike.

The increase in FY 2017 is due to the transfer of research efforts and activities previously conducted in the Advanced Sea Mines Future Naval Capability (FNC) effort (SHD-FY16-OSD Modular Undersea Effectors (MUSE)) from PE 0603673N Future Naval Capabilities Advanced Technology Development to PE 0603782N Mine and Expeditionary Warfare Advanced Technology.

B. Accomplishments/Planned Programs ($ in Millions)

	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: Joint EOD Demos	1.901	1.957	1.958	0.000	1.958

Description: This activity focuses on developing and demonstrating technologies to support a standoff or remote capability for detection and location, diagnosis, render safe, neutralization and enhanced access. Efforts include: electromagnetic, electro-optical, and acoustic sensors and systems for detection of explosive threat components including explosives, device housings/containers, and triggering mechanisms, standoff identification and confirmation of trace explosives, fusion of multi-sensor input for high confidence detection and diagnosis of buried threats, highly dexterous manipulators and imitative controllers for lightweight, efficient (strength/weight ratio) dual manipulator systems integrated onto EOD robots for enhanced access, enhanced robotic autonomy

Exhibit R-2A, **RDT&E Project Justification:** FY 2018 Navy		**Date:** May 2017
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
to support EOD missions, data compression and visualization techniques to support precise render safe and neutralization, and neutralization devices containing reactive materials to neutralize devices with low collateral damage. This S&T investment supports the Joint Requirements Oversight Council (JROC) and DoD EOD Program Board validated requirements for Joint EOD missions. This S&T investment provides critical S&T transitions to acquisition programs. This investment in Joint EOD S&T is reported annually to the DoD EOD Program Board. This S&T investment is documented in the DoD EOD Applied Research Program Plan which is reviewed and approved annually by the DoD EOD Program Board. *FY 2016 Accomplishments:* - Continued development of a laser interferometric sensor/system that can be integrated onto various platforms including EOD robots for detection and/or diagnosis of buried objects. - Continued development of highly dexterous dual manipulator systems (manipulators, controllers) that can be integrated onto EOD robots for precision render safe and neutralization missions. - Continued development of a Resonance Raman (single or dual wavelength) detector for standoff detection of trace explosives that can be integrated into a handheld device or onto an EOD robot. - Initiated development of sensors that can be integrated into a handheld device or onto an EOD robot to detect deeply buried objects. - Initiated development of excavation tools and techniques that can be integrated into a handheld device or onto an EOD robot for precision recovery and diagnosis of buried objects. - Initiated development of neutralization tools and techniques that can be deployed by an EOD technician or integrated onto an EOD robot for effective target neutralization with low collateral damage to surrounding infrastructure. *FY 2017 Plans:* - Continue all efforts of FY 2016 less those noted as completed above. - Initiate development of a robotic system demonstrator for stand-off detection of trace and bulk explosive materials. - Initiate development of a robotic system demonstrator for autonomous grasping and manipulation. *FY 2018 Base Plans:* Conduct advanced technology development and demonstration in electro-optic & acoustic technologies for buried mine detection, robotic manipulation for ordnance exploitation & neutralization, standoff detection					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
and classification for ordnance, and identification of explosives. Efforts in this thrust include prototype and demonstration of laser interferometric sensor / systems for detection of buried objects, highly dexterous dual manipulator systems (manipulators, controllers) for EOD robots for precision render safe and neutralization missions, Resonance Raman (single or dual wavelength) detector for standoff detection, and excavation tools and techniques for precision recovery and diagnosis of buried objects. ***FY 2018 OCO Plans:*** N/A					
Title: Mine Technology **Description:** This activity focuses on developing and demonstrating technology to support on-demand battlespace shaping through advanced undersea weapons. Efforts include command & control (C2), remote control, advanced sensing technologies, compatibility with unmanned delivery options, detection & classification, and targeting solutions. The program, Modular Undersea Effector System (MUSE), is a limited duration effort for advanced mining and responds to recent request for capability from the fleet. The increase in FY 2017 is due to the transfer of research efforts and activities previously conducted in the Advanced Sea Mines Future Naval Capability (FNC) effort (SHD-FY16-OSD Modular Undersea Effectors (MUSE)) from PE 0603673N Future Naval Capabilities Advanced Technology Development to PE 0603782N Mine and Expeditionary Warfare Advanced Technology for further technology maturation. The transfer was made to better align the research within the current DoN RDT&E program structure. ***FY 2016 Accomplishments:*** N/A ***FY 2017 Plans:*** - Initiate development of advanced sensing technologies - Initiate development of command & control and advanced detection & classification technologies ***FY 2018 Base Plans:*** Conduct advanced technology development and demonstration in advanced mining concepts including remote control, advanced sensing, command & control (C2), and more discriminative targeting solutions. Efforts in this	0.000	13.210	13.206	0.000	13.206

