Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 7: *Operational Systems Development*					R-1 Program Element (Number/Name) PE 0607131A *I Weapons and Munitions Product Improvement Programs*							
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	-	17.992	15.645	20.409	-	20.409	14.799	11.409	4.820	2.230	Continuing	Continuing
ER2: *Close Combat Technology*	-	3.042	2.056	6.764	-	6.764	3.511	2.744	0.666	0.000	Continuing	Continuing
ER5: *Indirect Fire and Fuze Technology*	-	3.227	5.064	4.890	-	4.890	4.518	2.398	2.156	2.230	Continuing	Continuing
ER6: *Direct Fire Technology*	-	11.723	8.525	8.755	-	8.755	6.770	6.267	1.998	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Project ER2 Close Combat Technology project includes development efforts to upgrade Close Combat technologies, energetics, and munitions, such as counter explosives, grenades, demolitions, shoulder launched munitions, pyrotechnic simulators, countermeasure flares, non-lethal ammunition/systems, networked munitions and mines, that have been fielded or have received approval for full rate production. This program will identify, characterize, study, analyze, test and develop technologies to resolve close combat munition reliability, safety, environmental, storage, standardization, obsolescence and manufacturing/producibility issues. Fiscal Year (FY) 2021 funds will resource improvements to the following grenade efforts: MK3A2 Replacement - XM111 Offensive Hand Grenade, M82 Simulant Smoke Practice Grenade, M67 (G881) Insensitive Munition (IM) Replacement, and M98/M99 Non-Lethal 66mm Grenades.

Project ER5 Indirect Fire and Fuze Technology Project includes product improvement development efforts to upgrade indirect fire weapon systems and munitions that have already been fielded and/or are in production. Efforts include improved target engagement, increased reliability, availability, maintainability, and safety, standardization and interoperability with weapons and munitions of Allied Nations, defense exportability features, reduction of failure mechanisms, and supply chain risk by introducing new and alternative technology and materiel solutions, improvement of manufacturing methods and their associated production processes, new capabilities in response to the evolving and emerging threats and countermeasures, and reduction/elimination of potential environmental and health risks associated with these products. FY 2021 funding will support the transition and incorporation of the newly translated transceiver prototypes into indirect production fuzes with the generation of Engineering Change Proposals (ECPs) to the Technical Data Packages (TDPs), conduct analysis of the improved prototyping techniques of the Microelectromechanical systems (MEMS) impact switches for use in mortar and medium caliber fuzes, support the evaluations on hand grenade fuzes to reduce the number of critical defects, which will increase producibility and safety, conduct tests to prove out performance on the next generation microcontroller for mortar proximity fuzes, conduct analysis on mortar training fuzes for performance improvements during early ballistic flight, and conduct testing of enhanced delay mode design on the M739A1 artillery fuze for increased safety and performance. FY 2021 funding will also support qualification of Hexachloroethane Zinc Oxide (HC) smoke fill formulation into the 60mm and 81mm smoke families of ammunition. Engineering efforts will identify the formulation percentage of constituents and identify the production processes required to promote effective smoke production that is less toxic and ultimately provides effective smoke screening and burn time performance.

Project ER6 Direct Fire Technology funding will be used to support direct fire ammunition from small caliber ammunition, 40mm grenade, medium caliber cannon ammunition and large caliber ammunition enhancements to lethality, effectiveness, survivability, accuracy and general product improvements. FY 2021 funds support making lethality and safety improvements to 40mm grenades, performing improvements to 30mm ammunition, making a number of improvements to training ammunition, performing improvements to small caliber primers to make the primers more environmentally friendly, and continuing the effort to reduce Soldier load

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 7: *Operational Systems Development*	**R-1 Program Element (Number/Name)** PE 0607131A *I Weapons and Munitions Product Improvement Programs*

by developing lightweight small caliber ammunition. FY 2021 also includes potential examination and implementation of improvements to 105mm and 120mm tank ammunition.

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	18.551	15.645	10.197	-	10.197
Current President's Budget	17.992	15.645	20.409	-	20.409
Total Adjustments	-0.559	0.000	10.212	-	10.212
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.559	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	10.212	-	10.212

Change Summary Explanation

FY 2021 increase of $4.714 million due to increased analysis, evaluation and qualification efforts for Project ER2 Close Combat Technology.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER2 / *Close Combat 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
ER2: *Close Combat Technology*	-	3.042	2.056	6.764	-	6.764	3.511	2.744	0.666	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Project ER2 Close Combat Technology includes development efforts to upgrade Close Combat technologies, energetics, and munitions, such as counter explosives, grenades, demolitions, shoulder launched munitions, pyrotechnic simulators, countermeasure flares, non-lethal ammunition/systems, and networked munitions and mines, that have been fielded or have received approval for full rate production. FY 2021 funding will allow the project to identify, characterize, study, analyze, test and develop technologies to resolve close combat munition reliability, safety, environmental, storage, standardization, obsolescence and manufacturing/producibility issues.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: MK3A2 Replacement , XM111 Offensive Hand Grenade	1.157	1.963	1.727
Description: The current MK3A2 Offensive Hand Grenade can expose the Warfighter to toxic levels of asbestos and is restricted for use in Continental United States and Outside Continental United State (CONUS/OCONUS). The warfighter cannot safely employ this grenade. Alternate munitions do not satisfy user requirements for incapacitating the enemy. This effort incorporates modern materials and insensitive explosives to provide a safer, producible offensive grenade and its associated training device, XM112.			
FY 2020 Plans: Continued development of alternate explosive fill and built hardware in support of qualification.			
FY 2021 Plans: Conduct testing of prototypes to determine safety, viability, and effectiveness of an alternative explosive fill..			
FY 2020 to FY 2021 Increase/Decrease Statement: Decrease due to reduced requirements to test prototypes.			
Title: M82 Simulant Smoke Practice Grenade	0.623	-	0.539
Description: The M82 encountered performance issues during the last production as a result of the less than optimal design for the base. Developing a new base design that minimizes any leak paths and facilitates the metal clip contact surface with the launcher will greatly improve the producibility and reliability of the grenade. This effort consists of the development and prove out of the base design.			
FY 2021 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Test prototype grenades and receive final test report from Pine Bluff Arsenal. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Increase required to support testing and qualification of new M82 base design.			
Title: M67 (G881) Fragmentation Hand Grenade ***Description:*** The current M67 Hand Grenade does not meet Insensitive Munitions (IM) requirements; effort will bring M213 fuze up to IM standard. ***FY 2021 Plans:*** Plan contract awards via Other Transactional Authority (OTA) to build prototype hardware for testing. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Increase due to resource requirements to build prototypes for testing.	-	-	3.478
Title: M98/M99 Non-Lethal 66mm Grenades ***Description:*** The M98/99 grenades utilize a legacy propulsion base design that is susceptible to leak paths through the clips and between the base and the grenade body. The current ignition mechanism utilizing an electric match crimped to the terminal lugs has also shown to have reliability issues. A new base design will greatly improve the producibility and reliability of the grenade. ***FY 2021 Plans:*** Support the development and initial testing of an improved M98 base design. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Increased required to support development of new M98 base and begin initial testing.	-	-	1.020
Title: AN-M8A1 Obscuration Grenade ***Description:*** This effort supports the Design/Type Classification/Production Prove Out of an improved obscurant grenade that provides the warfighter with screening performance similar to the legacy AN-M8 smoke grenade, using a different smoke formulation than the legacy's grenade's Hexachloroethane (HC). The use of HC has been restricted inside and outside the CONUS/OCONUS due to its toxic effects. The legacy AN-M8 grenade is limited to use in contingency operations only. The M83 training smoke grenade is currently used in lieu of the AN-M8 in both training and tactical operations, but does not give screening performance comparable to the legacy AN-M8. Soldiers must use two or three M8 grenades to produce obscuration effects comparable to a single AN-M8 grenade.	1.262	-	-
Title: FY 2020 SBIR/STTR Transfer	-	0.093	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	3.042	2.056	6.764

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
• E33010: *GRENADE, Hand, Offensive, XM111*	0.939	-	5.694	-	5.694	13.557	12.108	13.820	13.820	0.000	59.938

Remarks

D. Acquisition Strategy

The strategy for the MK3A2 Offensive Hand Grenade is to develop, test and qualify a new design, XM111, that eliminates the toxic hazards and provides the required performance for the user in FY 2019. Follow-on procurement efforts will be competitive pending market research.

