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Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Navy	Date: February 2015
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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 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
Total Program Element	6.291	2.320	2.878	36.045	-	36.045	24.918	15.978	17.006	14.939	Continuing	Continuing
3311: Navigation Systems	6.291	2.320	2.878	36.045	-	36.045	24.918	15.978	17.006	14.939	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.

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Appropriation/Budget Activity 1319: Research, Development, Test & Evaluation, Navy / BA 7: Operational Systems Development		R-1 Program Element (Number/Name) PE 0204228N / Surface Support			
B. Program Change Summary (\$ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	2.374	2.878	2.340	-	2.340
Current President's Budget	2.320	2.878	36.045	-	36.045
Total Adjustments	-0.054	-	33.705	-	33.705
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.002	-			
• SBIR/STTR Transfer	-0.052	-			
• Program Adjustments	-	-	33.933	-	33.933
• Rate/Misc Adjustments	-	-	-0.228	-	-0.228
Change Summary Explanation					
FY 2014 reduction reflect SBIR and other misc adjustments.					
FY 2016 Program Adjustments include increases for Navigation Wholeness to address Inertial Navigation System - Replacement (INS-R) Phase I Cybersecurity Enclave Defense Cybersecurity, MK27 Gyrocompass Replacement, Own Ship Speed (OSS) and Course Repeater, Time Frequency Distribution System (TFDS) Replacement, and Submarine Speed Sensors. FY 2016 also includes other Rate/Misc Adjustments for NWCF Rate Impact Adjustments and Inflation Rate Adjustments.					

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Exhibit R-2A, RDT&E Project Justification: PB 2016 Navy										Date: February 2015		
Appropriation/Budget Activity 1319 / 7					R-1 Program Element (Number/Name) PE 0204228N / <i>Surface Support</i>				Project (Number/Name) 3311 / <i>Navigation Systems</i>			
COST (\$ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
3311: <i>Navigation Systems</i>	6.291	2.320	2.878	36.045	-	36.045	24.918	15.978	17.006	14.939	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

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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.

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

	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Title: Inertial Navigation System - Replacement (INS-R)	2.320	2.878	25.076	-	25.076
Articles:	-	-	-	-	-
FY 2014 Accomplishments:					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
<div>- Continued initial design and development efforts for the surface INS-R variant. The surface INS-R variant consists of the Inertial Sensor Module (ISM) and Navigation Processor Module (NPM) connected by a defined interface.</div> <div>- Finalized initial Technical Requirements Documents (TRD) for the surface INS-R variant ISM and NPM.</div> <div>- Finalized initial Interface Requirement Specification (IRS) for the surface INS-R variant design.</div> <div>- Began design efforts associated with the surface INS-R variant NPM.</div> <div>FY 2015 Plans:</div> <div>- Continue design and development efforts for the surface INS-R variant.</div> <div>- Continue design efforts for the surface INS-R variant NPM and build three NPM prototypes. One NPM EDM will be provided as Government Furnished Equipment (GFE) to the ISM contractor and one NPM EDM will be provided to an ACB-16/AEGIS Land Based Test Site (LBTS) to reduce integration risks. Conduct design review on NPM.</div> <div>FY 2016 Base Plans:</div> <div>- Continue design and development efforts for the surface INS-R variant.</div> <div>- Award contract for ISM development</div> <div>- Conduct Preliminary Design Review on ISM</div> <div>- Build four ISM EDM to support integration and testing at the ACB-16/AEGIS LBTS and Surface Combat Systems Center (SCSC) LBTS.</div> <div>- Continue with development of NPM and provide last NPM prototype to support second ACB-16/AEGIS LBTS and Surface Combat Systems Center (SCSC) LBTS.</div> <div>- Begin design and development efforts for the amphibious, submarine, and carrier INS-R variants.</div> <div>- Update design and development documentation to include additional variants.</div> <div>- Increase design and development efforts under the ISM contract to include additional variants to meet test and integration schedules.</div> <div>FY 2016 OCO Plans:</div> <div>N/A</div>						
<div>Title: Phase I Cybersecurity Enclave Boundary Defense Capability</div> <div>Articles:</div>		-	-	5.000	-	5.000
<div>FY 2014 Accomplishments:</div> <div>N/A</div> <div>FY 2015 Plans:</div>		-	-	-	-	-

