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

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 5: System Development & Demonstration (SDD)</i>	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>
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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	258.470	12.602	15.290	25.635	-	25.635	18.495	15.705	16.362	20.023	Continuing	Continuing
0267: <i>Mine Improvements</i>	222.268	12.602	15.290	17.617	-	17.617	11.013	8.729	13.885	9.046	Continuing	Continuing
2993: <i>Encapsulated Effector</i>	36.202	0.000	0.000	8.018	-	8.018	7.482	6.976	2.477	10.977	Continuing	Continuing

A. Mission Description and Budget Item Justification

Mine development R&D supports the capability to maintain the effectiveness of mines facing new threat targets and increasing emphasis on major regional conflicts and littoral warfare in shallow water. Project tasks are grouped into several areas: (1) Threat Modeling/Analysis, which collects, analyzes, and develops digital models of data on current priority threat target characteristics to support computer simulations; (2) Target Detection and Response, which uses target models to develop optimal mine designs, settings, and firing algorithms; (3) Developing and upgrading Tactical Decision Aids (TDAs) to assist the warfighter in planning and placing more effective minefields; (4) Test and Evaluation (T&E) to support aircraft certification; (5) Design, develop and test the Clandestine Delivered Mine (CDM) capability; a conversion kit to convert legacy mine warheads into Unmanned Underwater Vehicle (UUV) delivered mines.

Beginning in FY16, integration of the second increment with the TDD Mk 71 and the addition of a remote command and control capability will provide improved performance and efficiencies of the system. Additional funds in FY17 will support the Joint Operational Need Statement (JEONS) to improve aerial delivery by converting a Joint Direct Attack Munition (JDAM) equipped bomb into a Quickstrike JDAM mine. Development of a new mining capability, to encapsulate a wide area of coverage weapon, such as a torpedo, to achieve mine warfare operational objectives will begin in FY18. The Encapsulated Effector program will be the transition path for multiple ongoing science and technology projects to allow for off-board sensing of targets, remote control of mines, and reduced number of warheads needed to achieve the intended effect.

B. Program Change Summary (\$ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	15.122	10.490	17.640	-	17.640
Current President's Budget	12.602	15.290	25.635	-	25.635
Total Adjustments	-2.520	4.800	7.995	-	7.995
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.050	0.000			
• SBIR/STTR Transfer	-0.470	0.000			
• Program Adjustments	0.000	4.800	2.728	-	2.728
• Rate/Misc Adjustments	0.000	0.000	5.267	-	5.267

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Change Summary Explanation Total Adjustments: FY16 -\$2,050k BTR to ONR, for mine rails and -\$470k SBIR Total Adjustments: FY17 +\$4,800k FY17 RAA in support of Quickstrike JEONS Total Adjustments: FY18 +\$2,728k Encapsulated Effector, -\$23k Misc adjustment		

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy										Date: May 2017		
Appropriation/Budget Activity 1319 / 5					R-1 Program Element (Number/Name) PE 0604601N / Mine Development				Project (Number/Name) 0267 / Mine Improvements			
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
0267: Mine Improvements	222.268	12.602	15.290	17.617	-	17.617	11.013	8.729	13.885	9.046	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Mine development R&D supports the capability to maintain the effectiveness of mines facing new threat targets and increasing emphasis on major regional conflicts and littoral warfare in shallow water. Project tasks are grouped into several areas: (1) Threat Modeling/Analysis, which collects, analyzes, and develops digital models of data on current priority threat target characteristics to support computer simulations; (2) Target Detection and Response, which uses target models to develop optimal mine designs, settings, and firing algorithms;(3) Developing and upgrading Tactical Decision Aids (TDAs) to assist the warfighter in planning and placing more effective minefields; (4) Test and Evaluation (T&E) to support aircraft certification; (5) Design, develop and test the Clandestine Delivered Mine (CDM) capability; a conversion kit to convert legacy mine warheads into Unmanned Underwater Vehicle (UUV) delivered mines.

Beginning in FY16, integration of the second increment with the TDD Mk 71 and the addition of a remote command and control capability will provide improved performance and efficiencies of the system. Additional funds in FY17 will support the Joint Operational Need Statement (JEONS) to improve aerial delivery by converting a Joint Direct Attack Munition (JDAM) equipped bomb into a Quickstrike JDAM mine.