The strategy for the AN-M8A1 is to qualify an alternative fill due to obsolescence and manufacturability driven changes required to provide smoke for use by Soldiers to meet existing validated requirements. Once the smoke fill is qualified, the plan is to investigate the cost and impact to upgrade the Pine Bluff Arsenal grenade loading facilities.

The M82 program is updating the design of specific parts to make it more producible and will be proving out the design for use in future production efforts.

The M98/M99 Non-Lethal 66mm Grenades program is updating the design of the propulsion base to make it more producible and will be proving out the design for use in future production efforts at Pine Bluff Arsenal.

The strategy for the legacy M67 Fragmentation Hand Grenade is to build up to 3 different prototype designs, conduct a shoot-off to down-select to the best design, and then qualify the new design that mitigates the insensitive munition hazards associated with the explosive fill and the fuze technology. Follow-on procurement efforts will be competitive pending market research.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER2 / *Close Combat Technology*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.093		-		-		-	0.000	0.093	-
		Subtotal	-	-		0.093		-		-		-	0.000	0.093	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
XM111, Offensive Hand Grenade	C/FFP	Battelle Memorial Institute : Columbus, OH	0.548	0.325	Mar 2019	0.427	Jan 2020	-		-		-	Continuing	Continuing	-
M82 Simulant Smoke Practice Grenade	C/FFP	Battelle Memorial Institute : Columbus, OH	-	0.251	Aug 2019	-		-		-		-	0.000	0.251	-
AN-M8A1 Enhanced Obscuration Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal, NJ	-	0.265	Jun 2019	-		-		-		-	0.000	0.265	-
M98/M99 Non-Lethal 66mm Grenades	C/FFP	Battelle Memorial Institute : Columbus, OH	-	-		-		0.200	Mar 2021	-		0.200	0.000	0.200	-
M67 (G881) Fragmentation Hand Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal, NJ	-	-		-		2.767	Mar 2021	-		2.767	0.000	2.767	-
		Subtotal	0.548	0.841		0.427		2.967		-		2.967	Continuing	Continuing	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
XM111, Offensive Hand Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal, NJ	2.895	0.325	Mar 2019	1.138	Jan 2020	0.284	Oct 2020	-		0.284	Continuing	Continuing	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
XM111, Offensive Hand Grenade	MIPR	Various : Various locations	0.031	0.007	Jun 2019	0.007	Mar 2020	-		-		-	0.000	0.045	-
AN-M8A1 Enhanced Obscuration Grenade	MIPR	CCDC - Edgewood : Edgewood, MD	0.141	0.749	Feb 2019	-		-		-		-	Continuing	Continuing	-
AN-M8A1 Enhanced Obscuration Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal, NJ	-	0.265	Jan 2019	-		-		-		-	0.000	0.265	-
M82 Simulant Smoke Practice Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal. NJ	-	0.265	Jan 2019	-		-		-		-	Continuing	Continuing	-
M82 Simulant Smoke Practice Grenade	MIPR	CCDC - Edgewood : Edgewood, MD	-	0.095	Feb 2019	-		-		-		-	Continuing	Continuing	-
M98/M99 Non-Lethal 66mm Grenades	MIPR	CCDC - Armaments Center : Picatinny Arseanl, NJ	-	-		-		0.225	Jan 2021	-		0.225	0.000	0.225	-
M98/M99 Non-Lethal 66mm Grenades	MIPR	CCDC - Edgewood : Edgewater, MD	-	-		-		0.075	Jan 2021	-		0.075	0.000	0.075	-
M67 (G881) Fragmentation Hand Grenade	MIPR	CCDC - Armaments Center : Picatinny Arsenal, NJ	-	-		-		0.705	Jan 2021	-		0.705	0.000	0.705	-
		Subtotal	3.067	1.706		1.145		1.289		-		1.289	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
XM111, Offensive Hand Grenade	MIPR	Redstone Tech Test Center : Redstone Arsenal, AL	0.037	-		0.391	Jul 2020	0.233	Oct 2020	-		0.233	Continuing	Continuing	-
XM111, Offensive Hand Grenade	MIPR	Yuma : Yuma Proving Grounds, AZ	-	-		-		0.454	Oct 2020	-		0.454	0.000	0.454	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER2 / *Close Combat Technology*	

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
XM111, Offensive Hand Grenade	MIPR	ATC : Aberdeen Proving Grounds, NJ	0.351	-		-		0.756	Oct 2020	-		0.756	Continuing	Continuing	-
M98/M99 Non-Lethal 66mm Grenades	PO	Pine Bluff Arsenal : Pine Bluff, AR	-	-		-		0.520	Jul 2021	-		0.520	0.000	0.520	-
M82 Simulant Smoke Practice Grenade	MIPR	Pine Bluff Arsenal : Pine Bluff Arsenal, Arkansas	-	0.495	Sep 2019	-		0.545	Oct 2020	-		0.545	0.000	1.040	-
		Subtotal	0.388	0.495		0.391		2.508		-		2.508	Continuing	Continuing	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	4.003	3.042		2.056		6.764		-		6.764	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