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
N/A						
FY 2016 Base Plans: - Effort to 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 2016 OCO Plans: N/A						
Title: MK27 Gyrocompass Replacement		-	-	3.400	-	3.400
Articles:		-	-	-	-	-
FY 2014 Accomplishments: N/A						
FY 2015 Plans: N/A						
FY 2016 Base Plans: - Effort to 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 2016 OCO Plans: N/A						
Title: Time Frequency Distribution System (TFDS) Replacement		-	-	1.400	-	1.400
Articles:		-	-	-	-	-
FY 2014 Accomplishments: N/A						
FY 2015 Plans: N/A						
FY 2016 Base Plans:						

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
<div>- Effort to 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).</div> <div>- Develop design documentation to adapt surface design to a submarine configuration and begin development of prototype.</div> <div>FY 2016 OCO Plans: N/A</div>						
<div>Title: Own Ship Speed (OSS) and Course Repeater</div> <div>Articles:</div> <div>FY 2014 Accomplishments: N/A</div> <div>FY 2015 Plans: N/A</div> <div>FY 2016 Base Plans: - Effort to 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.</div> <div>FY 2016 OCO Plans: N/A</div>		<div>-</div> <div>-</div>	<div>-</div> <div>-</div>	<div>0.722</div> <div>-</div>	<div>-</div> <div>-</div>	<div>0.722</div> <div>-</div>
<div>Title: Submarine Speed Sensors</div> <div>Articles:</div> <div>FY 2014 Accomplishments: N/A</div> <div>FY 2015 Plans: N/A</div> <div>FY 2016 Base Plans:</div>		<div>-</div> <div>-</div>	<div>-</div> <div>-</div>	<div>0.447</div> <div>-</div>	<div>-</div> <div>-</div>	<div>0.447</div> <div>-</div>

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
- Effort to 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 2016 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	2.320	2.878	36.045	-	36.045

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

Line Item	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
• OPN/0670: <i>Other Navigation</i>	33.386	39.298	87.481	-	87.481	67.181	58.298	104.240	122.593	-	758.740

Remarks

D. Acquisition Strategy

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

E. Performance Metrics

FY14:

- NPM development hardware/software.

FY15:

- NPM development hardware/software.

- Complete NPM Engineering Development Model (EDM).

- Delivery of EDM ACB-16/AEGIS Land Based Test Site (LBTS).

FY16:

- Award competitive contract for ISM development.

- Deliver Test Assets to Surface Combat Systems Center (SCSC) LBTS.

- Deliver ISM EDM to ACB-16/AEGIS LBTS

- 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.

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<div>- Build two prototype OSS and Course Repeaters.</div> <div>- Build two prototype Submarine Speed Sensors.</div>		

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2016 Navy												Date: February 2015			
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)				FY 2014		FY 2015		FY 2016 Base		FY 2016 OCO		FY 2016 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Systems Engineering/ Design	WR	SPAWAR Atlantic : Little Creek, VA	2.296	0.840	Oct 2013	0.315	Jan 2015	6.492	Dec 2015	-		6.492	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	WR Systems : Norfolk, VA	1.564	0.883	Oct 2013	0.766	Jan 2015	9.446	Dec 2015	-		9.446	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Penn State/ARL : Warminster, PA	1.391	0.200	Oct 2013	0.250	Jan 2015	-	Dec 2015	-		-	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	NSWC Dahlgren : Dahlgren, VA	0.271	0.087	Oct 2013	0.025	Jan 2015	0.068	Dec 2015	-		0.068	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Old Dominion University : Suffolk, VA	0.450	-		-		-		-		-	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Contractor 1 TBD : TBD	0.000	-		1.200	Apr 2015	15.675	Dec 2015	-		15.675	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	SPAWAR : Charleston, SC	0.000	-		-		0.563	Dec 2015	-		0.563	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	SPAWAR : San Diego, CA	0.000	-		-		0.450	Dec 2015	-		0.450	Continuing	Continuing	Continuing
Systems Engineering/ Design	WR	NAVSSSES : Philadelphia, PA	0.000	-		-		0.450	Dec 2015	-		0.450	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	TCNI : Middletown, MD	0.000	-		-		0.450	Dec 2015	-		0.450	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Northrop Grumman : Charlottesville, VA	0.000	-		-		0.225	Dec 2015	-		0.225	Continuing	Continuing	Continuing
Systems Engineering/ Design	C/CPFF	Contractor 2 TBD : TBD	0.000	-		-		1.669	Dec 2015	-		1.669	Continuing	Continuing	Continuing
Subtotal			5.972	2.010		2.556		35.488		-		35.488	-	-	-
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.															
- Key requirements driving increased funding from FY15 to FY16. These efforts include: (1) Build four ISM EDM to support integration testing at the ACB-16/AEGIS LBTS and Surface Combat Systems Center (SCSC) LBTS, (2) Begin design and development efforts for the amphibious, submarine, and carrier INS-R variants, (3) Update design and development documentation to include additional variants, (4) Increase design and development efforts under the ISM contract to include additional variants to meet test and integration schedules.															

