

**UNCLASSIFIED**

**Exhibit R-2, RDT&E Budget Item Justification:** PB 2017 Missile Defense Agency **Date:** February 2016

<b>Appropriation/Budget Activity</b> 0400: <i>Research, Development, Test &amp; Evaluation, Defense-Wide I BA 3: Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>
---	---

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	67.796	24.836	61.753	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
MD85: <i>Common Kill Vehicle Technology</i>	67.796	23.524	59.558	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
MD40: <i>Program Wide Support</i>	-	1.312	2.195	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**Program MDAP/MAIS Code:** 362

**Note**

In FY 2017 the funding will transfer from Common Kill Vehicle Technology program element 0603294C to the Multi-Object Kill Vehicle (MOKV) program element 0604894C.

**A. Mission Description and Budget Item Justification**

On 15 March 2013, the Secretary of Defense announced steps to bolster protection of the homeland and stay ahead of the evolving quantity and complexity of long range ballistic missile threats. These steps included adding Ground-Based Interceptors and shifting resources to develop advanced kill vehicle technology to improve all ballistic missile defense interceptors that operate outside the earth's atmosphere. The successful first phase of the Common Kill Vehicle Technology effort defined concepts for the redesign of the ground based interceptor Exo-atmospheric Kill Vehicle. This effort completed advanced technology development and transitioned to the redesigned kill vehicle effort in FY 2014.

The next phase of the Common Kill Vehicle Technology effort will enhance Ballistic Missile Defense System interceptor performance by improving discrimination and adding the capability to destroy several objects within a threat complex using multiple kill vehicles carried on a single interceptor. MDA is developing the concepts for a MOKV based on a modular, open architecture designed to common interfaces and standards, making upgrades easier and broadening MDA's vendor and supplier base. The Agency will focus on the competitive development of MOKV concepts with industry in FY 2015-2016.

This capability relies on a BMDS architecture that balances performance across the sensor, Command, Control, Battle Management and Communications, and kill vehicle elements. The Agency anticipates deploying this capability across the interceptor fleet in the next decade to address the evolving threat.

MD40 Program-Wide Support (PWS) consists of essential non-headquarters management efforts providing integrated and efficient support to MDA functions and activities across the entire BMDS.

**UNCLASSIFIED**

<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2017 Missile Defense Agency	<b>Date:</b> February 2016
---	----------------------------

<b>Appropriation/Budget Activity</b> 0400: <i>Research, Development, Test &amp; Evaluation, Defense-Wide I BA 3: Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>
---	---

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017 Base</b>	<b>FY 2017 OCO</b>	<b>FY 2017 Total</b>
Previous President's Budget	25.639	46.753	75.262	-	75.262
Current President's Budget	24.836	61.753	0.000	-	0.000
Total Adjustments	-0.803	15.000	-75.262	-	-75.262
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	15.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.372	0.000			
• SBIR/STTR Transfer	-0.431	0.000			
• Other Adjustment	0.000	0.000	-75.262	-	-75.262

**Change Summary Explanation**

The FY 2017 funding adjustment reflects the transfer of the funding from Common Kill Vehicle Technology program element 0603294C to the new Multi-Object Kill Vehicle program element 0604894C.

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2017 Missile Defense Agency										<b>Date:</b> February 2016		
<b>Appropriation/Budget Activity</b> 0400 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>				<b>Project (Number/Name)</b> MD85 / <i>Common Kill Vehicle Technology</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017 Base</b>	<b>FY 2017 OCO</b>	<b>FY 2017 Total</b>	<b>FY 2018</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
MD85: <i>Common Kill Vehicle Technology</i>	67.796	23.524	59.558	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**Note**

N/A

**A. Mission Description and Budget Item Justification**

In calendar year 2014, Phase I of the Common Kill Vehicle technology effort resulted in the transition of industry concepts for a Re-designed Kill Vehicle. The concepts informed the Agency's development of system requirements and served as the foundation for product development of the Re-designed Kill Vehicle.

In FY 2015, the Agency awarded several contracts with industry to define concepts for a Multi-Object Kill Vehicle (MOKV) based on this open architecture. The Agency's focus in FY 2016 is to develop government and industry concepts for a MOKV as a second phase of the common kill vehicle technology effort. A key element is the requirement for industry to comply with a modular, open architecture with common standards and interfaces defined by the government. These requirements make future upgrades easier and broaden our vendor and supplier base. The Government will develop MOKV system engineering guidelines from the industry concept(s), government analysis, modeling, and simulation along with hardware-in-the-loop prototype concept demonstration(s). The kill vehicle hardware-in-the-loop prototype concept(s) and identified technologies will formulate the trade space across cost, risk, and kill vehicle performance to establish requirements that are feasible and affordable for the engineering, manufacturing and development of a future MOKV.

