Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Office of the Secretary Of Defense	Date: February 2020
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602000D8Z / *Joint Munitions Technology*

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	19.053	19.067	19.306	19.409	-	19.409	19.833	20.178	20.695	21.116	Continuing	Continuing
000: *Insensitive Munitions*	12.867	12.883	13.069	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
204: *Enabling Fuze Technology*	6.186	6.184	6.237	6.288	-	6.288	6.408	6.513	6.679	6.815	Continuing	Continuing
076: *Enhanced Munitions*	-	0.000	0.000	13.121	-	13.121	13.425	13.665	14.016	14.301	Continuing	Continuing

Note

This Program Element (PE) aligns with PE 0603000D8Z, Joint Munitions Advanced Technology. The two project codes within each PE form the 6.2 applied research and 6.3 technology demonstration components of the Joint Enhanced Munitions Technology Program (JEMTP) and the Joint Fuze Technology Program (JFTP). The JEMTP funds applied research efforts from PE 0602000D8Z Project code (P) 076 Enhanced Munitions and technology demonstration efforts from PE 0603000D8Z P077. The JFTP funds applied research efforts from PE 0602000D8Z P204 Enabling Fuze Technology and technology demonstration efforts from PE 0603000D8Z P301.

A. Mission Description and Budget Item Justification

This program addresses applied research associated with improving the lethality, reliability, safety, and survivability of munitions and weapon systems. The goal is to develop joint enabling technologies that can be used by the Program Executive Officers (PEOs) as they develop their specific weapon programs. The program invests in research of technologies from a Joint Service perspective, thus maximizing efficiencies, ensuring the development of technologies with the broadest applicability while avoiding duplication of efforts. Increasing the lethality, range and performance of munitions, while striving to increase the safety for our warfighters for munitions in procurement and under development guide program investments. This munitions based science and technology (S&T) program focuses on enhancements in weapon speed, range, and lethality while largely utilizing existing advanced insensitive munitions (IM) technology to maximize weapon safety. U.S. power projection capabilities related to near peer competition are lagging and there is an urgent need to provide US warfighters with increased or new capabilities. The program is striving to develop the most lethal weapons possible and communicating associated risks intelligently, so U.S. warfighters can make informed decisions about their weapon systems capabilities and safe handling requirements. IM compliance requirements remain an important aspect of munitions reliability and readiness and thus will remain a critical characteristic of the program. The 2018 National Defense Strategy denotes that “Challenges to the U.S. military advantage represent another shift in the global security environment. For decades the United States has enjoyed uncontested or dominant superiority in every operating domain. Today, every domain is contested—air, land, sea, space, and cyberspace.” Therefore, the program will invest in technologies that will enable U.S. warfighters to regain the operational and battlefield advantages that technologies can provide through increased performance, range, and lethality to improve the Joint Force military advantages and build a more lethal force. This program's investment portfolio has been aligned to complement, and utilize, the Department's priority technology areas.

Munition Area Technology Groups (MATGs) and Fuze Area Technology Groups (FATGs) are established for each munition and capability area and are tasked with: 1) coordinating, establishing, and maintaining 2025, 2030, and 2035 year technology development plans and roadmaps, 2) coordinating biannual meetings to review technical and programmatic details of each funded and proposed effort, 3) developing and submitting Technology Transition Agreements in coordination with appropriate PEOs for insertion in their weapons system strategic plans / Fuze Technology Development Plans, and 4) interfacing with other MATGs / FATGs and IM / fuze science and technology projects as appropriate. The Joint Enhanced Munitions Technology Program (JEMTP) and Joint Fuze Technology Program (JFTP) utilize a Technical

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Office of the Secretary Of Defense	Date: February 2020
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602000D8Z / *Joint Munitions Technology*

Advisory Board (TAB) and Technical Advisory Committee (TAC) (consisting of senior Department of Defense (DoD) and Department of Energy (DOE) technology experts and laboratory representatives, plus senior Munitions PEO representatives) to provide program oversight, policy, direction, and priorities during its annual meeting.

