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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 7: Operational Systems Development</i>	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	323.162	66.934	72.265	110.349	-	110.349	121.877	130.793	117.884	116.583	Continuing	Continuing
0366: <i>MK 48 ADCAP</i>	323.162	66.934	72.265	110.349	-	110.349	121.877	130.793	117.884	116.583	Continuing	Continuing

A. Mission Description and Budget Item Justification

MK-48 ADCAP (Advanced Capability) Research, Development, Test and Evaluation (RDT&E) program executes incremental development of weapon performance improvements in two development product areas: (1) Advanced Processor Builds (APBs), and (2) Torpedo Technology Insertions (TIs). This Program Element (0205632N/0366) is tied to development programs that leverage a joint United States/Australia Armaments Cooperative Project (ACP) to develop MK-48 ADCAP CBASS; technologies developed by the Office of Naval Research (ONR), and the Office of the Secretary of Defense (OSD) Strategic Capabilities Office (SCO).

Countermeasure (CM) sophistication and availability on the open market directly affects ADCAP kill proficiency and its ability to counter rapidly evolving threats. The focus of the MK-48 ADCAP Torpedo Research and Development (R&D) program is on hardware upgrades, rapid Commercial-Off-the-Shelf (COTS) insertion, and software APBs, in order to rapidly upgrade the ADCAP to counter evolving threats and maintain robust performance. The CBASS program developed and fielded a new sonar capable of identifying CMs and discriminating them from the target. CBASS Phase I achieved IOC in FY 2006. CBASS Phase II achieved IOC in FY13 . APB5 conducted an early fielding decision in May 2019.

The Royal Australian Navy (RAN) is jointly participating to develop MK48 ADCAP upgrades and signed a Memorandum of Agreement (MOA) extension amendment in January 2019, which extends the MOA for fifteen (15) years.

The MK-48 ADCAP Torpedo R&D program focuses on two specific areas near term; Torpedo software APBs and hardware Tech Insertions (TIs). The CNO continues to stress shallow water as a critical operating area to counter third world diesel electric submarines and near-peer adversaries. In water testing, in conjunction with laboratory simulation efforts, has shown that significant performance improvements can be made by implementing changes to weapon tactics and software algorithms. Development, implementation, and testing of these changes are being accomplished under the Torpedo APB (TAPB) program. The TAPB program also leverages the RAN joint torpedo program and technologies developed by ONR and SCO in the areas of torpedo broadband signal processing, tactics processing, and alertment.

The TI program will provide for evolutionary torpedo hardware improvements and upgrades, including the transition and testing of advanced technologies from the R&D community. This approach will incorporate developmental testing of the transitioning technologies from ONR, and SCO for ADCAP upgrades in the areas of torpedo sensors, weapon propulsion, weapon/platform connectivity, and improved fusing. These efforts will continue torpedo development investment at a lower cost and shorter term than traditional torpedo programs.

The MK 48 MOD 7 APB6/TI-1 Heavyweight Torpedo (HWT) program is an evolutionary upgrade to the MK 48 MOD 7 HWT; it will consist of an Operational Software (OPSW) upgrade referred to as APB 6 and a hardware upgrade referred to as TI-1. TI-1 will include a Guidance and Control (G&C) section upgrade, and an Improved Post Launch Communications System (IPLCS). TI-1 will also include features from three ONR Future Naval Capabilities (FNC) programs.

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The APB7/TI-2 HWT program is an evolutionary improvement to the MK 48 MOD 7 HWT, providing extended range and advanced multi-mission capabilities against surface and sub-surface targets. It will consist of an Operational Software (OPSW) upgrade referred to as APB7 and a hardware upgrade referred to as TI-2. APB7/TI-2 includes sensing, processing, warhead and propulsion technologies developed under SCO and ONR FNC research and development programs. APB6/TI-1 and APB7/TI-2 provide two distinctly different capabilities and are operationally intended for different mission sets.

APB5 software upgrades achieved early fielding in May 2019, and are currently in operational testing for MK-48 ADCAP torpedoes to field the full capability in FY20.