The effectiveness of the BMDS relies on balancing performance requirements across the elements in the architecture. For example, the goal of the sensor portion of the architecture is to detect, acquire, track and discriminate lethal object(s), deployment debris, and countermeasures.

Analysis shows that having multiple kill vehicles on each interceptor dramatically improves the performance of the system, while maximizing the use of the interceptor inventory, and reducing our cost to defend the Homeland.

The Agency's past efforts on multiple kill vehicle research showed that the most difficult technical challenge for Multiple Kill Vehicles was managing the many-on-many engagements that occur. In FY 2016, MDA will resume tackling this challenge by investigating the engagement management concepts authored by industry as well as our government concepts. MDA will test these algorithms and strategy using our hardware-in-the-loop, and invest in key technologies that will enable a MOKV concept including kill vehicle-to-kill vehicle communications, and a more accurate and lighter weight inertial measurement unit.

The MOKV industry prototype concept(s) will identify and reduce development risk; identify technology readiness; and demonstrate critical technical features and capabilities. The Agency will use industry concept models to assess MOKV performance and the utility of the MOKV architecture. The prototype demonstration will validate the industry concept models for higher confidence and prove the viability of the MOKV. These results will inform Agency requirements development efforts that may support a future milestone decision.

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2017 Missile Defense Agency	<b>Date:</b> February 2016
--	----------------------------

<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>	<b>Project (Number/Name)</b> MD85 / <i>Common Kill Vehicle Technology</i>
--	---	--

Accurate and reliable inertial measurement units are essential for navigation during the long kill vehicle flight times required to engage Intercontinental ballistic missile threats. MOKV investments will develop precise, small, lightweight, highly reliable, and low cost inertial measurement units to increase kill vehicle performance for long flight times. Continued investment will satisfy the inertial measurement unit performance needed for the small, high performance kill vehicle concepts that can defeat future interceptor threats. This inertial measurement unit will demonstrate improved performance over current state of the art by reducing navigation error. The initial hardware inertial measurement unit prototype will demonstrate reduced size, weight and power requirements.

High band width kill vehicle-to-kill vehicle and kill vehicle-to-ground communications will enable engagement management for Multi-Object Kill Vehicle (MOKV) architecture. MOKV investments will focus on minimizing size, weight and power of a software defined radio that provides flexible communication capabilities that are robust and reliable. Design and development efforts of this communications technology in 2016 will lead to a future prototype demonstration of high band-width communications using software defined radio technology.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2015	FY 2016	FY 2017
<p><b>Title:</b> Common Kill Vehicle</p> <p><b>Description:</b> The Missile Defense Agency is developing common kill vehicle technology to address emerging threats and enable the missile defense of our homeland.</p> <p><b>FY 2015 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>- Developed Kill Vehicle payload criteria to support Broad Agency Announcement (BAA) for the Multi-Object Kill Vehicle (MOKV) concept definition</li> <li>- Received and assessed proposals for MOKV concept definition awards in FY2015</li> <li>- Developed initial government MOKV concept for independent performance predictions via government simulations to establish baseline for contractor concept assessment(s)</li> <li>- Developed a second source design of a 512x512 digital Read Out Integrated Circuit (ROIC) focal plane array to support enhanced discrimination for future BMDS interceptors</li> <li>- Developed initial inertial measurement unit (IMU) design using a ring laser gyro and a micro-electro-mechanical system (MEMS) accelerometer to upgrade BMDS interceptors</li> <li>- Completed initial radiation environment screening of IMU parts</li> <li>- Awarded industry contracts for the development of MOKV concepts</li> </ul> <p><b>FY 2016 Plans:</b></p> <ul style="list-style-type: none"> <li>- The FY 2016 \$13.221 million increase to Common Kill Vehicle Technology, MD85, begins the concept definition for a MOKV to address an emerging threat</li> <li>- MOKV industry contractor(s) will deliver initial concepts and modeling parameters for preliminary government assessment</li> <li>- Initiate development of the MOKV engagement management algorithms to address managing the many-on-many engagement challenges due to complex threats</li> </ul>	23.524	59.558	0.000

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2017 Missile Defense Agency		<b>Date:</b> February 2016
<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>	<b>Project (Number/Name)</b> MD85 / <i>Common Kill Vehicle Technology</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
- Update and refine government MOKV concept for independent performance predictions via government simulations to initiate contractor concept assessment(s) - Build, assemble and test initial inertial measurement unit prototype to support model validation - Initiate design and analysis of a high band width software defined radio to support kill vehicle-to-kill vehicle and kill vehicle-to-ground communications  <b>FY 2017 Plans:</b> - In FY 2017 the funding will transfer from Common Kill Vehicle Technology program element 0603294C to the MOKV program element 0604894C			
<b>Accomplishments/Planned Programs Subtotals</b>	23.524	59.558	0.000