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	19.126	19.306	19.589	-	19.589
Current President's Budget	19.067	19.306	19.409	-	19.409
Total Adjustments	-0.059	0.000	-0.180	-	-0.180
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.056	-			
• Other Adjustments	-0.003	-	-0.161	-	-0.161
• Economic Assumption	-	-	-0.019	-	-0.019

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense			Date: February 2020
Appropriation/Budget Activity 0400 / 2	R-1 Program Element (Number/Name) PE 0602000D8Z / *Joint Munitions Technology*	Project (Number/Name) 000 / *Insensitive Munitions*	

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
000: *Insensitive Munitions*	12.867	12.883	13.069	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

The enhanced munitions effort will explore and develop advanced energetics concepts and explosive and propellant materials with the potential to improve the performance, range, and lethality of weapons. Technologies and concepts developed will have the potential to impact multiple munitions technologies with wide applicability to improve the performance, lethality, and range of weapons to ensure the U.S. is not outgunned and outranged on the battlefield of the future.

The Joint Enhanced Munitions Technology Program (JEMTP) investments focus on five Munition Areas: 1) High Performance Rocket Propulsion, 2) Minimum Signature Rocket Propulsion, 3) Blast and Fragmentation Warheads (Area Effects Warheads), 4) Anti-Armor Warheads (Hard Target Effects Warheads), and 5) Gun Propulsion. Munition Area Technology Groups (MATG), under tri-service leadership, have developed technology roadmaps for each Munition Area which is used to guide investments based on goals consistent with the DoD IM Strategic Plan. These IM technologies, alone or in combination, will be incorporated in hardware, simulating real-world munitions, to demonstrate their utility and feasibility as part of Technology Transition Agreements with PEOs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Enhanced Munitions (previously Insensitive Muntions)	12.883	13.069	-
Description: Enhance Munitions focuses on the following key areas: - High Performance Propulsion - focuses on the development of technologies to improve the range and speed of HPP systems, rocket motors with Ammonium Perchlorate, and with or without a metal fuel, for rockets and missiles launched from air, ground, and sea platforms. - Minimum Signature Rocket Propulsion (MSP) - focuses on the development and demonstration of technologies to improve range and speed of minimum signature propellant missiles. - Blast and Fragmentation Warheads (BFW) - focuses on the development of technologies to enhance the lethality of blast/ fragmentation munitions. - Anti-Armor Warheads (AAW) - focuses on the development of explosive ingredients, explosives, and warhead technologies for improving performance of AAW munitions. - Gun Propulsion (GP) - focuses on the development and demonstration of technologies in the area of GP systems. ***FY 2020 Plans:*** - Evaluation of novel ingredients to increase conventional propellant burn rate for extended range across a suite of munitions. Investigate the addition of new metal materials to increase the trust of solid fuel hypersonic weapons. Demonstrate the printing of a new ignition feature for use in boost motors for hypersonic weapons.			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602000D8Z / *Joint Munitions Technology*	**Project (Number/Name)** 000 / *Insensitive Munitions*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
- Evaluate proven binder materials for high specific impulse (isp) propellant that can be used in multiple minimum signature applications. Downselect modified high sensitivity formulations to six candidates to compare against baseline propellant and conduct performance testing. Formulate propellant using CL-20 and advanced processing to reduce risk. - Additively manufacture fragmenting warheads with low drag to tailor fragment size to target sets. Investigate mach stem detonations for improved fragmentation and lethality. Evaluation of CL-20 in novel explosives for high energy warheads. - Produce precursor materials for new novel explosive material and produce 10 kg of new material, then for studies to ensure viability and optimize material. Evaluate Nano CL-20 for use with multiple binder systems for increased jet performance and penetration. Investigate a Pressed Cured Explosive Utilizing a Thiol-ene Binder System to be formulated with multiple nitramines. Development of a dual explosive shaped charge jet for improved performance. - Evaluate coextruded propellant and novel processing techniques for improved flame spread and thermal consistency over a wide firing range. Investigate novel solventless processing for improved thermal properties and tailored energy release. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort transitions from the Insensitive Munitions (Project Code 000) to Enhanced Munitions (new Project Code 076) in FY 2021.			
Accomplishments/Planned Programs Subtotals	12.883	13.069	-