APB5+ software upgrades are currently in process for MK-48 ADCAP torpedoes. APB5+ enhancements are required to address Combat Control System (CCS)/MK48 pre and post launch interface issues which limit crew full implementation of the weapon and provide numerous capability enhancements requested and endorsed by the Fleet.

ONR and SCO technologies and MK-54 LWT developments will be transitioned into ADCAP through APBs and TI packages.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	68.255	85.973	108.520	-	108.520
Current President's Budget	66.934	72.265	110.349	-	110.349
Total Adjustments	-1.321	-13.708	1.829	-	1.829
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-13.708			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.321	0.000			
• Rate/Misc Adjustments	0.000	0.000	1.829	-	1.829

Change Summary Explanation

FY2021: Increased budget request is due to additional funds being provided to transition hardware development and testing from the OSD Strategic Capabilities Office (SCO) into TI-2. Furthermore, funds continue to support APB 6 software development and TI-1 Hardware development contract and Hardware support. As APB 5 completes testing, support funding shifts from APB 5 to APB 5+ and APB 6 software support. The FY2021 increase in Test & Evaluation funds are due to the increased number of test events to support the APB 5+, APB 6/TI-1, and APB7/TI-2.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy										Date: February 2020		
Appropriation/Budget Activity 1319 / 7					R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP				Project (Number/Name) 0366 / MK 48 ADCAP			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
0366: MK 48 ADCAP	323.162	66.934	72.265	110.349	-	110.349	121.877	130.793	117.884	116.583	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

MK-48 ADCAP RDT&E program executes incremental development of weapon performance improvements in two development product areas: (1) APBs, and (2) Torpedo Technology Insertion. The budget enables development to address CNO defined capability-based requirements and mission needs. This Program Element (0205632N/0366) is tied to development programs that leverage a joint United States/Australia ACP to develop MK-48 ADCAP; and technologies being developed by the ONR and SCO. APB Software upgrades will improve torpedo performance in challenging water and countered environments. Hardware technology insertions will improve weapon availability through development of a G&C replacement, new warhead, propulsion, and an Automated Test Equipment replacement.

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

	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: TORPEDO APB / TEST & EVALUATION	66.934	72.265	110.349	0.000	110.349
Articles:	-	-	-	-	-
FY 2020 Plans: Continue APB 6 Software development. Continue TI-1 Hardware development. Conduct TI-1 System Functional Review (SFR). Conduct APB 6/TI-1 Preliminary Design Review (PDR). APB5 - Complete Operational Testing (OT). APB5 - Complete Initial Operational Capability (IOC). APB5+ - Conduct CDR. APB5+ - Conduct DTRR. APB5+ - Conduct Development Test (DT) in-water testing.					
FY 2021 Base Plans: Continue APB6 Software development. Continue TI-1 Hardware development. Continue APB6 Modeling & Simulation development. APB6 - Conduct CDR TI-1 - Conduct CDR APB5+ - Conduct OTRR APB5+ - Begin Operational Testing (OT) APB5+ - Conduct Modeling & Simulation testing.					

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
APB5+ - Complete Operational Testing (OT). APB5+ - Complete Initial Operational Capability (IOC). APB7 - software prototype development and builds. Prototype combat system software development. APB7/TI-2 - Modeling and Simulation. APB7/TI-2 - In-water Test Events and Prototype Demonstration. FY 2021 OCO Plans: N/A FY 2020 to FY 2021 Increase/Decrease Statement: FY21 increase is due to the funding requirement needed to transition TI-2 hardware development from the OSD Strategic Capabilities Office (SCO) and conduct rapid prototype demonstration.					
Accomplishments/Planned Programs Subtotals	66.934	72.265	110.349	0.000	110.349

C. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021 Base</u>	<u>FY 2021 OCO</u>	<u>FY 2021 Total</u>	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• WPN/3225: MK-48 Torpedo ADCAP Mods	39.997	39.508	56.454	-	56.454	36.328	20.573	59.876	61.073	0.000	1,538.609
• WPN/3117: MK-48 Torpedo	103.616	114.000	284.355	-	284.355	146.855	153.040	198.103	236.702	Continuing	Continuing

Remarks

D. Acquisition Strategy

In FY 2016, a competitive contract was awarded to procure additional warshot torpedos and continue procurement of CBASS Kits. The Program will continue to execute competitive, build to print contracts, until inventory requirements are met and all Mod 6 torpedos are converted. Throughout the contract the program will execute life of type buys to minimize the impact of obsolescence avoiding redesign and qualification during a contract cycle. The next competitive contract is planned for FY 2021 and will include fuel tank and warhead electronic sections.