<b>C. Other Program Funding Summary (\$ in Millions)</b>											
<b>Line Item</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017 Base</b>	<b>FY 2017 OCO</b>	<b>FY 2017 Total</b>	<b>FY 2018</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
• 0603176C: <i>Advanced Concepts and Performance Assessment</i>	9.999	12.139	17.880	-	17.880	12.599	12.897	13.004	13.221	Continuing	Continuing
• 0603178C: <i>Weapons Technology</i>	61.396	51.153	71.843	-	71.843	69.004	53.745	66.400	67.487	Continuing	Continuing
• 0603180C: <i>Advanced Research</i>	18.476	17.364	23.433	-	23.433	19.870	20.529	21.131	21.494	Continuing	Continuing
• 0603904C: <i>Missile Defense Integration and Operations Center (MDIOC)</i>	53.972	47.939	54.750	-	54.750	53.894	55.524	58.100	59.029	Continuing	Continuing

**Remarks**

**D. Acquisition Strategy**

The acquisition strategy consists of three focus areas. First, through competition with missile integration contractors, develop kill vehicle architecture and interfaces with follow on competitive design of multi-object kill concepts incorporating engagement management concept of operations, lightweight kill vehicles and enhanced discrimination capability. Second, conduct risk reduction activities to identify and mature the technology necessary to increase the reliability and performance of our kill vehicles using the Advanced Technology Innovation Broad Agency Announcement and competitive procurements. Make the necessary investments to maturing component technology; enhanced inertial navigation and kill vehicle-to-kill vehicle communications. Third, leverage the technical expertise of Federally Funded Research and Development Centers, University Applied Research Centers, and Universities and government laboratories to independently develop reference concept using proven modeling/analysis techniques.

**E. Performance Metrics**

N/A

**UNCLASSIFIED**

**Exhibit R-2A, RDT&E Project Justification:** PB 2017 Missile Defense Agency **Date:** February 2016

<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>	<b>Project (Number/Name)</b> MD40 / <i>Program Wide Support</i>
--	---	--

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
MD40: <i>Program Wide Support</i>	-	1.312	2.195	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

**Note**

Beginning in FY 2017, Program Wide Support was proportionately reallocated as a result of the Common Kill Vehicle Technology Program Element 0603294C transfer to Multi Object Kill Vehicle Program Element 0604894C.

**A. Mission Description and Budget Item Justification**

PWS contains non-headquarters management costs in support of MDA functions and activities across the entire BMDS. It Includes Government Civilians, and Contract Support Services. This provides integrity and oversight of the BMDS as well as supports MDA in the development and evaluation of technologies that will respond to the changing threat. Additionally, PWS includes Global Deployment personnel and support performing deployment site preparation and activation and, provides facility capabilities for MDA Executing Agent locations. Other MDA wide costs includes: physical and technical security; civilian drug testing; audit readiness; the Science, Technology, Engineering, and Mathematics (STEM) program; legal services and settlements; travel and agency training; office, equipment, vehicle, and warehouse leases; utilities and base operations; data and unified communications support; supplies and maintenance; materiel and readiness and central property management of equipment; and similar operating expenses. PWS is allocated on a pro-rata basis and therefore, fluctuates by year based on the adjusted RDT&E profile (which excludes: 0305103C Cyber Security Initiative, 0603274C Special Programs, 0603913C Israeli Cooperative Program and 0901598C Management Headquarters).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<b>Title:</b> Program Wide Support	1.312	2.195	0.000
<b>Description:</b> N/A			
<b>FY 2015 Accomplishments:</b> - Beginning in FY 2015, Program Wide Support was proportionately allocated to Common Kill Vehicle Technology - See paragraph A: Mission Description and Budget Item Justification			
<b>FY 2016 Plans:</b> - See paragraph A: Mission Description and Budget Item Justification.			
<b>FY 2017 Plans:</b> - In FY 2017, Program Wide Support was proportionately reallocated as a result of the Common Kill Vehicle Technology transfer to the Multi Object Kill Vehicle, Program Element 0604894C.			
<b>Accomplishments/Planned Programs Subtotals</b>	1.312	2.195	0.000

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

N/A

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2017 Missile Defense Agency		<b>Date:</b> February 2016
<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603294C / <i>Common Kill Vehicle Technology</i>	<b>Project (Number/Name)</b> MD40 / <i>Program Wide Support</i>

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

**Remarks**

**D. Acquisition Strategy**  
N/A

**E. Performance Metrics**  
N/A

**UNCLASSIFIED**

**THIS PAGE INTENTIONALLY LEFT BLANK**

**UNCLASSIFIED**