Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 7: *Operational Systems Development*					R-1 Program Element (Number/Name) PE 0204228N / *Surface Support*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	8.611	3.000	36.045	21.156	-	21.156	13.529	14.554	12.421	12.749	Continuing	Continuing
3311: *Navigation Systems*	8.611	3.000	36.045	21.156	-	21.156	13.529	14.554	12.421	12.749	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Surface Support RDT&E funding will be used for the research, design, development, integration testing, and documentation of a new Inertial Navigation System (INS) for all Navy platforms. The program will implement systems engineering processes to investigate major navigation system error sources, define new functions, research new technologies, algorithms, and techniques to improve system performance, conduct analyses of alternatives, create preliminary and final design concepts, develop new hardware components and associated software, and conduct land based and shipboard testing. The INS-R consists of an Inertial Sensor Module (ISM) and a Navigation Processing Module (NPM). The ISM is planned to be designed, developed, and procured through an open competition. The NPM is a Government design. A Request for Information (RFI) was issued in 22 Aug 2013 for initial concepts and market availability of the ISM. The results of the RFI changed the FY16 and out requirements to complete development of all INS-R configurations (surface/amphib, submarine, and carrier).

The Navy's current INS is the AN/WSN-7(V) Ring Laser Gyro Navigator (RLGN), a legacy 1980's design that was first installed in 1998 and is now obsolete. This is a proprietary design. The RLGN is reaching its limit with respect to providing the high-accuracy navigation solution required to meet known and emerging mission requirements. Navigator of the Navy's Vision 2025 identified emergent requirements with respect to improved navigation in a GPS denied environment, littoral warfare, mine countermeasures, and manned and unmanned vehicle operations that cannot be met with existing systems. The RLGN employs an Inertial Measuring Unit (IMU) with three single-axis ring laser gyros that allow the system to provide continuous and automatic data outputs of the ship's geographic position (latitude, longitude), horizontal and vertical linear velocity (Ve, Vn, Vv), attitude (heading, roll, and pitch) and attitude rates. The INS provides mission critical ship's position and attitude data to shipboard sensors (such as radars), combat systems, gun, and missile systems. The INS uses data from the Global Positioning System (GPS) to periodically update (i.e., reset) its position and internal clock. The INS is the ship's primary position source in absence of GPS.

In addition to INS-R, this funding will be used for the research, development, integration testing, and documentation of other navigation wholeness initiatives, including Phase I Cybersecurity Enclave Boundary Defense Capability, MK27 Gyrocompass Replacement, Own Ship Speed (OSS) and Course Repeater Replacement, submarine Time Frequency Distribution System (TFDS) Replacement, and new submarine speed sensors. These efforts will provide replacement designs and architectures to address legacy obsolescence, capability gaps, and performance shortfalls that impact the quality, reliability, and total ownership costs of the overall navigation suite.

Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy					Date: February 2016
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 7: *Operational Systems Development*		R-1 Program Element (Number/Name) PE 0204228N *I Surface Support*			
B. Program Change Summary ($ in Millions)	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	2.878	36.045	24.918	-	24.918
Current President's Budget	3.000	36.045	21.156	-	21.156
Total Adjustments	0.122	0.000	-3.762	-	-3.762
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.179	0.000			
• SBIR/STTR Transfer	-0.057	0.000			
• Program Adjustments	0.000	0.000	-2.000	-	-2.000
• Rate/Misc Adjustments	0.000	0.000	-1.762	-	-1.762

Change Summary Explanation

FY 2015 funding request includes an increased of $0.179 million for Navigation sensors and systems and reduction of $0.057 million for SBIR Transfer.