Continue to incrementally develop technology to pace the threats to be integrated into the production baseline. A competitive contract for TI-1 hardware development was awarded in FY 2019. The development contract includes a LRIP options to procure kits to be used for OT and a new competitive FRP contract will be awarded in FY26. This hardware will be used to upgrade the entire inventory.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity	R-1 Program Element (Number/Name)	Project (Number/Name)
1319 / 7	PE 0205632N / <i>MK-48 ADCAP</i>	0366 / <i>MK 48 ADCAP</i>

The APB7/TI-2 acquisition strategy is to fund the Penn State University Applied Research Laboratory to complete prototype builds and testing from the OSD SCO program and implement design refinements for industry builds. Competitive industry manufacturing contract awards are planned starting in FY23 for developmental and operational test units.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP
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Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
Software Development - APB 5 / 5+	WR	NUWC NPT : Newport RI	38.959	9.057	Oct 2018	2.594	Nov 2019	2.248	Nov 2020	-		2.248	Continuing	Continuing	Continuing
Software Development - APB 6	WR	NUWC NPT : Newport RI	18.448	16.774	Oct 2018	17.799	Nov 2019	19.623	Nov 2020	-		19.623	Continuing	Continuing	Continuing
Hardware Development - TI-1	WR	NUWC NPT : Newport RI	21.415	5.798	Oct 2018	4.163	Nov 2019	1.984	Nov 2020	-		1.984	Continuing	Continuing	Continuing
Hardware Development - TI-1	C/CPIF	Progeny : Manassas, VA	0.000	5.071	Mar 2019	27.545	Dec 2019	38.166	Jan 2021	-		38.166	Continuing	Continuing	Continuing
Hardware Development - IPLCS	C/CPFF	Harris Corp. : Melbourne, FL	0.087	5.462	Oct 2018	5.462	Nov 2019	8.010	Nov 2020	-		8.010	Continuing	Continuing	Continuing
Hardware Development - IM	WR	Indian Head : Indian Head, MD	1.636	0.450	Jan 2019	0.450	Nov 2019	0.450	Oct 2020	-		0.450	Continuing	Continuing	Continuing
Software Development - APB 7	WR	NUWC NPT : Newport RI	0.000	0.000		0.000		2.140	Dec 2020	-		2.140	0.000	2.140	-
Hardware Development - Blue Wolf	WR	NUWC NPT : Newport RI	0.000	5.000	May 2019	0.000		0.000		-		0.000	0.000	5.000	-
Software Development - Sprial 4 / PY Development	WR	NUWC NPT : Newport RI	31.839	0.000		0.000		0.000		-		0.000	0.000	31.839	-
Hardware Development - TI-2	C/CPFF	ARL / PSU : State College PA	0.000	0.000		0.000		11.394	Nov 2020	-		11.394	0.000	11.394	-
Hardware Development - TI-2	WR	NUWC NPT : Newport RI	0.000	0.000		0.000		4.584	Nov 2020	-		4.584	0.000	4.584	-
Hardware Development - TI-2	WR	NSWC, IH : Indian Head, MD	0.000	0.000		0.000		1.059	Nov 2020	-		1.059	0.000	1.059	-
Subtotal			112.384	47.612		58.013		89.658		-		89.658	Continuing	Continuing	N/A