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

	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: Product Development	9.826	11.105	11.984	0.000	11.984
Articles:	-	-	-	-	-
FY 2016 Accomplishments:					
Software Development: Modified algorithms based on testing results. Continued generating OPDATA for the Fast Patrol Boat, Air Cushioned Vehicle, and large ship algorithms. Completed detailed design of a Clandestine Delivered Mine (CDM) that uses existing Submarine Launched Mobile Mine (SLMM) components and legacy TDD Mk 57 to allow for delivery of mines by UUV. Design includes modifications to fuze components, batteries, weapon casing, and mine rails which attach the mines to the UUV. Initial prototyping and testing was conducted successfully. Began development of remote command and control capability for CDM and integration of the programmable TDD Mk 71.					
FY 2017 Plans:					
Support JEONS capability development by generating damage effects data for 2000 pound version of Quickstrike compatible with JDAM tail kits, performing system safety analysis to support a Joint Services Weapon Safety Review, and developing upgrades to minefield planning software to add this capability into the next software build. Modify algorithms based on testing results. Continue generating OPDATA for the Fast Patrol Boat, Air Cushioned Vehicle, and large ship algorithms based on updated fleet priorities. Deliver					

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy	Date: May 2017
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Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>	Project (Number/Name) 0267 / <i>Mine Improvements</i>
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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
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to the fleet new algorithms for the TDD Mk 71 for Fast Patrol Boat. Support and assess results of end-to-end testing of CDM phase 1 during an in-water event that demonstrates weapon build-up, loading, transit, delivery, arming sequence, target detection, and simulated fire. Obtain Weapon System Explosive Safety Review Board (WSESRB) concurrence for CDM phase 1. Continue development and integration of remote control hardware and TDD Mk 71 in CDM upgrades.

FY 2018 Base Plans:
Continue development of 2000 pound Quickstrike to support JEONS requirements. Tasks include generating damage effects data against a range of targets, performing system safety analysis, and finishing upgrades to minefield planning software to add this capability into the next software build. Deliver large ship target detection algorithm to the fleet for use within the TDD Mk 71. Continue development of CDM phase 2, including finalizing interface design, by integrating the programmable TDD Mk 71 and a remote command and control capability.

FY 2018 OCO Plans:
N/A

Title: Support

Articles:

	0.050	0.060	0.085	0.000	0.085
	-	-	-	-	-
	0.050	0.060	0.080	0.000	0.080

FY 2016 Accomplishments:
Provided Information Assurance (IA) and technical support of Mine Warfare development lab for Quickstrike Mines.

FY 2017 Plans:
Provide Information Assurance (IA) and technical support of Mine Warfare development lab for Quickstrike Mines. Begin cyber security analysis and documentation in support of the remote control of the Clandestine Delivered Mine.

FY 2018 Base Plans:
Continue to provide Information Assurance (IA) and technical support of Mine Warfare development lab for Quickstrike Mines. Continue cyber security analysis and documentation in support of the remote control of the Clandestine Delivered Mine. Initiate cyber security analysis during conceptual design phase of Encapsulated Effector program.

FY 2018 OCO Plans:
N/A

Title: Management:

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>	Project (Number/Name) 0267 / <i>Mine Improvements</i>

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
<p align="right"><i>Articles:</i></p> <p>FY 2016 Accomplishments: Program Management Support, contract support and Travel</p> <p>FY 2017 Plans: Program Management Support, contract support and Travel</p> <p>FY 2018 Base Plans: Program Management Support, contract support and Travel</p> <p>FY 2018 OCO Plans: N/A</p>	-	-	-	-	-
<p>Title: Test and Evaluation</p> <p align="right"><i>Articles:</i></p> <p>FY 2016 Accomplishments: Continued aircraft certification (to include F/A-18). Conducted in-water testing for planned algorithms for TDD Mk 71. Conducted subsystem level testing on CDM in preparation for an end-to-end demonstration in FY17. Conducted laboratory integration testing and an in-water test of CDM to evaluate interfaces with delivery vehicle, proper deployment and safe arming sequence. Successfully conducted proof-of-concept, in-water demonstration of remote control of a minefield.</p> <p>FY 2017 Plans: In order to support JEONS for maritime mining, perform water impact testing of a Quickstrike JDAM configuration. Conduct aircraft integration testing and analysis of Quickstrike JDAM on US Air Force bomber platforms. Complete aircraft certification of F/A-18. Conduct explosive ordnance disposal (EOD) render safe procedures testing to ensure safe disposal procedures are safe and effective for EOD forces. Conduct end-to-end testing of CDM phase 1 during an in-water event that demonstrates weapon build-up, loading, transit, delivery, arming sequence, target detection, and simulated fire. Complete safety qualification testing of fuze and battery components of CDM.</p> <p>FY 2018 Base Plans: In support of JEONS for maritime mining, complete water impact testing of a Quickstrike JDAM configuration. Continue aircraft integration testing and analysis of Quickstrike JDAM on US Air Force bomber platforms. Complete aircraft certification of B-52. Conduct explosive ordnance disposal (EOD) render safe procedures testing to ensure safe disposal procedures are safe and effective for EOD forces, based on updated</p>	2.676	4.065	5.468	0.000	5.468
	-	-	-	-	-