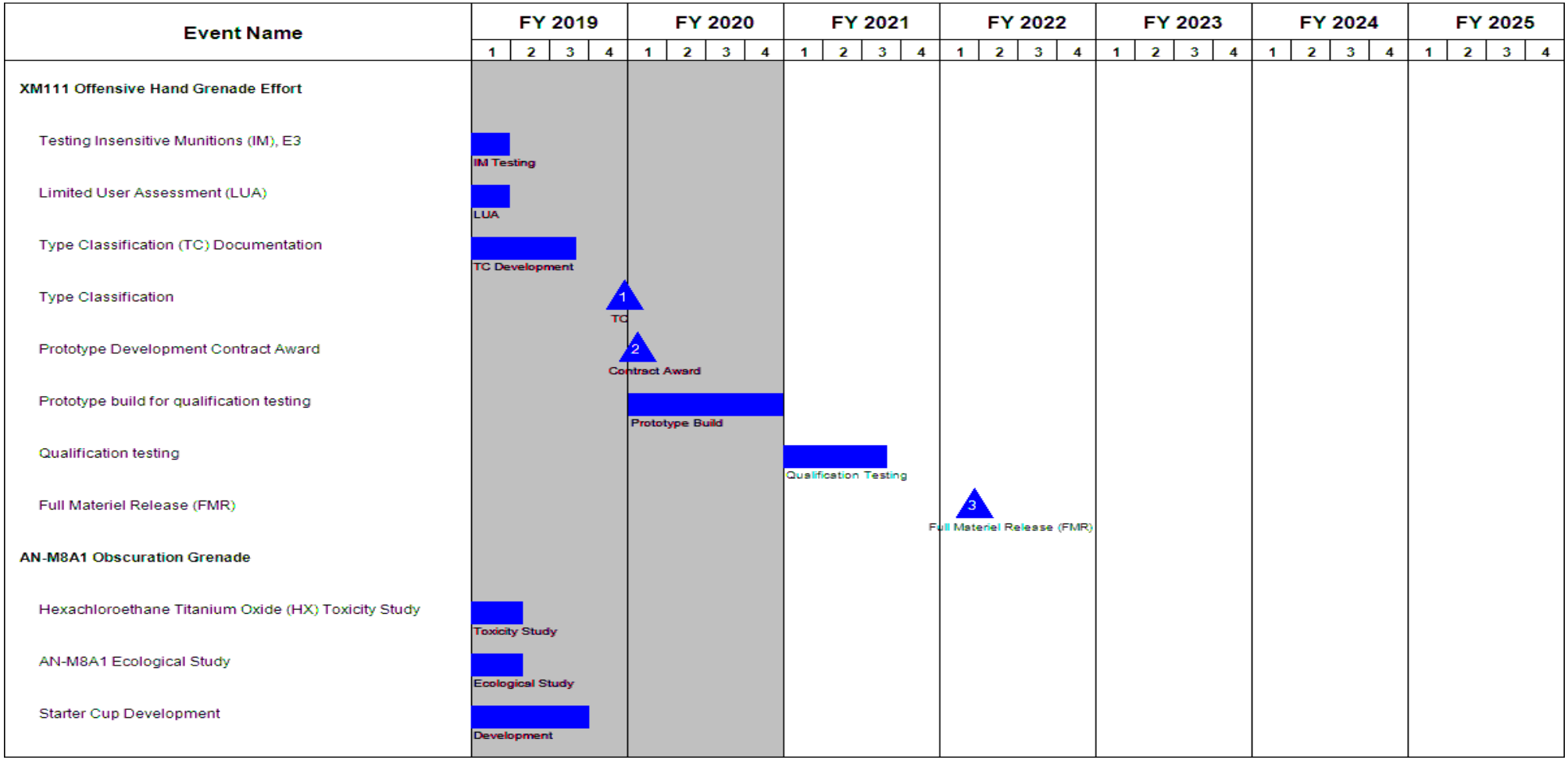

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

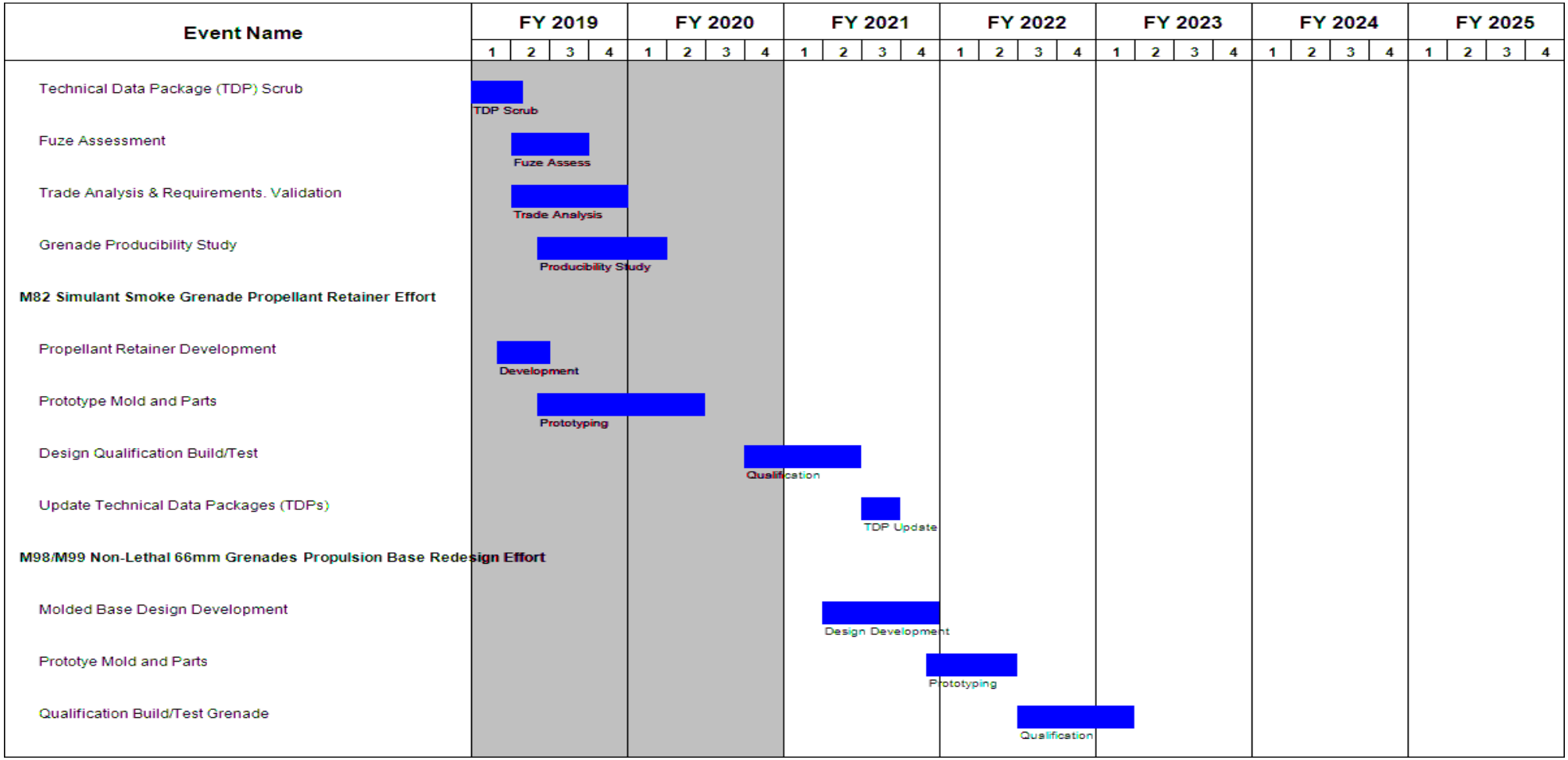

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

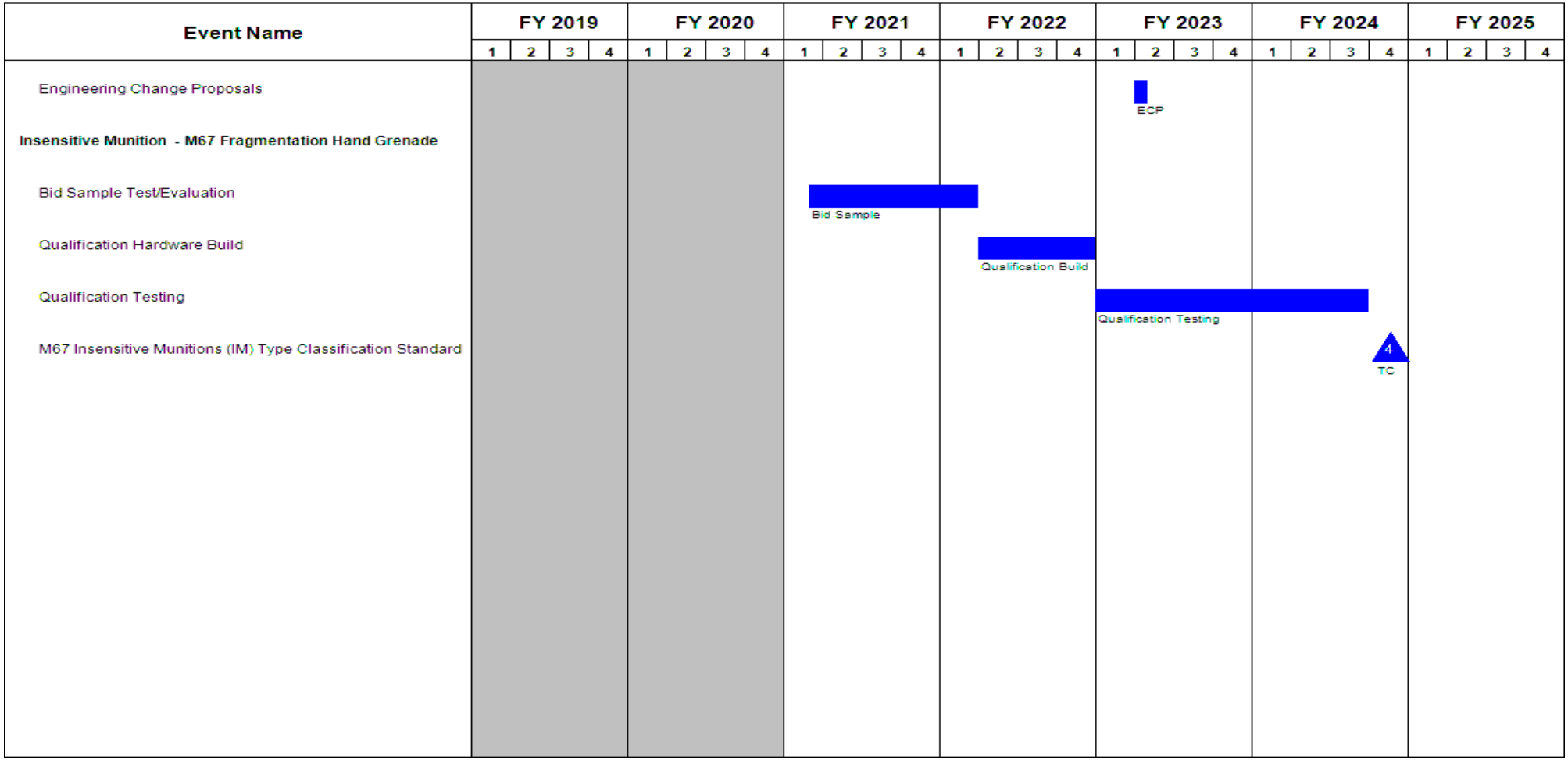

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
XM111 Offensive Hand Grenade Effort	1	2017	4	2020
Testing Insensitive Munitions (IM), E3	3	2018	1	2019
Limited User Assessment (LUA)	4	2018	1	2019
Type Classification (TC) Documentation	2	2018	3	2019
Type Classification	4	2019	4	2019
Prototype Development Contract Award	1	2020	1	2020
Prototype build for qualification testing	1	2020	4	2020
Qualification testing	1	2021	3	2021
Full Materiel Release (FMR)	1	2022	1	2022
AN-M8A1 Obscuration Grenade	1	2017	4	2020
Hexachloroethane Titanium Oxide (HX) Toxicity Study	1	2017	1	2019
AN-M8A1 Ecological Study	4	2018	1	2019
Starter Cup Development	2	2018	3	2019
Technical Data Package (TDP) Scrub	1	2019	1	2019
Fuze Assessment	2	2019	3	2019
Trade Analysis & Requirements. Validation	2	2019	4	2019
Grenade Producibility Study	2	2019	1	2020
M82 Simulant Smoke Grenade Propellant Retainer Effort	1	2017	4	2020
Propellant Retainer Development	1	2019	2	2019
Prototype Mold and Parts	2	2019	2	2020
Design Qualification Build/Test	4	2020	2	2021
Update Technical Data Packages (TDPs)	3	2021	3	2021

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER2 / *Close Combat Technology*

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
M98/M99 Non-Lethal 66mm Grenades Propulsion Base Redesign Effort	2	2021	2	2023
Molded Base Design Development	2	2021	4	2021
Prototye Mold and Parts	4	2021	2	2022
Qualification Build/Test Grenade	3	2022	1	2023
Engineering Change Proposals	2	2023	2	2023
Insensitive Munition - M67 Fragmentation Hand Grenade	1	2021	4	2027
Bid Sample Test/Evaluation	1	2021	1	2022
Qualification Hardware Build	2	2022	4	2022
Qualification Testing	1	2023	3	2024
M67 Insensitive Munitions (IM) Type Classification Standard	4	2024	4	2024

Note

MK3A2 Replacement, XM111 Offensive Hand Grenade Effort: schedule, with the exception of Full Material Release (FMR), depicts efforts funded via RDT&E Program Element 0607131, Project ER2 line. Efforts, beginning in FY21, are funded with Procurement of Ammunition, Army funding (Standard Study Number E33010) Grenade Hand, Offensive XM111 and are not depicted on this schedule.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER5 / *Indirect Fire and 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
ER5: *Indirect Fire and Fuze Technology*	-	3.227	5.064	4.890	-	4.890	4.518	2.398	2.156	2.230	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Indirect Fire and Fuze Technology Project includes product improvement development efforts to upgrade indirect fire weapon systems and munitions that have already been fielded and/or are in production. Efforts include improved target engagement, increased reliability, availability, maintainability, and safety, standardization and interoperability with weapons and munitions of Allied Nations, defense exportability features, reduction of failure mechanisms, and supply chain risk by introducing new and alternative technology and materiel solutions, improvement of manufacturing methods and their associated production processes, new capabilities in response to the evolving and emerging threats and countermeasures, and reduction/elimination of potential environmental and health risks associated with these products.

This Project supports the identification, study, analysis, and integration of fuzing technologies and safe arm devices in production and in the field. The Project implements new technologies into fuzing systems to preclude obsolescence, maximize standardization, enhance performance, and improve the safety and exportability of existing munitions. The Project addresses two major areas: (1) analysis and (2) block upgrades. Analysis efforts will identify second sources for fuzing systems that may reduce costs as a result of competition, and maintain production when sources or parts are no longer available. It will also allow for the performance enhancement of current ammunition items by conducting studies of major fuze components to detect and identify latent defects. Block upgrades will identify and support studies on improvements to fuzes, increase commonality of fuze components and requirements. Upgrades will enable the introduction of the latest technologies into fuzing, keep the fuze design current to avoid obsolescence issues, and add