Remarks

- Increased funding in FY21 for TI-1 hardware development.
- Increased funding in FY21 for IPLCS development and Engineering Development Model (EDM) fabrication.
- Increased funding in FY21 for TI-2 hardware prototype demonstration and testing. This includes system engineering, hardware/software prototype design updates, assembly, and rebuilds in support of in-water testing and demonstration program.
- Decreased funding in FY21 for APB 5/5+ as product development funding shifts to APB 7 and TI-2 development.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP
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Support (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
Software Development - APB 5/APB5+	WR	NUWC NPT : Newport RI	35.143	3.130	Oct 2018	2.200	Oct 2019	2.200	Nov 2020	-		2.200	Continuing	Continuing	Continuing
Software Development - APB 6	WR	NUWC NPT : Newport RI	1.545	1.195	Oct 2018	1.652	Oct 2019	1.661	Nov 2020	-		1.661	Continuing	Continuing	Continuing
Software Development - APB 6	WR	NUWC KPT : Keyport WA	1.622	0.230	Oct 2018	0.435	Oct 2019	0.438	Nov 2020	-		0.438	Continuing	Continuing	Continuing
Software Development / PY Development	Various	Various : Not Specified	36.317	0.000		0.000		0.000		-		0.000	0.000	36.317	-
Integrated Logistics Support	WR	NUWC NPT : Newport RI	2.243	0.000		0.000		0.000		-		0.000	0.000	2.243	-
Systems Engineering WCF	C/LH	NUWC NPT : Newport RI	17.750	0.000		0.000		0.000		-		0.000	0.000	17.750	-
Systems Engineering	Various	NUWC NPT : Newport RI	0.676	0.000		0.000		0.000		-		0.000	0.000	0.676	-
Subtotal			95.296	4.555		4.287		4.299		-		4.299	Continuing	Continuing	N/A

Test and Evaluation (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
Test & Evaluation - APB 5/5+	WR	NUWC NPT : Newport RI	21.989	5.282	Oct 2018	3.370	Oct 2019	5.838	Oct 2020	-		5.838	Continuing	Continuing	Continuing
Test & Evaluation - APB 5/5+	WR	NUWC KPT : Keyport WA	32.007	5.783	Oct 2018	4.160	Oct 2019	2.080	Oct 2020	-		2.080	Continuing	Continuing	Continuing
Test & Evaluation - APB 5/5+	WR	OPTEVFOR : Norfolk VA	11.195	1.631	May 2019	0.515	May 2020	0.530	Dec 2020	-		0.530	Continuing	Continuing	Continuing
Test & Evaluation - APB 6	C/CPFF	ARL / PSU : State College PA	0.873	1.510	Apr 2019	1.344	Oct 2019	1.589	Nov 2020	-		1.589	Continuing	Continuing	Continuing
Modeling & Simulation	WR	NUWC NPT : Newport RI	9.745	0.000		0.000		0.000		-		0.000	0.000	9.745	Continuing
Modeling & Simulation	C/CPFF	ARL / PSU : State College PA	14.112	0.000		0.000		0.000		-		0.000	0.000	14.112	Continuing

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP
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Test and Evaluation (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
Test & Evaluation - Spiral 4 / PY	WR	NUWC NPT : Newport RI	18.376	0.000		0.000		0.000		-		0.000	0.000	18.376	-
Test & Evaluation - TI-2	WR	NUWC KPT : Keyport WA	0.000	0.000		0.000		5.778	Nov 2020	-		5.778	0.000	5.778	-
Subtotal			108.297	14.206		9.389		15.815		-		15.815	Continuing	Continuing	N/A

Remarks
 - Increased funding in FY21 for APB 5+ test events and post test analysis.
 - Increased funding in FY21 for TI-2 hardware prototype in-water testing and range events.

Management Services (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
Program Management	C/CPFF	Serco : Mclean VA	5.836	0.511	Dec 2018	0.526	Dec 2019	0.542	Dec 2020	-		0.542	0.000	7.415	-
Travel	WR	NAVSEA : Washington DC	1.349	0.050	Dec 2018	0.050	Dec 2019	0.035	Dec 2020	-		0.035	0.000	1.484	-
Subtotal			7.185	0.561		0.576		0.577		-		0.577	0.000	8.899	N/A

Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract			
Project Cost Totals			323.162	66.934	72.265	110.349	-	110.349	Continuing	Continuing	N/A