C. Other Program Funding Summary ($ in Millions)

Line Item	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
• 0603000D8Z P002: *BA 3 Insensitive Munitions Advanced Technology*	19.052	19.205	16.321	-	16.321	16.724	17.103	17.621	18.040	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense			Date: February 2020
Appropriation/Budget Activity 0400 / 2	R-1 Program Element (Number/Name) PE 0602000D8Z / *Joint Munitions Technology*	Project (Number/Name) 204 / *Enabling Fuze Technology*	

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
204: *Enabling Fuze Technology*	6.186	6.184	6.237	6.288	-	6.288	6.408	6.513	6.679	6.815	Continuing	Continuing

A. Mission Description and Budget Item Justification

This RDT&E effort will demonstrate fuze enabling technologies needed to develop weapons that address Joint priority capability areas including ones highlighted by OSD R&E Technology-Focused Modernization and Service S&T priorities such as Hypersonics, Long Range Precision Fires, Air Defense and Scalable Lethality. This effort will develop enabling technologies at the laboratory scale and transition them into Budget Activity (BA) 6.3 demonstration programs for weapons where priority capabilities and technology needs have been identified and validated by the Program Executive Officers (PEOs) and the Heads of the Service Science and Technology (S&T) communities. Mature BA 6.2 fuze technologies will be transitioned, thereby decreasing their program costs and schedule risk and facilitating spin-offs to other munitions within their portfolios.

The Joint Fuze Technology Program (JFTP) investments are focused on capability areas that driven by next generation hypersonic and advanced weapons. The four capability areas are:

1) Extreme Environment Survivable Fuzing, 2) Tailorable Effects Fuzing and Warhead Initiation, 3) High Reliability Safe and Arm Technology, and 4) Target Detection and Burst Point Control.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Enabling Fuze Technology	6.184	6.237	6.288
Description: Enabling fuze technology focuses on the following areas: - Extreme Environmental Survivable Fuzing - challenges are addressed with improved modeling and simulation (M&S) capabilities to provide the computational tools necessary understand extreme weapon environments, test equipment, instrumentation, and analysis techniques that provide basic phenomenology and understanding of the fuze environment, and survivable fuze components are developed to increase the effectiveness of hypersonic munitions by improving the prediction tools and testing methodologies to evaluate the survivability and functionality of future fuzes. Development of these technologies will enable next generation of hypersonic weapon fuzes to survive and function. - Tailorable Effects Fuzing and Warhead Initiation - develops technologies for tailorable effects weapons that encompasses the ability to selectively vary the output of the weapon and the ability to generate selectable effects, initiation and multi-point technologies; electronic safe and arm based multi-point initiators, MicroElectro-Mechanical Systems (MEMS) based multi-point initiators, and smart fuzing for tailorable effects weapons. - High Reliability Safe and Arm Technology - develops high reliability fuzing architectures, fuzing components, and Unexploded Ordnance (UXO) reduction features. - Target Detection and Burst Point Control - develops smaller, more survivable fuze solutions while meeting or exceeding the performance of existing technologies in order to operate in extreme and challenging weapon environments.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602000D8Z / *Joint Munitions Technology*	**Project (Number/Name)** 204 / *Enabling Fuze Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
- Complete and release modeling and simulation tools to Service weapon designers that improve the prediction of the dynamic response of embedded fuze systems for High G shock environments. Conduct High G characterization testing for establishing design guidelines of ruggedizing fuzes in high shock environment. - Investigate government owned detonator formulation for in-line electronic safe arm device (ESAD) used in conventional and High G weapon applications. Develop initial prototypes of fuze critical component technologies for in-line ESADs such as high voltage switches that provide alternatives to current single point solutions. - Investigate prototype designs for miniature safe and arm components for area effects weapons. Develop highly reliable and robust safe and arm sensors for Hypersonic and Counter UAS weapons. - Develop, through additive manufacturing, initial prototype conformal antennas with wideband operation to provide fuze sensor waveforms for target detection. Develop non-RF detection and advanced algorithm technologies for fuzing applications for Counter-UAS weapons. ***FY 2021 Plans:*** - Conduct High G characterization testing for establishing design guidelines of ruggedizing fuzes in high shock environment. - Develop fuze critical component technologies for in-line ESADs such as high voltage switches that provide alternatives to current single point solutions. - Demonstrate highly reliable and robust safe and arm sensors for Hypersonic and Counter UAS weapons. - Demonstrate non-RF detection and advanced algorithm technologies for fuzing applications for Counter-UAS weapons. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The level of effort is consistent between FY 2020 and FY 2021. Small changes reflect minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	6.184	6.237	6.288