capabilities. Fiscal Year (FY) 2021 funding will support the transition and incorporation of the newly translated transceiver prototypes into indirect production fuzes with the generation of Engineering Change Proposals (ECPs) to the Technical Data Packages (TDPs), conduct analysis of the improved prototyping techniques of the Microelectromechanical systems (MEMS) impact switches for use in mortar and medium caliber fuzes, support the evaluations on hand grenade fuzes to reduce the number of critical defects, which will increase producibility and safety, conduct tests to prove out performance on the next generation microcontroller for mortar proximity fuzes, conduct analysis on mortar training fuzes for performance improvements during early ballistic flight, and conduct testing of enhanced delay mode design on the M739A1 artillery fuze for increased safety and performance.

This Project also supports the incorporation of the new Hexachloroethane Zinc Oxide (HC) smoke fill formulation while utilizing the existing illumination shell body configuration to support mortar smoke training for US Army Europe (USAREUR). The HC smoke fill formulation is less toxic and less incendiary than the current Mortar Red Phosphorus (RP) or White Phosphorous (WP) Smoke rounds and will reduce risk of unintended collateral damage or environmentally hazardous waste. USAREUR has yearly requirements for procurement of smoke mortar cartridges across all calibers to be used for training, but is prohibited from training with the current WP or RP smoke munitions in Europe due to environmental restrictions. FY 2021 funding will support qualification of HC smoke fill formulation into the 60mm and 81mm smoke families of ammunition. Engineering efforts will identify the formulation percentage of constituents and identify the production processes required to promote effective smoke production that is less toxic and ultimately provides effective smoke screening and burn time performance.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Fuze Technology Improvements (FTI)	3.227	2.120	2.263

Description: This project implements new, mature, technologies into fuzing systems to preclude obsolescence, maximize standardization, enhance performance, and improve the safety and exportability of existing munitions. The FTI project addresses two major areas: (1) analysis/risk mitigation and (2) block upgrades. Analysis efforts will identify second sources for fuzing systems that may reduce costs by providing competition, and maintain production when sources or parts are no longer available. It will also allow for the performance enhancement of current ammunition items by conducting studies of major fuze components to detect and identify latent defects. The second major area is block upgrades, which will identify and perform studies on improvements to fuzes, increase commonality of fuze components and requirements. Block upgrades will enable the introduction of the latest technologies into fuzing, keep the fuzing design current to avoid obsolescence issues, and add capabilities.

FY 2020 Plans:
Block Upgrades: Conducted engineering tests of the medium caliber fuze safety design modifications, conducted analysis of the prototype low cost electronic safe and arm devices, conducted analysis on the hand grenade fuzes to reduce the number of critical defects that improved producibility and increase safety, and conducted studies on power sources for increased producibility and higher throughput.

Analysis / Risk Mitigation: Supported the engineering tests and evaluations on the prototype replacement electronic transceiver prototypes for indirect fire and direct fire proximity fuzes, conducted engineering tests on the optimized impact switches for use in mortar and medium caliber fuzes, and conducted evaluations on the next generation microcontroller to replace a one time programmable component due to part obsolescence for mortar proximity fuzes.

FY 2021 Plans:
Block Upgrades: Will conduct engineering tests of enhanced fuze delay mode designs on the M739A1 Point Detonation (PD) fuze for increased safety and improved performance, will conduct laboratory evaluations on the hand grenade fuzes to reduce the number of critical defects that will improve producibility and increase safety, will conduct studies of airburst fuzing technologies for medium and large caliber munitions, and will conduct analysis and laboratory evaluations on mortar training fuzes for increased safety and improved performance.