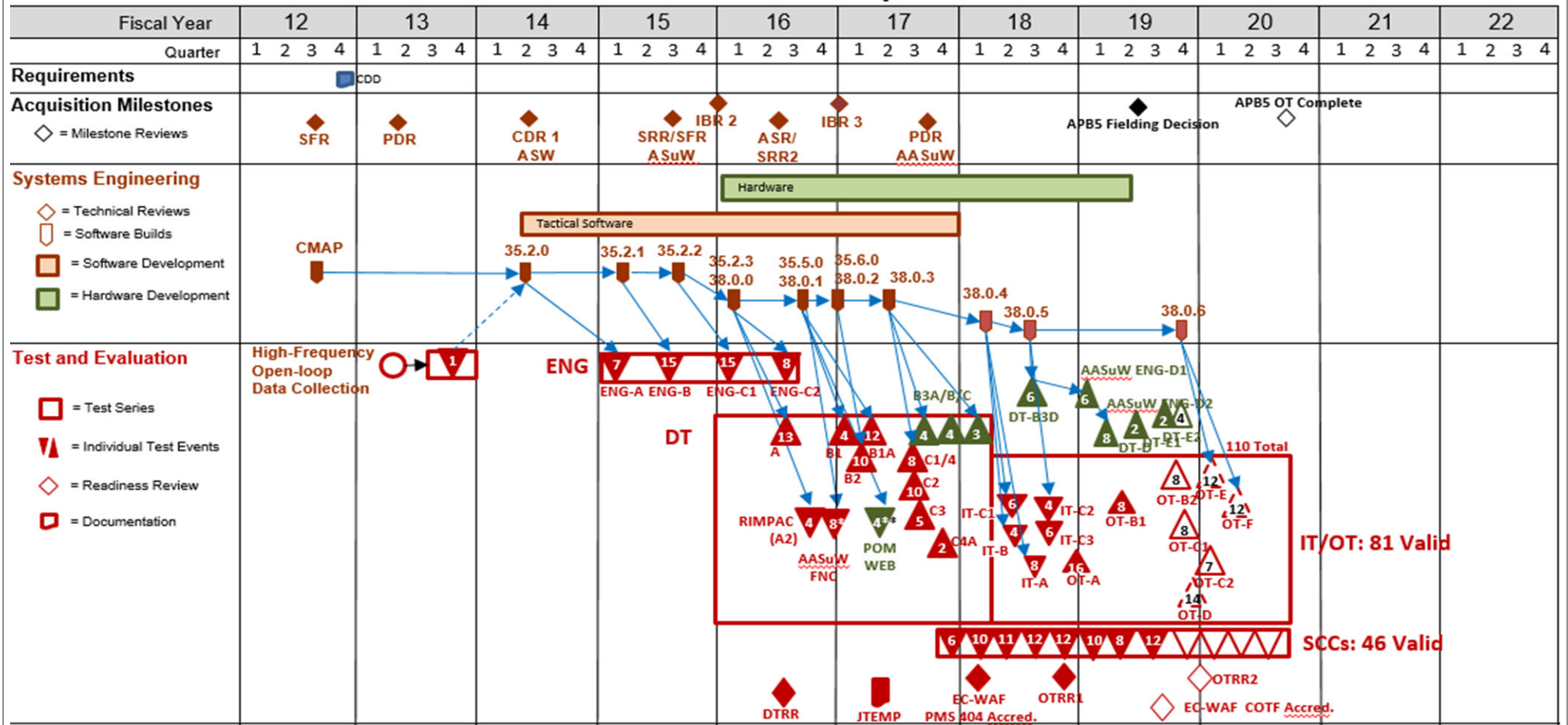
Remarks

Appropriation/Budget Activity
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R-1 Program Element (Number/Name)
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Project (Number/Name)
0366 / MK 48 ADCAP