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy			**Date:** May 2017
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*		**Project (Number/Name)** 2917 / *Shallow Water MCM Demos*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
thrust include prototyping advanced sensors and sensor configuration technologies for improved discrimination as well as communications, command, and control technologies. ***FY 2018 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	1.901	15.167	15.164	0.000	15.164

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

D. Acquisition Strategy
 N/A

E. Performance Metrics
 The overall metrics of this advanced technology program are the development of technologies supporting the Mine and Expeditionary Warfare challenges of reducing the MCM tactical timeline from months to days and eliminating the need for Navy divers and manned equipment to enter minefields. Another important metric is the scheduled transition of 6.3 advanced technology projects from the FNCs program into Navy and Marine Corps acquisition programs at agreed upon Technology Readiness Levels. Technology-specific metrics include: Mine warfare data fusion capabilities yielding a 10%-25% reduction in time and risk to mine hunting activities; Mine hunting sensors - Probability of Detection = 95%, Probability of Identification of Proud Mines = 90%, Probability of Classification of Buried Mines = 80%; Unmanned Systems for MCM sized for inclusion in the Littoral Combat Ship Mine Warfare Mission Package; MCM sensors sized, packaged and capable of 12 hour missions with a search rate greater than .05 square nautical mines per hour; Mine sweeping: Modular magnetic and acoustic influence sweeping systems packaged for deployment from Unmanned Surface Vehicles; Minesweeping single sortie coverage > 9.4 square nautical miles at 20 nautical miles per hour during a 4 hour mission up to Sea State 3; Surface-laid mine and obstacle breaching capability > 90% in the Beach Zone (BZ) using unitary warheads, and > 80% in the Surf Zone (SZ).

Exhibit R-2A, **RDT&E Project Justification:** FY 2018 Navy											**Date:** May 2017	
Appropriation/Budget Activity 1319 **/** 3				**R-1 Program Element (Number/Name)** PE 0603782N **/** *Mine and Expeditionary Warfare Advanced Technology*						**Project (Number/Name)** 9999 **/** *Congressional Adds*		
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
9999: *Congressional Adds*	0.000	1.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.448

A. Mission Description and Budget Item Justification

This congressional increase further develops and demonstrates technologies to support a standoff or remote capability for detection and location, diagnosis, render safe, neutralization and enhanced access. Efforts include: electromagnetic, electro-optical, and acoustic sensors and systems for detection of explosive threat components including explosives, device housings/containers, and triggering mechanisms, standoff identification and confirmation of trace explosives, fusion of multiple-sensor input for high confidence detection and diagnosis of buried threats, highly dexterous manipulators and imitative controllers for lightweight, efficient (strength/weight ratio) dual manipulator systems integrated onto EOD robots for enhanced access, enhanced robotic autonomy to support EOD missions, data compression and visualization techniques to support precise render safe and neutralization, and neutralization devices containing reactive materials to neutralize devices with low collateral damage.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**
Congressional Add: Program Increase **FY 2016 Accomplishments:** - Expand development of sensors that can be integrated into a handheld device or onto an EOD robot to detect deeply buried objects. - Expand development of excavation tools and techniques that can be integrated into a handheld device or onto an EOD robot for precision recovery and diagnosis of buried objects. - Expand development of neutralization tools and techniques that can be deployed by an EOD technician or integrated onto an EOD robot for effective target neutralization with low collateral damage. **FY 2017 Plans:** N/A	1.448	0.000
Congressional Adds Subtotals	1.448	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This activity supports the development and transition of technologies to PMS-408 for Joint Service missions. This S&T investment supports the Joint Requirements Oversight Council (JROC) and DoD EOD Program Board validated requirements for Joint EOD missions. This S&T investment provides critical S&T transitions to

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		**Date:** May 2017
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology*	**Project (Number/Name)** 9999 / *Congressional Adds*

the acquisition programs managed by PMS-408. This investment in Joint EOD S&T is reported annually to the DoD EOD Program Board. This S&T investment is documented in the DoD EOD Applied Research Program Plan which is reviewed and approved annually by the DoD EOD Program Board.