FY 2017 funding request is reduced by $0.321 million for rate/miscellaneous adjustments, $2 million for Navigation Sensor and Tools adjustments, $0.545 million to account for the availability of prior year balances, and $0.896 million for the Department of the Navy to comply with the Bipartisan Budget Act of 2015.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0204228N / *Surface Support*	Project (Number/Name) 3311 / *Navigation Systems*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
3311: *Navigation Systems*	8.611	3.000	36.045	21.156	-	21.156	13.529	14.554	12.421	12.749	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Surface Support RDT&E funding will be used for the research, design, development, integration testing, and documentation of a new Inertial Navigation System (INS) for all Navy platforms. The program will implement systems engineering processes to investigate major navigation system error sources, define new functions, research new technologies, algorithms, and techniques to improve system performance, conduct analyses of alternatives, create preliminary and final design concepts, develop new hardware components and associated software, and conduct land based and shipboard testing. The INS-R consists of an Inertial Sensor Module (ISM) and a Navigation Processing Module (NPM). The ISM is planned to be designed, developed, and procured through an open competition. The NPM is a Government design. A Request for Information (RFI) was issued in 22 Aug 2013 for initial concepts and market availability of the ISM. The results of the RFI changed the FY16 and out requirements to complete development of all INS-R configurations (surface/amphib, submarine, and carrier).

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Inertial Navigation System - Replacement (INS-R)	2.821	25.076	15.973	0.000	15.973
Articles:	-	-	-	-	-
FY 2015 Accomplishments:					
- Continued design and development of the surface and submarine variants of the NPM.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Completed NPM initial design for the test lab. - Completed Modeling and Simulation (M&S) for the Inertial Simulation Module (ISM) to support the NPM EDM. - Completed an Initial Design Review (IDR) on the NPM. - Released the ISM request for proposal to Industry for the ISM development, Low Rate Initial Production (LRIP) and Full Rate Production (FRP) contract. ***FY 2016 Plans:*** - Continue NPM Engineering Development Model (EDM) design. - Award the development contract for ISM development. - Complete Preliminary Design Review (PDR) for the ISM development. - Complete Preliminary Design Review (PDR) for the NPM development. - Build four ISM EDM's to support integration and testing - Integrate design of NPM and ISM and conduct an INS-R program level PDR. - Complete design documents to include the Systems Engineering Plan (SEP). - Deliver one NPM and one ISM simulator to CSEDS lab for testing. ***FY 2017 Base Plans:*** - Complete development of the ISM EDM. - Begin ISM EDM and NPM EDM hardware (HW) and software (SW) integration. - Complete the system test plans to support Developmental/Operational (DT/OA) testing. - Conduct Critical Design Review (CDR) on the ISM EDM, and NPM EDM. - Conduct CDR at the INSR system level. - Begin initial Vendor testing on the ISM EDM. - Award the ISM Pre Production Unit (PPU) Contract Line Item Number (CLIN) for production of ISM's. - Conduct Environmental Qualification Testing (EQT) on the NPM EDM. - Complete program documentation. ***FY 2017 OCO Plans:*** N/A					
Title: Phase I Cybersecurity Enclave Boundary Defense Capability	0.000	5.000	4.392	0.000	4.392
Articles:	-	-	-	-	-
FY 2015 Accomplishments: N/A					
FY 2016 Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete development, testing, and implementation of external boundary enclave cyber defense solutions. - Develop navigation wholeness Cybersecurity requirements based on mandated requirements, threats and standards via Functional Requirements Document (FRD). - Develop navigation architecture changes and Cybersecurity protections for current and future equipment. - Develop future Boundary Defense technologies to meet Advanced Cyber threats. ***FY 2017 Base Plans:*** -Design a Navy ECDIS cybersecurity solution for fielded unclassified configurations -Address firewall planning -Develop an architecture design for the Navigation Suite/Enclave for the layered boundary defense architecture -Develop requirements for shore to ship Navy Electronic Chart Display and Information System (ECDIS) software downloading procedures to ensure a robust cybersecurity posture. ***FY 2017 OCO Plans:*** N/A					
Title: MK27 Gyrocompass Replacement ***Articles:*** ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** - Complete design, development, and testing of a MK27 gyrocompass replacement for surface, amphibious and submarine platforms leveraging the INS-R architecture. Includes build of three prototypes (one of each variant). ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A	0.000 -	3.400 -	0.000 -	0.000 -	0.000 -
Title: Time Frequency Distribution System (TFDS) Replacement ***Articles:*** ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:***	0.000 -	1.400 -	0.791 -	0.000 -	0.791 -