Analysis / Risk Mitigation: Will conduct engineering tests on the next generation micro-controller to modernize and replace a one-time programmable component for mortar proximity fuzes, will transition prototype replacement electronic transceivers into indirect fire fuzes and generate Engineering Change Proposals (ECPs) to incorporate into the Technical Data Packages (TDPs). Will also conduct analysis on alternative suppliers for critical fuzing components.

FY 2020 to FY 2021 Increase/Decrease Statement:

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Increase in funding due to additional Fuze Technology Integration projects that have been identified for execution.			
Title: Mortar Smoke Development ***Description:*** The initial phase of this project will focus on validating smoke canister and mortar cartridge designs for the 120 millimeter (mm) caliber culminating in a technology demonstration. Qualification, and safety testing will follow to work towards a full Type Classification. The second and third phase of this project will identify similar solutions for the 81mm and 60mm caliber respectively. ***FY 2020 Plans:*** Phase 1 - 120mm qualification and safety testing followed to work towards a full Type Classification. Phase 2 - 81mm caliber design qualification: Activities focused on engineering efforts to identify the formulation percentage of constants that provides effective smoke screening and burn time performance. Analysis of results for smoke performance was conducted to identify the production processes required to provide consistent results during both mixing and pressing operations. Engineering efforts focused on development of a smoke canister design that promoted effective smoke production and screening while being adapted to existing mortar cartridge carrier designs. ***FY 2021 Plans:*** FY 2021 funding will support qualification of HC smoke fill formulation into the 60mm and 81mm smoke families of ammunition. Engineering efforts will identify the formulation percentage of constituents and identify the production processes required to promote effective smoke production that is less toxic and ultimately provides effective smoke screening and burn time performance. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Increase in funding from FY 2020 to FY 2021 due to 60mm and 81mm Hexachloroethane Zinc Oxide (HC) Smoke Mortar qualification and safety testing requirements.	-	1.591	2.627
Title: Conventional Ammunition Range and Reliability Improvements ***Description:*** This project explores possibilities of increasing range, enhancing reliability, and increasing performance of Artillery and Mortar ammunition. This effort supports analysis efforts to identify improvement areas to key parameters. ***FY 2020 Plans:*** Studies and analysis (Key Parameter Development and Management (KPDM) and Model Based Systems Engineering (MBSE)) was conducted. The outcomes of these activities identified areas of possible improvement. ***FY 2020 to FY 2021 Increase/Decrease Statement:***	-	1.123	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Decrease in funding from FY 2020 to FY 2021 due to reduced requirements.			
Title: FY 2020 SBIR/STTR Transfer	-	0.230	-
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	3.227	5.064	4.890

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Fuze Technology Integration (FTI) will improve current production munitions by exploiting existing fuzing technologies and inserting them into current fielded and/or production fuzes, providing safer, more producible, and more lethal fuzing solutions. FTI develops second source suppliers and resolves component obsolescence issues to mitigate risk and prevent production interruptions in order to continue to provide safer, more reliable munitions for the Warfighter with significant risk reduction to production fuzes also benefiting the U.S. Taxpayer. The effort is a continuation of studies, analysis, evaluations, and development of fuzing technologies and safe and arm devices in production and in the field. This program will implement these technologies into fuzing systems to preclude component obsolescence, maximize standardization, enhance performance, and improve the safety and exportability of existing munitions. FTI utilizes both the DoD Ordnance Technology Consortium (DOTC) Other Transaction Agreement (OTA) to produce prototypes of the fuze technologies and devices, and Federal Acquisition Regulation (FAR) based contracts to implement proven efforts into production fuzes.

The Hexachloroethane Zinc Oxide (HC) smoke mortar cartridge project will use existing production process and technologies at Government Owned Government Operated (GOGO) facilities that currently produce 60mm/81mm/120mm smoke and illumination munitions. Crane Army Ammunition Activity (CAAA) Pyro will be responsible for mixing and pressing HC smoke compositions for all testing and development, and CAAA fabrication shop will produce smoke canisters. Pine Bluff Arsenal (PBA) will conduct body load and Load Assemble and Pack (LAP) of all cartridge test samples for qualification and validation testing. All other components will use standard parts currently in inventory or can be purchased through existing component contracts.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER5 / *Indirect Fire and Fuze Technology*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.230		-		-		-	0.000	0.230	-
		Subtotal	-	-		0.230		-		-		-	0.000	0.230	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Fuze Technology Integration Development	MIPR	DoD Ordnance Technology Consortium (DOTC) : Various	1.298	2.161	Oct 2018	0.975	Oct 2019	1.350	Oct 2020	-		1.350	0.000	5.784	-
Mortar Smoke Development	MIPR	Government Owned Government Operated (GOGO) Facilities : Various	0.357	-		0.775	Feb 2020	0.637	Jan 2021	-		0.637	0.000	1.769	-
Conventional Ammunition Range and Lethality Improvements	MIPR	DoD Ordnance Technology Consortium (DOTC) : Various	-	-		0.820	Feb 2020	-		-		-	0.000	0.820	-
		Subtotal	1.655	2.161		2.570		1.987		-		1.987	0.000	8.373	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Fuze Technology Integration Engineering Support	MIPR	Combat Capabilities Development Command Armaments Center (CCDC AC) : Picatinny Arsenal, NJ	2.217	1.066	Oct 2018	1.071	Oct 2019	0.913	Oct 2020	-		0.913	0.000	5.267	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER5 / *Indirect Fire and Fuze Technology*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Mortar Smoke Development Engineering Support	MIPR	Combat Capabilities Development Command Armaments Center (CCDC AC) : Picatinny Arsenal, NJ	0.553	-		0.249	Feb 2020	0.525	Oct 2020	-		0.525	0.000	1.327	-
Mortar Smoke Development Engineering Support	MIPR	Combat Capabilities Development Command Chemical Biological Center (CCDC CBC) : Army Research Laboratory, MD	0.212	-		0.144	Feb 2020	0.175	Nov 2020	-		0.175	0.000	0.531	-
Conventional Ammunition Range and Lethality Improvements	MIPR	Combat Capabilities Development Command Armaments Center (CCDC AC) : Picatinny Arsenal, NJ	-	-		0.329	Feb 2020	-		-		-	0.000	0.329	-
		Subtotal	2.982	1.066		1.793		1.613		-		1.613	0.000	7.454	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Fuze Technology Integration Ballistic Testing	MIPR	Army Test and Evaluation Command (ATEC) : Yuma Proving Ground, AZ	0.100	-		0.074	Mar 2020	-		-		-	0.000	0.174	-
Mortar Smoke Testing	MIPR	Army Test and Evaluation Command (ATEC) : Yuma Proving Ground, AZ	0.199	-		0.397	Feb 2020	1.290	Feb 2021	-		1.290	0.000	1.886	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
		Subtotal	0.299	-		0.471		1.290		-		1.290	0.000	2.060	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	4.936	3.227		5.064		4.890		-		4.890	0.000	18.117	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