MK 48 MOD 7 APB5 Acquisition Schedule

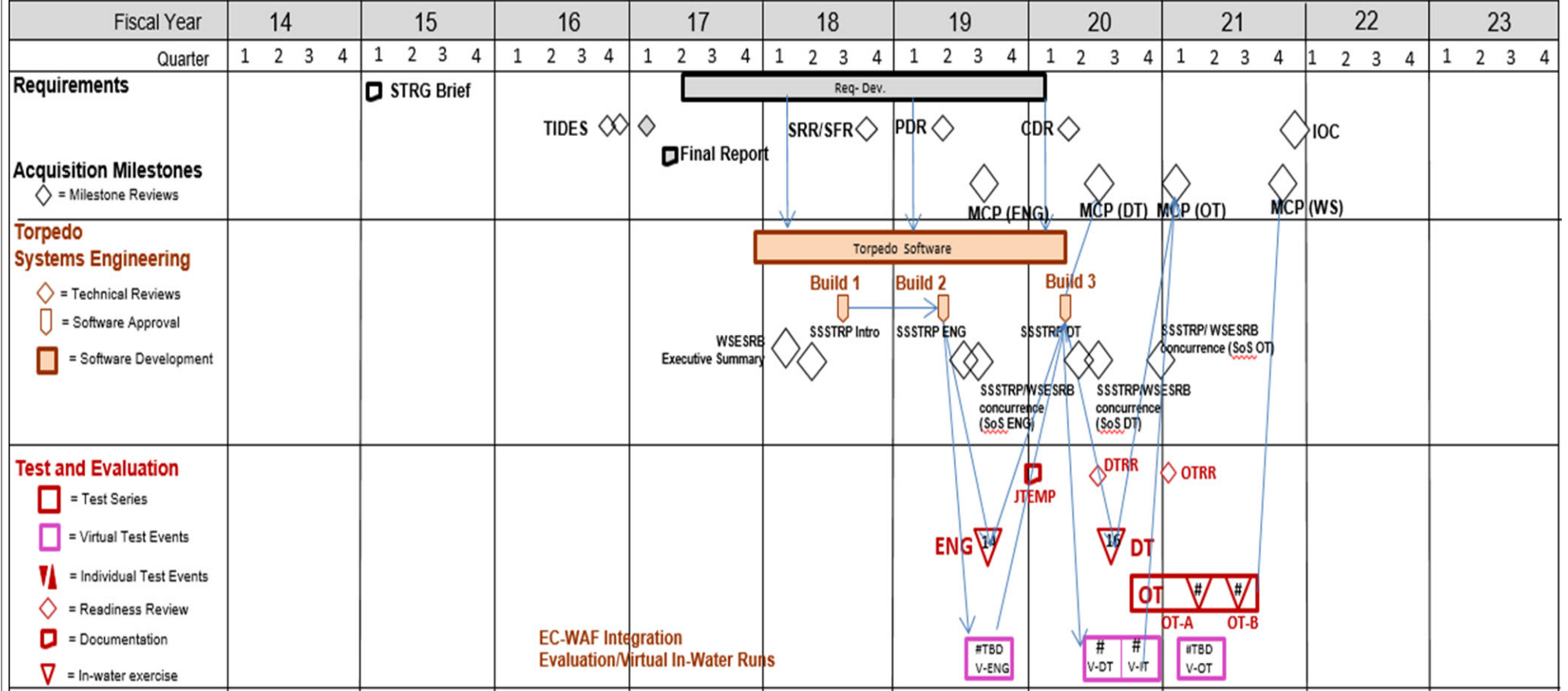


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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Navy Date: February 2020

Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP
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MK 48 MOD 7 APB5+ Acquisition Schedule