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Replace legacy Time Frequency Distribution System (TFDS) architecture on submarines with modern architecture. This leverages the development effort associated with the surface Time and Frequency Component (TFC) of Global Positioning System (GPS) - Based Positioning, Navigation, and Timing Service (GPNTS). - Develop design documentation to adapt surface design to a submarine configuration and begin development of prototype. ***FY 2017 Base Plans:*** -Conduct the TFDS Analysis of Alternatives (AoA) to analyze options for meeting timing requirements for Submarines. -Finalize the Technical Requirements Document (TRD). ***FY 2017 OCO Plans:*** N/A					
Title: Own Ship Speed (OSS) and Course Repeater ***Articles:*** ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** - Complete design, development, and testing of an Own Ship Speed (OSS) and Course Repeater replacement for surface platforms. Includes build of two prototypes for testing. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A	0.000 -	0.722 -	0.000 -	0.000 -	0.000 -
Title: Submarine Speed Sensors ***Articles:*** ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:***	0.000 -	0.447 -	0.000 -	0.000 -	0.000 -

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Test new shark fin and Doppler speed sensors for submarines using Commercial Off the Shelf (COTS) technology to replace legacy speed sensors. Effort will be used to guide future development of new speed sensor. Includes build of two prototypes for testing. ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A					
Title: Assured Positioning, Navigation and Timing Analysis of Alternatives ***Articles:*** ***FY 2015 Accomplishments:*** Began Assured Positioning, Navigation and Timing Analysis of Alternatives (AoA). ***FY 2016 Plans:*** N/A ***FY 2017 Base Plans:*** N/A ***FY 2017 OCO Plans:*** N/A	0.179 -	0.000 -	0.000 -	0.000 -	0.000 -
Accomplishments/Planned Programs Subtotals	3.000	36.045	21.156	0.000	21.156

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
• OPN/0670: *Other Navigation*	39.298	87.481	63.942	-	63.942	65.002	108.772	121.780	124.285	0.000	877.351

Remarks

D. Acquisition Strategy

Inertial Navigation System (INS) contract planned to be competitively awarded in FY 2016.

E. Performance Metrics

FY15:
- Completed the Inertial Simulation Module (ISM).

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

- Continued design of NPM EDM.
- Completed NPM initial design for the test lab.
- Released the ISM development contract Request for Proposal.
- Completed NPM design review.

FY16:
- Award ISM development contract.
- Complete ISM component PDR.
- Complete NPM component PDR.
- Complete system level (INSR) PDR.
- Build four ISM EDM's to support integration and testing
- Deliver NPM EDM to CSEDS lab for initial testing.
- Deliver ISM simulator to CSEDS lab for initial testing.
- Complete INSR design documents including the SEP.
- Doppler/Sharkfin speed sensor completed testing.
- Complete FRD for Phase I Cybersecurity Enclave Boundary Defense Capability.
- Build three prototype MK27 Gyrocompass Replacement.
- Initiate TFDS prototype.
- Build two prototype OSS and Course Repeaters.
- Build two prototype Submarine Speed Sensors.

FY17:
- Complete development of the ISM EDM.
- Begin ISM EDM and NPM EDM hardware (HW) and software (SW) integration.
- Complete CDR for the ISM EDM and NPM EDM.
- Complete system level CDR for the INSR.
- Complete the system test plans to support Developmental/Operational (DT/OA) testing.
- Complete the Program Protection Plan (PPP).
- Complete Vendor Test Readiness Review (TRR). Begin Vendor testing.
- Build one ISM PPU.
- Start NPM EQT.
- SCSC/CSEDS Navigation Unit (NU) deliveries
- Consolidated Off Hull Assembly Test Site (COATS) NPM delivery