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

Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>	Project (Number/Name) 0267 / <i>Mine Improvements</i>
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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
target algorithms. Conduct system-level integration testing of CDM phase 2 using engineering design models to ensure TDD Mk 71 and remote control devices function as designed. Initiate safety qualification testing of updated fuze and battery components of CDM Phase 2.					
FY 2018 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	12.602	15.290	17.617	0.000	17.617

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

<u>Line Item</u>	<u>FY 2016</u>	<u>FY 2017</u>	<u>FY 2018 Base</u>	<u>FY 2018 OCO</u>	<u>FY 2018 Total</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• WPN 3231: <i>Quickstrike Mine</i>	10.754	1.236	10.276	-	10.276	7.294	5.210	5.320	5.426	0.000	96.409

Remarks

D. Acquisition Strategy

Procurement of Target Detecting Device (TDD) Mk 71, MK 62/63 kits, MK 65, Clandestine Delivered Mine (CDM) kits and associated components.

E. Performance Metrics

N/A

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Exhibit R-3, RDT&E Project Cost Analysis: FY 2018 Navy **Date:** May 2017

Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / Mine Development	Project (Number/Name) 0267 / Mine Improvements
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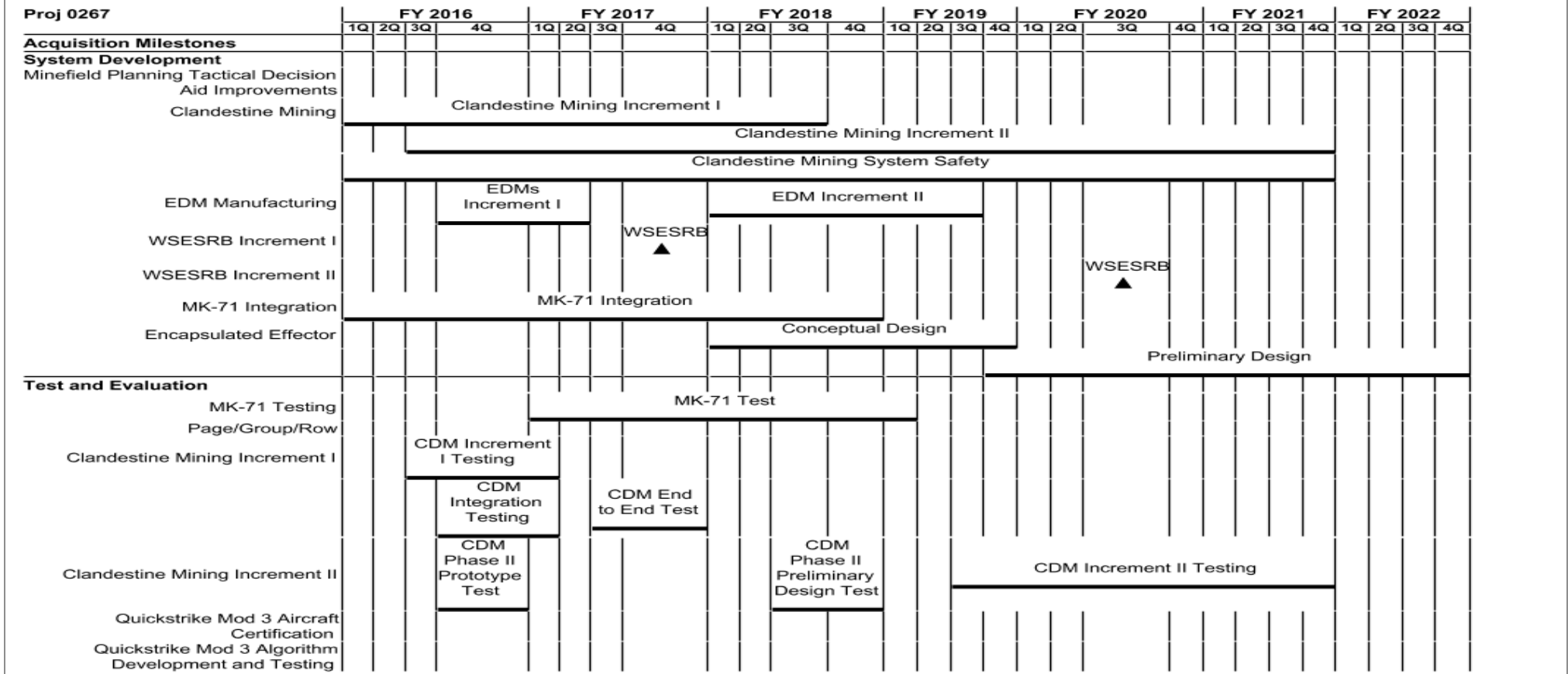
Product Development (\$ in Millions)				FY 2016		FY 2017		FY 2018 Base		FY 2018 OCO		FY 2018 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
Primary Hardware Development	WR	NSWC PC : Panama City, FL	117.357	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Ancillary Hardware Development	C/CPAF	Various : Various	4.012	0.050	Nov 2015	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Ship Suitability	WR	NSWC PC : Panama City, FL	2.467	0.000		0.000		0.000		-		0.000	0.000	2.467	-
GFE	C/CPAF	Various : Various	4.790	0.000		0.000		0.000		-		0.000	0.000	4.790	-
Software Development	WR	NSWC, PC : Panama City, FL	20.015	1.200	Nov 2015	1.570	Oct 2016	2.050	Oct 2017	-		2.050	0.000	24.835	-
Clandestine Mine	WR	NSWC, PC : Panama City, FL	1.940	2.578	Nov 2015	2.282	Oct 2016	3.233	Oct 2017	-		3.233	0.000	10.033	-
Clandestine Mine	WR	NSWC, IH : Indian Head, MD	2.050	2.938	Nov 2015	2.767	Nov 2016	4.533	Nov 2017	-		4.533	0.000	12.288	-