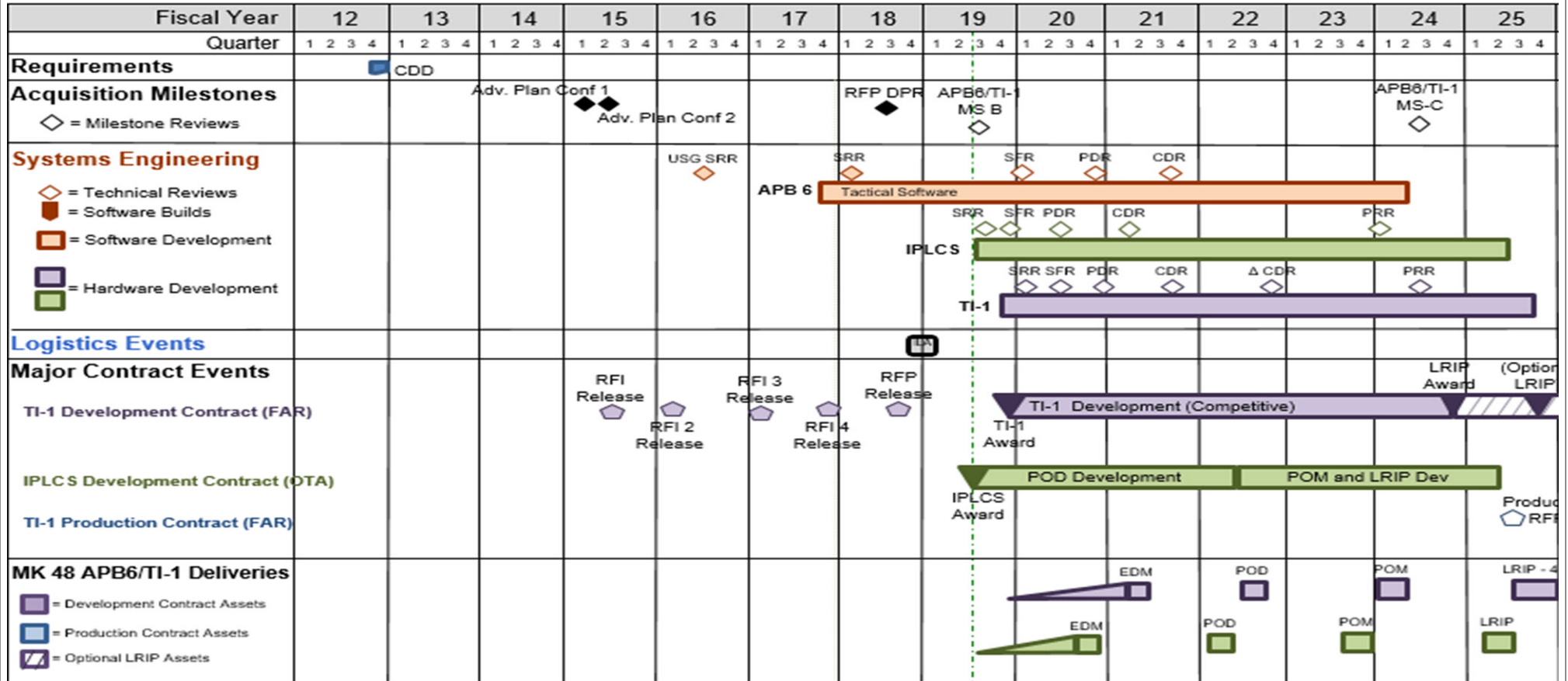


Appropriation/Budget Activity
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R-1 Program Element (Number/Name)
PE 0205632N / MK-48 ADCAP