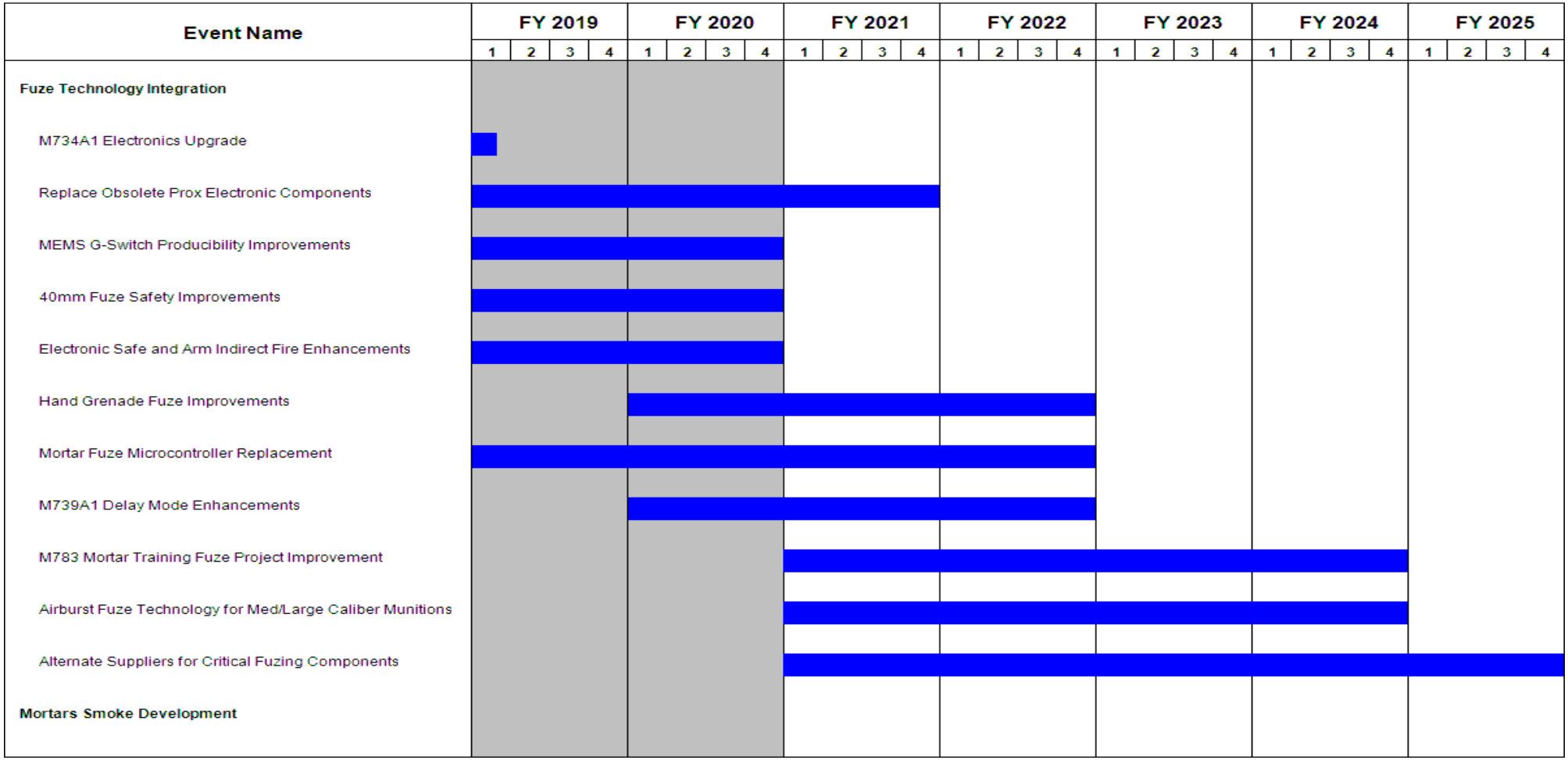

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

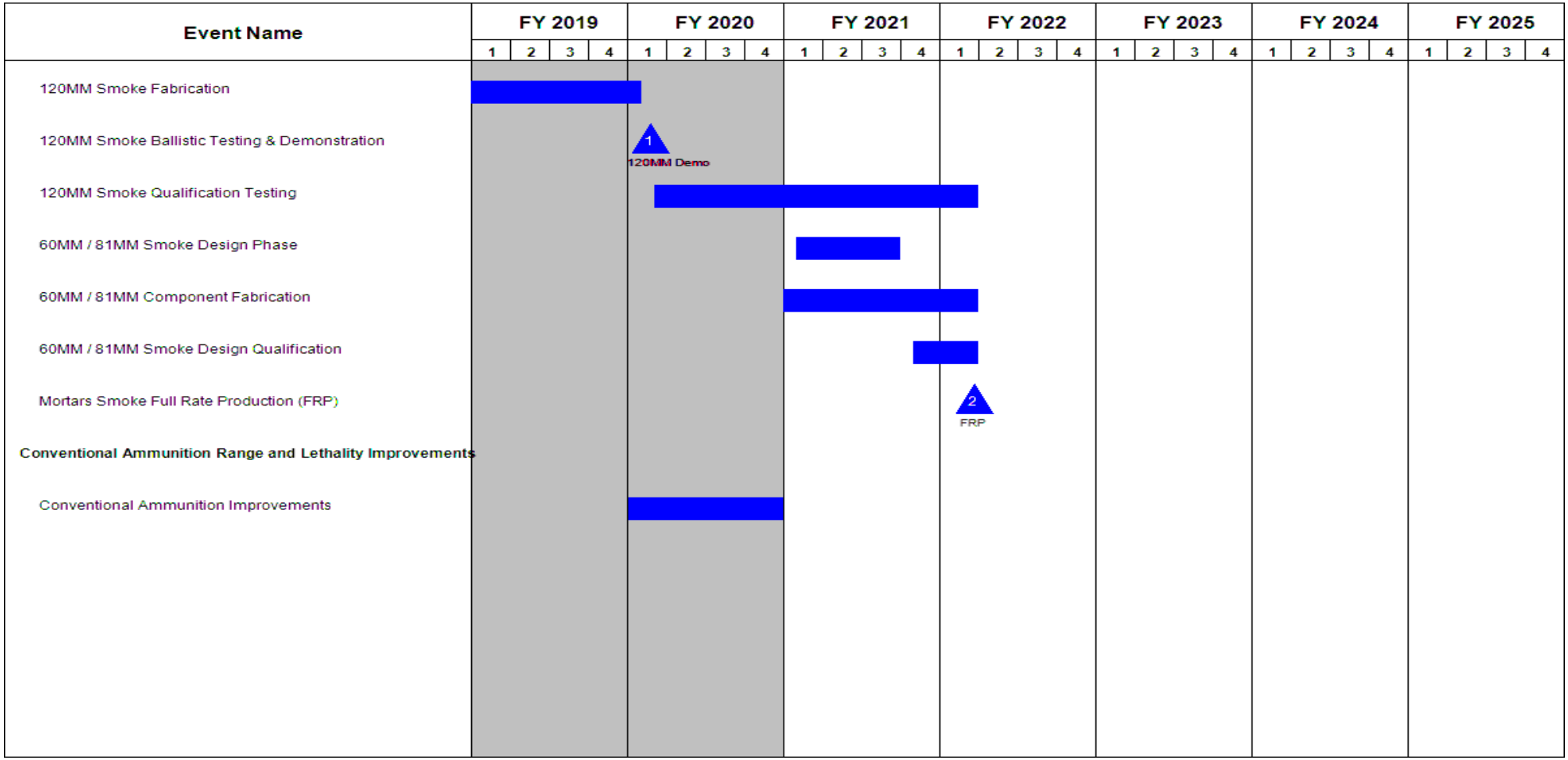

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER5 / *Indirect Fire and Fuze Technology*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
Fuze Technology Integration	1	2016	4	2025
M734A1 Electronics Upgrade	1	2016	1	2019
Replace Obsolete Prox Electronic Components	1	2017	4	2021
MEMS G-Switch Producibility Improvements	1	2018	4	2020
40mm Fuze Safety Improvements	1	2018	4	2020
Electronic Safe and Arm Indirect Fire Enhancements	1	2019	4	2020
Hand Grenade Fuze Improvements	1	2020	4	2022
Mortar Fuze Microcontroller Replacement	1	2019	4	2022
M739A1 Delay Mode Enhancements	1	2020	4	2022
M783 Mortar Training Fuze Project Improvement	1	2021	4	2024
Airburst Fuze Technology for Med/Large Caliber Munitions	1	2021	4	2024
Alternate Suppliers for Critical Fuzing Components	1	2021	4	2025
Mortars Smoke Development	1	2020	4	2023
120MM Smoke Fabrication	3	2018	1	2020
120MM Smoke Ballistic Testing & Demonstration	1	2020	1	2020
120MM Smoke Qualification Testing	1	2020	1	2022
60MM / 81MM Smoke Design Phase	1	2021	3	2021
60MM / 81MM Component Fabrication	1	2021	1	2022
60MM / 81MM Smoke Design Qualification	4	2021	1	2022
Mortars Smoke Full Rate Production (FRP)	1	2022	1	2022
Conventional Ammunition Range and Lethality Improvements	1	2020	4	2022
Conventional Ammunition Improvements	1	2020	4	2020