Exhibit R-3, RDT&E Project Cost Analysis: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0204228N / *Surface Support*	Project (Number/Name) 3311 / *Navigation Systems*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2015 Cost	FY 2015 Award Date	FY 2016 Cost	FY 2016 Award Date	FY 2017 Base Cost	FY 2017 Base Award Date	FY 2017 OCO Cost	FY 2017 OCO Award Date	FY 2017 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Systems Engineering/ Design	WR	SPAWAR Atlantic : Little Creek, VA	3.136	0.315	Jan 2015	6.492	Dec 2015	3.880	Dec 2016	-		3.880	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	WR Systems : Norfolk, VA	2.447	0.766	Jan 2015	9.446	Dec 2015	6.640	Dec 2016	-		6.640	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Penn State/ARL : Warminster, PA	1.591	0.429	Jan 2015	0.000	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	NSWC Dahlgren : Dahlgren, VA	0.358	0.025	Jan 2015	0.068	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Old Dominion University : Suffolk, VA	0.450	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Contractor 1 TBD : TBD	0.000	0.000		15.675	Dec 2015	10.282	Jan 2017	-		10.282	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	SPAWAR : Charleston, SC	0.000	1.200	Apr 2015	0.563	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	SPAWAR : San Diego, CA	0.000	0.000		0.450	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	NSWC/Carderock : Philadelphia, PA	0.000	0.000		0.450	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	TCNI : Middletown, MD	0.000	0.000		0.450	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Northrop Grumman : Charlottesville, VA	0.000	0.000		0.225	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Contractor 2 TBD : TBD	0.000	0.000		1.669	Dec 2015	0.000		-		0.000	Continuing	Continuing	Continuing
		Subtotal	7.982	2.735		35.488		20.802		-		20.802	-	-	-

Remarks

- Based on the responses from the 22 Aug 2013 issued Request for Information (RFI) for initial concepts and market availability of the ISM, additional funding to complete development of all INS-R configurations (surface/amphib, submarine, and carrier) has been added in FY16 and out.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0204228N / *Surface Support*	Project (Number/Name) 3311 / *Navigation Systems*	

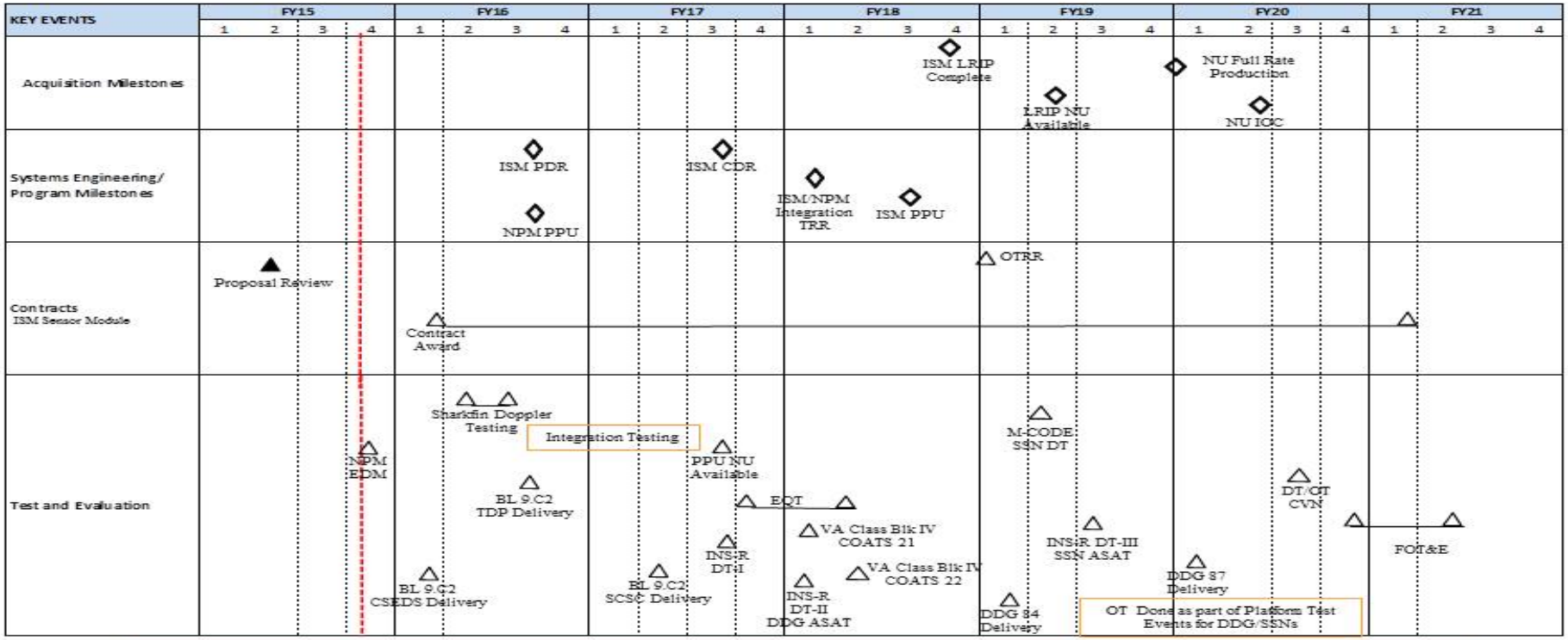
Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2015 Cost	FY 2015 Award Date	FY 2016 Cost	FY 2016 Award Date	FY 2017 Base Cost	FY 2017 Base Award Date	FY 2017 OCO Cost	FY 2017 OCO Award Date	FY 2017 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Management	C/CPFF	TBD : TBD	0.629	0.265	Feb 2015	0.557	Dec 2015	0.354	Jan 2017	-		0.354	Continuing	Continuing	Continuing
		Subtotal	0.629	0.265		0.557		0.354		-		0.354	-	-	-