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2016 Navy												Date: February 2015			
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)				FY 2014		FY 2015		FY 2016 Base		FY 2016 OCO		FY 2016 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
- In addition to funding for the INS-R development efforts, the increase in FY16 provides funding to initiate and complete other navigation design and development efforts. (1) Effort to complete design, development, and testing of a MK27 gyrocompass replacement for surface, amphibious and submarine platforms leveraging the INS-R architecture; (2) Effort to complete design, development, and testing of an Own Ship Speed (OSS) and Course Repeater replacement for surface platforms; (3) Effort to complete design, development, and testing of a modern architecture to replace the legacy submarine Time Frequency Distribution System (TFDS) architecture; this leverages the development effort associated with the surface Time and Frequency Component (TFC) of the Global Positioning System (GPS) - Based Positioning, Navigation, and Timing Service (GPNTS); (4) Effort to test new shark fin and Doppler speed sensors for submarines using Commercial Off the Shelf (COTS) technology to replace legacy speed sensors. Test results will be used to guide future development of new speed sensors.															
Support (\$ in Millions)				FY 2014		FY 2015		FY 2016 Base		FY 2016 OCO		FY 2016 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Management	C/CPFF	TBD : TBD	0.319	0.310	Dec 2013	0.322	Feb 2015	0.557	Dec 2015	-		0.557	Continuing	Continuing	Continuing
Subtotal			0.319	0.310		0.322		0.557		-		0.557	-	-	-
			Prior Years	FY 2014		FY 2015		FY 2016 Base		FY 2016 OCO		FY 2016 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals			6.291	2.320		2.878		36.045		-		36.045	-	-	-
Remarks															

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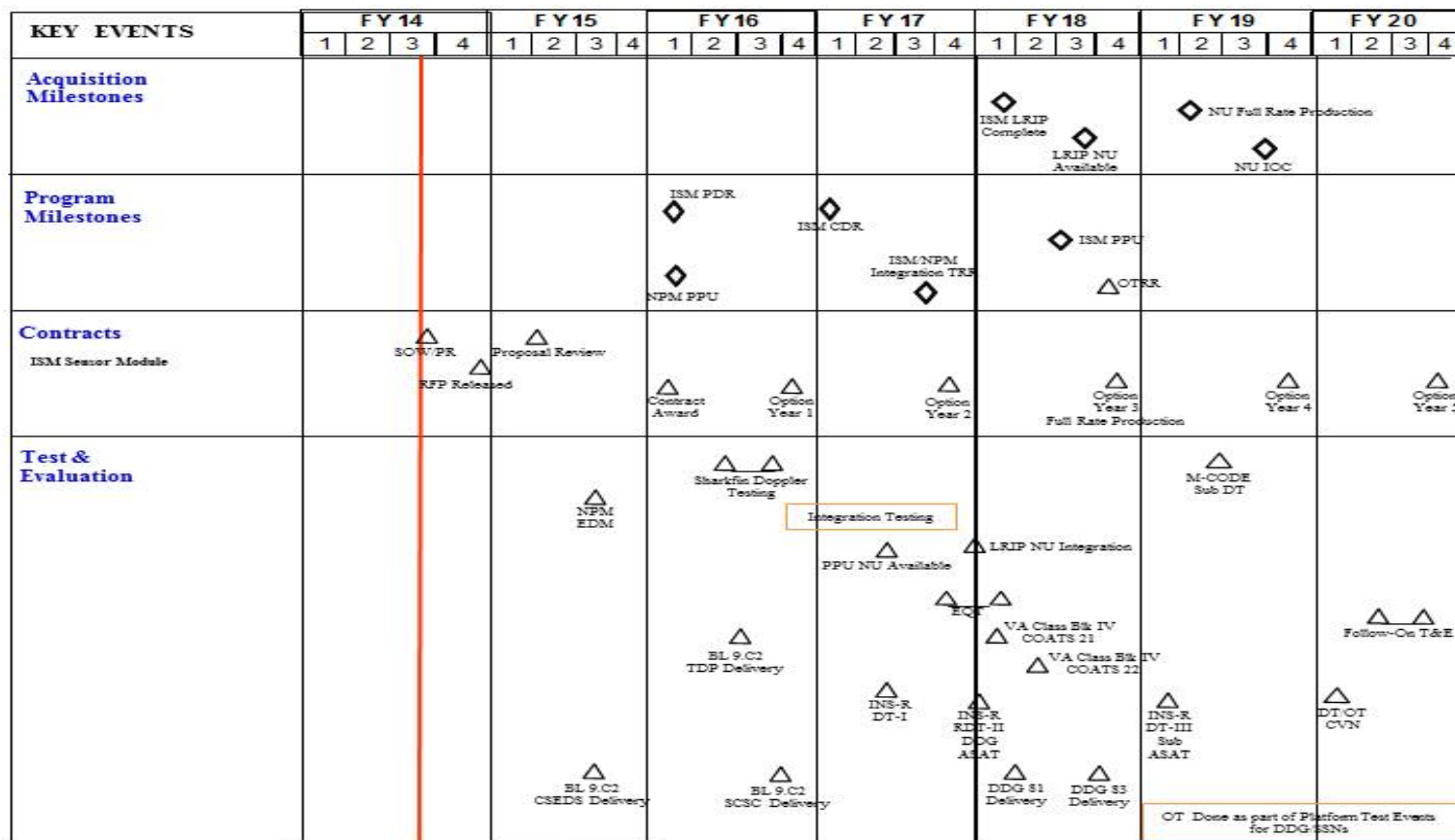
Exhibit R-4, RDT&E Schedule Profile: PB 2016 Navy