C. Other Program Funding Summary ($ in Millions)

Line Item	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
• 0603000D8Z P301: *BA 3 Enabling Fuze Advanced Technology*	6.627	6.678	6.621	-	6.621	6.782	6.865	7.042	7.185	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense			Date: February 2020
Appropriation/Budget Activity 0400 / 2	R-1 Program Element (Number/Name) PE 0602000D8Z / *Joint Munitions Technology*	Project (Number/Name) 076 / *Enhanced Munitions*	

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
076: *Enhanced Munitions*	-	0.000	0.000	13.121	-	13.121	13.425	13.665	14.016	14.301	Continuing	Continuing

Note

New FY 2021 Project Code; funding re-aligned from P000 Insensitive Munitions.

A. Mission Description and Budget Item Justification

The enhanced munitions effort will explore and develop advanced energetics concepts and explosive and propellant materials with the potential to improve the performance, range, and lethality of weapons. Technologies and concepts developed will have the potential to impact multiple munitions technologies with wide applicability to improve the performance, lethality, and range of weapons to ensure the U.S. is not outgunned and outranged on the battlefield of the future.
The Joint Enhanced Munitions Technology Program (JEMTP) investments focus on five Munition Areas: 1) High Performance Rocket Propulsion, 2) Minimum Signature Rocket Propulsion, 3) Area Effects Warheads, 4) Hard Target Effects Warheads, and 5) Gun Propulsion. Munition Area Technology Groups (MATG), under tri-service leadership, have developed technology roadmaps for each Munition Area which is used to guide investments based on goals consistent with the DoD IM Strategic Plan. These IM technologies, alone or in combination, will be incorporated in hardware, simulating real-world munitions, to demonstrate their utility and feasibility as part of Technology Transition Agreements with PEOs.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Ehanced Munitions	-	-	13.121
Description: Enhanced Munitions focuses on the following key areas: - High Performance Propulsion (HPP) - focuses on the development of technologies to improve the range and speed of HPP systems, rocket motors with Ammonium Perchlorate, and with or without a metal fuel, for rockets and missiles launched from air, ground, and sea platforms. - Minimum Signature Rocket Propulsion (MSP) - focuses on the development and demonstration of technologies to improve range and speed of minimum signature propellant missiles. - Area Effects Warheads (AEW) - focuses on the development of technologies to improve the effectiveness and reduce the size of Area Effects munitions. - Hard Target Effects Warheads (HTEW) - focuses on the development of explosive ingredients, explosives, and warhead technologies for improving performance of Hard Target Effects munitions. - Gun Propulsion (GP) focuses on the development and demonstration of technologies in the area of GP systems. The development and demonstration of gun propulsion technologies, when applied to munition systems, will improve the range and/or time to target of all gun launched munitions to include small/medium caliber, tank/mortar and large caliber propulsion systems.			
FY 2021 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602000D8Z / *Joint Munitions Technology*	**Project (Number/Name)** 076 / *Enhanced Munitions*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
- Demonstrate the feasibility of a dual use propellant that can be used as an explosive to create fragments. Investigate novel materials that can be used to reduce weight by replacing the rocket motor casing. - Utilize tailored nitrate esters to increase the specific impulse (isp) of MSP above 15.5. Integrate novel mixing methods to create formulations using proven binder materials like GAP and functionalized nitrate esters for demonstration in systems like Hellfire. - Scale up of novel caged nitramines for use in formulations loaded in Extended Range Canon Artillery (ERCA) and Thor munitions. - Scale up and formulation of novel caged nitramine ingredients for use in multiple formulations. - Demonstrate advanced coatings for improved performance at cold temperature. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** New Project Code in FY 2021. Transfers efforts from Project Code 000 Insensitive Munitions.			
Accomplishments/Planned Programs Subtotals	-	-	13.121

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A