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER6 / *Direct Fire 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
ER6: *Direct Fire Technology*	-	11.723	8.525	8.755	-	8.755	6.770	6.267	1.998	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Direct Fire Technology funding will be used to support direct fire ammunition from small caliber ammunition, 40 millimeter (mm) grenade, medium caliber cannon ammunition and large caliber ammunition enhancements to lethality, effectiveness, survivability, accuracy and general product improvements. Fiscal Year (FY) 2021 funds support making lethality and safety improvements to 40mm grenades, performing improvements to 30mm ammunition, making a number of improvements to training ammunition, performing improvements to small caliber primers to make the primers more environmentally friendly, and continuing the effort to reduce Soldier load by developing lightweight small caliber ammunition. FY 2021 also includes potential examination and implementation of improvements to 105mm and 120mm tank ammunition.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Lightweight Ammunition	0.512	2.950	3.075
Description: Develop, demonstrate, and qualify a Lightweight Small Caliber Ammunition (LSCA) 7.62mm, 5.56mm, .50 caliber and other caliber capability that will provide an ammunition weight savings of ten to fifty percent to the M2, M240, M4A1, and M249 gunner, assistant gunner, and ammo bearer. ***FY 2020 Plans:*** In FY 2020, the Government down-selected to a single contractor and 7.62mm concept before entering into Phase III. Phase III contractor is optimizing their 7.62mm lightweight cartridge design ahead of Validation Testing (VT) and Limited User Evaluation (LUE). Supported multiple contract awards to develop a Lightweight .50 caliber design ahead of down-selecting to a single design. ***FY 2021 Plans:*** FY 2021 funding will support Phase III development contract to build lightweight 7.62mm ammunition, performing Validation Testing, conducting and Limited User Evaluation (LUE), and accomplishing the Engineering Change Proposal (ECP) in preparation for Low-Rate Initial Production (LRIP). FY 2021 also supports Phase I development efforts for the lightweight .50 Caliber ammunition variant, performing Validation Testing, conducting a Limited User Evaluation, and conducting a Critical Design Review (CDR). ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Planned development costs for both the 7.62mm and .50 caliber lightweight ammunition efforts.			
Title: Lead Free Primer	1.800	1.875	3.062

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Description: Automate and integrate environment friendly lead free primary explosives within the small caliber family of ammunition. Addresses health concerns of lead intake during firing by removing lead styphnate from small caliber primers. Automated pilot line combined with new mix reduces human exposure, improves quality, improves safety and reduces environmental waste in manufacturing process. ***FY 2020 Plans:*** FY 2020 supported completion of 5.56mm green primer Production Qualification Testing (PQT), completed the build and test in support of Pre-Production Qualification Testing (PPQT) for 7.62mm green primer ammunition, and begun the build for .50 Caliber PPQT. ***FY 2021 Plans:*** FY 2021 funding will support the prove out of the prototype manufacturing line for building lead free primers for multiple small caliber ammunition variants and performing Pre Production Qualification Testing (PPQT) activities for the 5.56mm/7.62mm ammunition. Commercial primer testing will also be done to determine extreme temperature sensitivity and overall reliability. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Request increase due to planned qualification testing occurring in FY 2021.			
Title: Support Sniper Ammunition Integration Into Army Standard Sniper Weapons ***Description:*** Modify existing sniper ammunition to support integration into new Army standard sniper weapons. Maintain compatibility with legacy sniper weapons while improving operational availability. ***FY 2020 Plans:*** FY 2020 supported test and evaluate sniper ammunition improvements. ***FY 2021 Plans:*** FY 2021 funding will support evaluating and testing sniper ammunition for potential future improvements. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.	0.500	0.176	0.200
Title: Support Improvements in Direct Fire Propulsion Systems ***Description:*** Improve Direct Fire Propulsion Systems to increase user survivability. ***FY 2020 Plans:***	0.500	0.076	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
FY 2020 supported improvements to address temperature sensitivities of energetics and primer ballistics. Continued exploring technology improvements to reduce muzzle flash and increased precision by reducing dispersion of the M80A1, M118LR, and other sniper compatible ammunition. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No funding planned in FY 2021.			
Title: Improved M789 Lethality, Warhead Fragmentation Improvement ***Description:*** Improve 30mm M789 warhead lethality by performing trade studies and implementing advanced warhead and fuze technologies to promote more efficient fragmentation. ***FY 2020 Plans:*** FY 2020 supported shape charge testing, ballistics testing, and lethality modeling. ***FY 2021 Plans:*** FY 2021 will support the implementation of the improved warhead fragmentation technology into 30mm HEDP M789 or XM1206 30mm M789 with selectable proximity fuze. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No funding planned in FY 2021.	0.650	0.226	0.250
Title: M433 Warhead Improvement ***Description:*** Improve 40mm warhead design to increase fragmentation and aeroballistics in order to improve lethality (fragmentation) and accuracy of the M433 grenade. ***FY 2020 Plans:*** FY 2020 supported the start the pre-production qualification testing to assess safety and performance increases. Integration of dual spin fuze into M433E1 qualification testing. ***FY 2021 Plans:*** FY 2021 will complete the Pre Production Qualification Test (PPQT) and finalize ECP and Type Classification documentation. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.	2.400	0.575	0.600
Title: 20mm C-RAM Ammo Improvement ***Description:*** As per Joint Urgent Operational Needs Statement (JUONS) CC-0562 for enhanced lethality, M940 20mm ammunition requires research and development efforts to increase the lethality effects of the Land-based Phalanx Weapon	0.500	0.126	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
System (LPWS) against larger rocket threats. This effort will increase the current capability of the M940 by incorporating design features to provide improvement to probability of Kill. This effort will also evaluate the effects the new ammunition has on the weapon system barrel wear. ***FY 2020 Plans:*** FY 2020 supported the design and development of an optimized M940 concept and conducted studies and testing to improve barrel wear. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No funding planned in FY 2021.			
Title: Tank Ammunition Improvements ***Description:*** Develop and test potential improvements to 105mm and 120mm gun system ammunition. ***FY 2020 Plans:*** FY 2020 supported various efforts for 105mm and 120mm tank ammunition, including tracer improvements, combustible cartridge case design and fabrication improvements, and cartridge testing for the M68 cannon. Additionally, initial feasibility studies and developmental efforts explored a 105mm Advanced Multipurpose (AMP) cartridge. ***FY 2021 Plans:*** FY 2021 funding will support continuing various 105mm and 120mm tank ammunition improvement efforts, including tracer improvements, combustible cartridge case design and fabrication improvements, and continuing efforts to assess the 105mm Advanced Multipurpose (AMP) cartridge/solution. Evaluate 105mm candidate cartridges, perform warhead lethality studies, modeling and simulation, conduct fuze assessment studies, perform propulsion system evaluation, assess fabrication improvements, and perform integration and testing of tank cartridges. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** FY 2021 increase request due to planned testing of modified 105mm and 120mm ammunition prototypes.	1.700	0.476	0.518
Title: 40mm M576 Improvement Study ***Description:*** 40mm M576 product improvement will provide the warfighter with the ability to quickly defeat closed-in personnel targets ***FY 2020 Plans:*** FY 2020 funding supported exploration of improved candidate designs. ***FY 2020 to FY 2021 Increase/Decrease Statement:***	0.300	0.176	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
No funding planned in FY 2021.			
Title: Single Crystal Tungsten Evaluation ***Description:*** Testing will be conducted to determine the effectiveness of single crystal tungsten penetrators against armored targets. ***FY 2020 Plans:*** FY 2020 funding supported testing and explored improvements to kinetic energy munitions to increase armor penetration effects. ***FY 2021 Plans:*** FY 2021 funding will support continued testing and explore improvements to kinetic energy munitions to increase armor penetration effects. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.	0.600	0.176	0.200
Title: M550 Fuze Improvement ***Description:*** Replace 40mm M550 single stage fuze with a dual spinlock fuze to improve safety and performance reliability. ***FY 2020 Plans:*** FY 2020 funding supported completing and building the quantity required to support qualification testing planned for FY 2021. ***FY 2021 Plans:*** FY 2021 funding will support qualification testing of the 40mm grenades in preparation for implementation of the Engineering Change Proposal (ECP). ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.	0.300	0.276	0.300
Title: Caliber .50 Improvement ***Description:*** Explore options for improvement to current legacy .50 caliber ammunition in response to the .50 caliber Munitions Capabilities Development Document (CDD). ***FY 2020 Plans:*** FY 2020 supported Design Verification Test (DVT) 1 and DVT 2 of enhanced M903, M962, and other .50 caliber rounds as per required in the .50 Caliber Munitions CDD. ***FY 2020 to FY 2021 Increase/Decrease Statement:***	0.561	0.476	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
No funding planned in FY 2021.			
Title: Operation Inherent Resolve for ISIL - JUONS CC-0562 M940 Ammunition ***Description:*** FY 2019 Overseas Contingency Operations request for a Joint Urgent Operational Needs Statement for M940 ammunition.	1.400	-	-
Title: 40mm Airburst Training ***Description:*** Conduct studies and explore options to satisfy 40mm airburst training requirements. ***FY 2020 Plans:*** FY 2020 funding supported conducting a study to explore options that satisfied 40mm airburst training requirements. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No funding planned in FY 2021.	-	0.076	-
Title: 7.62mm Dispersion Improvement ***Description:*** Explore options for dispersion improvement to 7.62mm ammunition, specifically the XM1158 and M80A1, to provide increased lethality to the warfighter. ***FY 2020 Plans:*** FY 2020 funding supported exploration into 7.62mm dispersion improvement methods to provide increased lethality to the warfighter. ***FY 2021 Plans:*** FY 2021 funding will support assessing potential modifications such as design changes and propellant changes to improve the dispersion on 7.62mm ammunition. Funding will also support building prototypes and delivering the prototypes to Government test activities to perform testing. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.	-	0.276	0.300
Title: Handgun Ammunition Enhancements ***Description:*** Modify existing handgun ammunition to increase battlefield effectiveness beyond current capabilities. ***FY 2020 Plans:***	-	0.126	0.150