Project (Number/Name)
0366 / MK 48 ADCAP

MK 48 APB6/TI-1 Acquisition Schedule

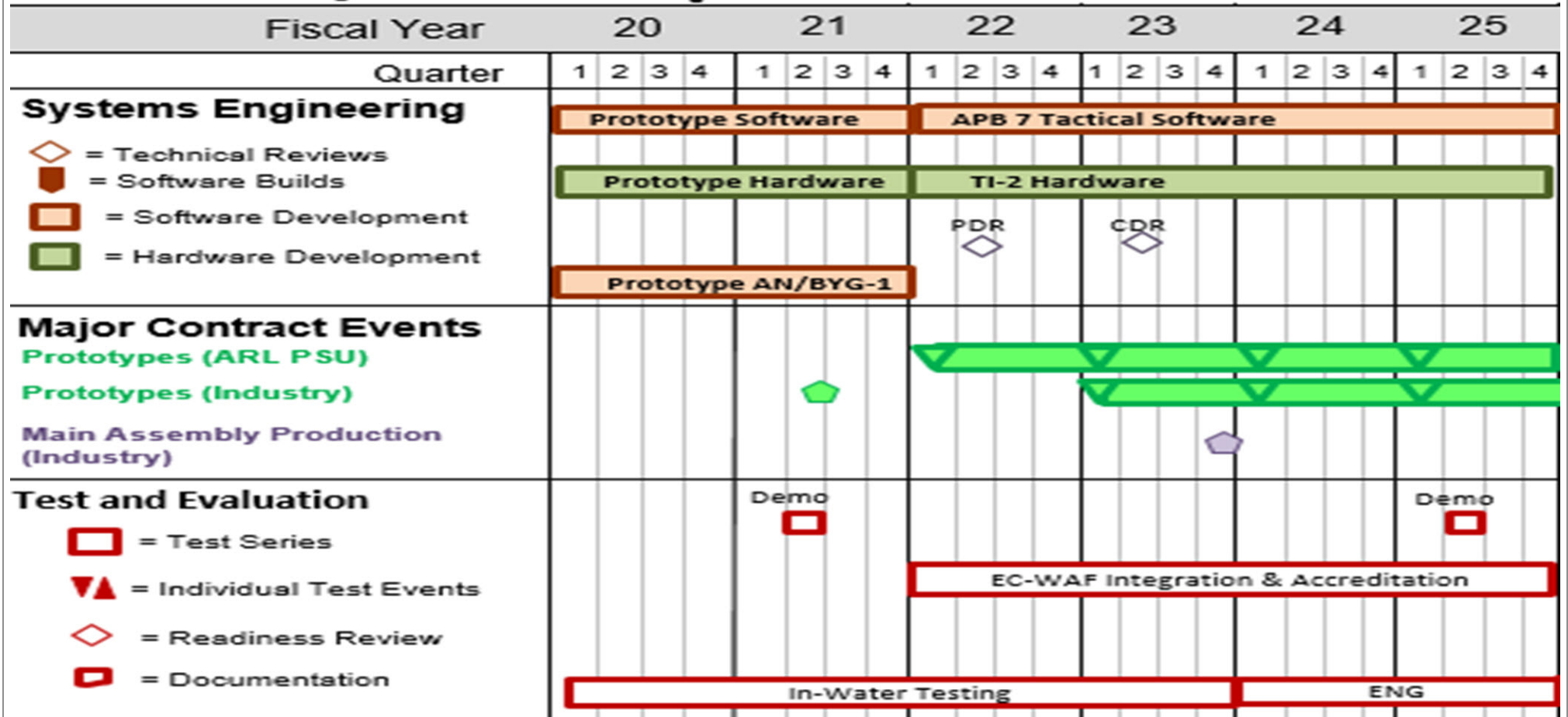


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R-1 Program Element (Number/Name)
PE 0205632N / MK-48 ADCAP

Project (Number/Name)
0366 / MK 48 ADCAP

APB7/TI-2 Acquisition Schedule



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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy **Date:** February 2020

Appropriation/Budget Activity 1319 / 7	R-1 Program Element (Number/Name) PE 0205632N / MK-48 ADCAP	Project (Number/Name) 0366 / MK 48 ADCAP
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
Proj 0366				
APB 5 Development: Early Fielding Decision	3	2019	3	2019
APB 5 Development: APB 5 Operation Test (OT)	4	2018	3	2020
APB 5 Development: APB 5 IOC	4	2020	4	2020
APB 5+ Development: APB 5+-1 Developmental Test (DT)	3	2020	4	2020
APB 5+ Development: APB 5+ Operation Test (IT/OT)	4	2020	3	2021
APB 5+ Development: APB 5+ IOC	4	2021	4	2021
APB 6 Software / TI-1 Hardware Development: APB 6 Development	1	2018	2	2024
APB 6 Software / TI-1 Hardware Development: TI-1 Development	4	2019	4	2024
APB 6 Software / TI-1 Hardware Development: APB 6/TI-1 Developmental Test (DT)	3	2023	4	2024
APB7 / TI-2 Development: APB7 / TI-2 Prototype Testing and Demonstration	1	2021	1	2022
APB7 / TI-2 Development: APB7 / TI-2 Development: APB 7 Software Development and Engineering Tests	1	2022	4	2025
APB7 / TI-2 Development: APB7 / TI-2 Development: TI-2 Hardware Development and Engineering Tests	1	2022	4	2025