Clandestine Mine	C/CPFF	JHU/APL : Baltimore, MD	2.730	3.060	Nov 2015	1.211	Dec 2016	2.168	Dec 2017	-		2.168	0.000	9.169	-
Mk 84 minefield planning	WR	NSWC PC : Panama City, FL	0.000	0.000		1.628	May 2017	0.000		-		0.000	0.000	1.628	-
Mk84 damage & system analysis	WR	NSWC IH : Indian Head, Md	0.000	0.000		1.647	May 2017	0.000		-		0.000	0.000	1.647	-
Subtotal			155.361	9.826		11.105		11.984		-		11.984	-	-	-

Support (\$ in Millions)				FY 2016		FY 2017		FY 2018 Base		FY 2018 OCO		FY 2018 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
IA/ILS/Technical	WR	NSWC PC : Panama City, FL	0.822	0.050	Nov 2015	0.060	Oct 2016	0.085	Nov 2017	-		0.085	Continuing	Continuing	Continuing
Subtotal			0.822	0.050		0.060		0.085		-		0.085	-	-	-

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Exhibit R-4, RDT&E Schedule Profile: FY 2018 Navy **Date: May 2017**

Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / Mine Development	Project (Number/Name) 0267 / Mine Improvements
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Exhibit R-4A, RDT&E Schedule Details: FY 2018 Navy **Date:** May 2017

Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>	Project (Number/Name) 0267 / <i>Mine Improvements</i>
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
Proj 0267				
System Development: Clandestine Mining: Increment I	1	2016	3	2018
System Development: Clandestine Mining: Increment II	3	2016	4	2021
System Development: Clandestine Mining: System Safety	1	2016	4	2021
System Development: EDM Manufacturing: EDM Manufacturing Increment I	4	2016	2	2017
System Development: EDM Manufacturing: EDM Manufacturing Increment II	1	2018	3	2019
System Development: WSESRB Increment I: Increment I	4	2017	4	2017
System Development: WSESRB Increment II: Increment II	3	2020	3	2020
System Development: MK-71 Integration: MK-71 Integration	1	2016	4	2018
Test and Evaluation: MK-71 Testing: MK-71 Test	1	2017	1	2019
Test and Evaluation: Clandestine Mining Increment I: Increment I Testing	3	2016	1	2017
Test and Evaluation: Clandestine Mining Increment I: CDM Integration Testing	4	2016	1	2017
Test and Evaluation: Clandestine Mining Increment I: End to End Test	3	2017	4	2017
Test and Evaluation: Clandestine Mining Increment II: Testing	3	2019	4	2021
Test and Evaluation: Clandestine Mining Increment II: CDM Phase II Prototype Test	4	2016	4	2016
Test and Evaluation: Clandestine Mining Increment II: CDM Phase II Preliminary Design Test	3	2018	4	2018