Date: February 2015

Appropriation/Budget Activity
1319 / 7

R-1 Program Element (Number/Name)
PE 0204228N / Surface Support

Project (Number/Name)
3311 / Navigation Systems



Acronym List
ASAT: Air-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, consist of two NU
TDP: Technical Data Package
TRR: Test Readiness Review

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Exhibit R-4A, RDT&E Schedule Details: PB 2016 Navy			Date: February 2015
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
Proj 3311				
ISM LRIP Complete	1	2018	1	2018
LRIP Navigation Unit (NU) Available	3	2018	3	2018
NU Full Rate Production (FRP)	2	2019	2	2019
NU IOC	3	2019	3	2019
ISM Preliminary Design Review (PDR)	1	2016	1	2016
NPM Pre-Production Unit (PPU)	1	2016	1	2016
ISM/NPM IntegrationTest Readiness Review (TRR)	3	2017	3	2017
ISM Critical Design Review (CDR)	1	2017	1	2017
ISM PPU	2	2018	2	2018
Operational Test Readiness Review (OTRR)	4	2018	4	2018
ISM Sensor Module Statement of Work/Purchase Request (SOW/PR)	3	2014	3	2014
ISM Sensor Module Request for Proposal (RFP) Released	4	2014	4	2014
ISM Sensor Module Proposal Review	2	2015	2	2015
ISM Sensor Module Contract Award	1	2016	1	2016
ISM Sensor Module Option Year 1	4	2016	4	2016
ISM Sensor Module Option Year 2	4	2017	4	2017
ISM Sensor Module Option Year 3 FRP	4	2018	4	2018
ISM Sensor Module Option Year 4	4	2019	4	2019
ISM Sensor Module Option Year 5	4	2020	4	2020
NPM EDM	3	2015	3	2015
BL 9.C2 CSEDS Delivery	3	2015	3	2015
Sharkfin Doppler Testing	2	2016	3	2016

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Exhibit R-4A, RDT&E Schedule Details: PB 2016 Navy **Date:** February 2015

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Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
BL 9.C2 Technical Data Package (TDP) Delivery	3	2016	3	2016
BL 9.C2 SCSC Delivery	4	2016	4	2016
PPU NU Available	2	2017	2	2017
Low Rate Initial Production (LRIP) NU Integration	4	2017	4	2017
Environmental Qualification Test (EQT)	3	2017	1	2018
Inertial Navigation System-Replacement (INS-R) Development Testing I (DT-1)	2	2017	2	2017
INS-R DT-II DDG At Sea Alignment Test (ASAT)	1	2018	1	2018
VA Class BLK IV Consolidated Off Hull Assemblies Test Site (COATS) 21	1	2018	1	2018
VA Class BLK IV COATS 22	2	2018	2	2018
DDG-81 Delivery	1	2018	1	2018
DDG-83 Delivery	3	2018	3	2018
M-CODE SSN DT	2	2019	2	2019
INS-R DT-III SSN ASAT	1	2019	1	2019
Follow-On Test & Evaluation (T&E)	2	2020	3	2020
DT/OT CVN	1	2020	1	2020