	Prior Years	FY 2015		FY 2016		FY 2017 Base		FY 2017 OCO		FY 2017 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	8.611	3.000		36.045		21.156		-		21.156	-	-	-

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*



Acronym List

ASAT: At-Sea Alignment Testing
CDR: Critical Design Review
CSEDS: Combat Systems Engineering Development Site
DT/OT: Development Test/ Operational Test
EDM: Engineering Development Model
EQT: Engineering Qualification Test
FOT&E: Follow-On Test and Evaluation
INS-R: Inertial Navigation System-Replacement
IOC: Initial Operational Capability
ISM: Inertial Sensor Module
LRIP: Low Rate Initial Production
NPM: Navigation Processor Module
NU: Navigation Unit, consist of two ISM and one NPM
OTRR: Operational Test Readiness Review
PDR: Preliminary Design Review
PPU: Pre-Production Unit
RDT: Reliability Demonstration Test
SCSC: Surface Combat Systems Center
SOW: Statement of Work
SS: Ship Set consists of two NU
SSN: Sub-Surface Navigation
TDP: Technical Data Package
TRR: Test Readiness Review

Exhibit R-4A, RDT&E Schedule Details: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 3311				
ISM LRIP Complete	4	2018	4	2018
LRIP Navigation Unit (NU) Available	2	2019	2	2019
NU Full Rate Production (FRP)	1	2020	1	2020
NU IOC	2	2020	2	2020
ISM Preliminary Design Review (PDR)	3	2016	3	2016
NPM Pre-Production Unit (PPU)	3	2016	3	2016
ISM Critical Design Review (CDR)	3	2017	3	2017
ISM/NPM Integration Test Readiness Review	1	2018	1	2018
Operational Test Readiness Review	1	2019	1	2019
ISM Proposal Review	2	2015	2	2015
ISM Contract	1	2016	1	2021
NPM EDM	4	2015	4	2015
BL9C2 CSEDS Delivery	1	2016	1	2016
Sharkfin Doppler Testing	2	2016	3	2016
BL9C2 Technical Data Package (TDP)	3	2016	3	2016
BL9C2 SCSC Delivery	2	2017	2	2017
PPU NU Available	3	2017	3	2017
Environmental Qualification Testing (EQT)	4	2017	2	2018
Inertial Navigation System-Replacement (INS-R) Development Testing I (DT-I)	3	2017	3	2017
INS-R DT-II DDG At Sea Alignment Testing (ASAT)	1	2018	1	2018
VA Class Blk IV Consolidated Off Hull Assembly Test Site (COATS) 21	1	2018	1	2018
VA Class Blk IV COATS 22	2	2018	2	2018

Exhibit R-4A, RDT&E Schedule Details: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 7	**R-1 Program Element (Number/Name)** PE 0204228N / *Surface Support*	**Project (Number/Name)** 3311 / *Navigation Systems*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
DDG 84 Delivery	1	2019	1	2019
DDG 87 Delivery	1	2020	1	2020
M-Code SSN DT	2	2019	2	2019
INS-R DT-III SSN ASAT	3	2019	3	2019
DT/OT CVNs	3	2020	3	2020
Follow-on Test & Evaluation	4	2020	2	2021

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