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy										Date: May 2017		
Appropriation/Budget Activity 1319 / 5					R-1 Program Element (Number/Name) PE 0604601N / Mine Development				Project (Number/Name) 2993 / Encapsulated Effector			
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
2993: Encapsulated Effector	36.202	0.000	0.000	8.018	-	8.018	7.482	6.976	2.477	10.977	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Encapsulated Effector transitions technology developed by the Advanced Undersea Weapon System (AUWS) Enabling Capability starting in FY18. The program provides maritime mining capability in intermediate water depths compared to existing bottom mines, uses existing kinetic payloads to engage enemy targets, and provides a wide area of coverage per each weapon. The program uses a weapon which is self-contained and is released when a target is detected and uses mobility to engage the target. The system uses modern sensing and processing technology to enable accurate targeting at increased range, incorporates remote control to allow operational flexibility to active/deactivate and/or change targeting parameters, and maintain minefield resilience even as weapons are expended against targets. The result is expanded operating areas to restrict or deny adversary access to the intended area while using fewer weapons than traditional mines.

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

	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: Product Development	0.000	0.000	7.693	0.000	7.693
Articles:	-	-	-	-	-
FY 2016 Accomplishments: N/A					
FY 2017 Plans: N/A					
FY 2018 Base Plans: Conduct engineering analysis to allocate requirements to subsystems, develop engineering architecture products, and document the conceptual design baseline. generate a technical data package to solicit feedback on the system safety approach from the Navy Weapon System Explosive Safety Review Board. Begin development of engineering guiding documents such as the Systems Engineering Plan and Test and Evaluation Master Plan. Coordinate transition of technology products from the Office of Naval Research's Advanced Undersea Weapon System Future Naval Capability program. Research existing decision support systems applicable to undersea warfare mission planning and develop requirements for integration of minefield planning capabilities into those systems. Perform rapid prototyping of design concepts to assess feasibility and interoperability with host platform and various subcomponent elements.					
FY 2018 OCO Plans: N/A					
Title: Support	0.000	0.000	0.205	0.000	0.205

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy	Date: May 2017
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Appropriation/Budget Activity 1319 / 5	R-1 Program Element (Number/Name) PE 0604601N / <i>Mine Development</i>	Project (Number/Name) 2993 / <i>Encapsulated Effector</i>
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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
<p align="right"><i>Articles:</i></p> <p>FY 2016 Accomplishments: N/A</p> <p>FY 2017 Plans: N/A</p> <p>FY 2018 Base Plans: Provide Information Assurance (IA) and technical support of Mine Warfare development lab. Provide cyber security analysis and documentation in support of the remote control of the Encapsulated Effector.</p> <p>FY 2018 OCO Plans: N/A</p>	-	-	-	-	-
<p>Title: Management:</p> <p align="right"><i>Articles:</i></p> <p>FY 2016 Accomplishments: N/A</p> <p>FY 2017 Plans: N/A</p> <p>FY 2018 Base Plans: Program Management Support, contract support and Travel</p> <p>FY 2018 OCO Plans: N/A</p>	0.000 -	0.000 -	0.120 -	0.000 -	0.120 -
Accomplishments/Planned Programs Subtotals	0.000	0.000	8.018	0.000	8.018

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

N/A

Remarks

D. Acquisition Strategy

The encapsulated effector plans to leverage Navy warfare center expertise to perform requirements analysis and engineering architecture design to identify mature technologies to meet the operational objectives. Those engineering products will be provided to a prime contractor for final system integration and testing. The

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

Appropriation/Budget Activity	R-1 Program Element (Number/Name)	Project (Number/Name)
1319 / 5	PE 0604601N / <i>Mine Development</i>	2993 / <i>Encapsulated Effector</i>

contractor will be responsible for the final design to optimize producibility, manufacture engineering design models to be used during testing, and test planning and execution to gather the required data to support a production decision.

E. Performance Metrics

N/A