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
FY 2020 activities supported testing and evaluating new handgun ammunition improvements. ***FY 2021 Plans:*** FY 2021 funding will support testing and evaluating potential improvements to handgun ammunition to achieve an increase in overall lethality and effectiveness. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding increase from FY 2020 to FY 2021 due to economic adjustments.			
Title: Grenade Rifle Entry Munition (GREM) Improvements ***Description:*** Explore improvements to the Grenade Rifle Entry Munition (GREM) in order to increase performance and reliability and reduce costs. ***FY 2020 Plans:*** FY 2020 funding supported conducting studies and performing preliminary tests to increase the performance and reliability of the Grenade Rifle Entry Munition (GREM) system. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No funding planned in FY 2021.	-	0.076	-
Title: 40mm Improvements ***Description:*** Improve training and tactical rounds in the Low and High Velocity family of ammunition. ***FY 2021 Plans:*** FY 2021 funding will support exploring air bursting and other potential improvements to the M430A1 direct fire grenade by conducting assessments and testing of potential solutions to increase the lethal effects of the M430 grenade. Explore improvements to 40mm Day Night Thermal rounds. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Planned costs to conduct assessments in FY 2021.	-	-	0.100
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 to FY 2021 Increase/Decrease Statement:***	-	0.387	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	11.723	8.525	8.755

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The acquisition strategy for small, medium and large caliber product improvements is that all contracts will be full and open competition firm fixed price.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.387		-		-		-	0.000	0.387	-
		Subtotal	-	-		0.387		-		-		-	0.000	0.387	N/A

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Manager Maneuver Ammunition Systems (PM MAS)	Various	Picatinny Arsenal : New Jersey	-	0.110	Dec 2018	0.055	Dec 2019	0.110	Dec 2020	-		0.110	0.000	0.275	-
M433 Warhead Improvement - Contract 1	C/FFP	Amtec Corporation : Janesville, WI	-	0.820	Sep 2019	-		-		-		-	0.000	0.820	-
M789 Enhanced Lethality - Contract 1	C/FFP	General Dynamics : Marion, Virginia	-	0.350	Apr 2019	-		-		-		-	0.000	0.350	-
Lightweight Ammunition - Contract 1	C/FFP	To Be Determined : To Be Determined	-	-		1.545	Mar 2020	2.000	Mar 2021	-		2.000	Continuing	Continuing	Continuing
Green Primer - Contract 1	C/FFP	Innovative Materials & Processes (IMP), LLC : Rapid City, South Dakota	-	-		0.160	Feb 2020	-		-		-	0.000	0.160	-
Green Primer - Contract 2	C/FFP	TBD : TBD	-	-		0.245	Mar 2020	0.900	Mar 2021	-		0.900	Continuing	Continuing	Continuing
Green Primer - Contract 3	C/FFP	Frankilin Engineering Group : Nashville, Tennessee	-	0.200	Sep 2019	-		-		-		-	0.000	0.200	-
JUONS CC-0562 M940 Ammunition - Contract 1	C/FFP	General Dynamics Ordnance and Tactical Systems (GS OTS) : St. Petersburg, Florida	-	1.500	Aug 2019	-		-		-		-	0.000	1.500	-
Single Crystal Tungsten Penetrators - Contract 1	Option/ CPFF	Savit Corporation : Rockaway, New Jersey	-	0.020	Jul 2019	-		-		-		-	0.000	0.020	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
M550 Fuze Development - Contract 1	C/FFP	AMTEC CORPORATION : Janesville, WI	-	0.020	Sep 2019	-		-		-		-	0.000	0.020	-
Tank Ammunition Improvement Contract	TBD	To Be Determined : To Be Determined	-	-		-		0.600	Mar 2021	-		0.600	Continuing	Continuing	Continuing
		Subtotal	-	3.020		2.005		3.610		-		3.610	Continuing	Continuing	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CCDC Armaments Center Support	MIPR	CCDC Armaments Center : Picatinny Arsenal, New Jersey	-	4.314	Nov 2018	3.409	Nov 2019	3.145	Nov 2020	-		3.145	Continuing	Continuing	Continuing
JUONS CC-0562 M940 Ammunition Support ARL	MIPR	CCDC Army Research Lab : Aberdeen, Maryland	-	0.050	Jan 2019	-		-		-		-	0.000	0.050	-
JUONS CC-0562 M940 Ammunition Support AC	MIPR	CCDC Armaments Center : Picatinny Arsenal, New Jersey	-	0.712	Jan 2019	-		-		-		-	0.000	0.712	-
Lightweight Ammunition Demil Assesment	MIPR	Tooele Army Depot : Tooele, Utah	-	0.080	Jul 2019	-		-		-		-	0.000	0.080	-
		Subtotal	-	5.156		3.409		3.145		-		3.145	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Army Research Lab (ARL)	MIPR	CCDC Army Research Lab (ARL) : Aberdeen, Maryland	-	0.585	Jan 2019	0.845	Jan 2020	0.900	Jan 2021	-		0.900	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607131A / *Weapons and Munitions Product Improvement Programs*	Project (Number/Name) ER6 / *Direct Fire Technology*	

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Aberdeen Test Center (ATC)	MIPR	Aberdeen Test Center (ATC) : Aberdeen, Maryland	-	1.965	Jan 2019	1.879	Jan 2020	1.100	Jan 2021	-		1.100	Continuing	Continuing	Continuing
JUONS CC-0562 M940 Ammunition Testing	MIPR	CCDC Aviation & Missle Center : Redstone Arsenal, Alabama	-	0.847	Jan 2019	-		-		-		-	0.000	0.847	-
Lightweight Ammunition - User Evaluaton	MIPR	Maneuver Battle Lab : Fort Benning, Georgia	-	0.150	Jul 2019	-		-		-		-	0.000	0.150	-
		Subtotal	-	3.547		2.724		2.000		-		2.000	Continuing	Continuing	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	-	11.723		8.525		8.755		-		8.755	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

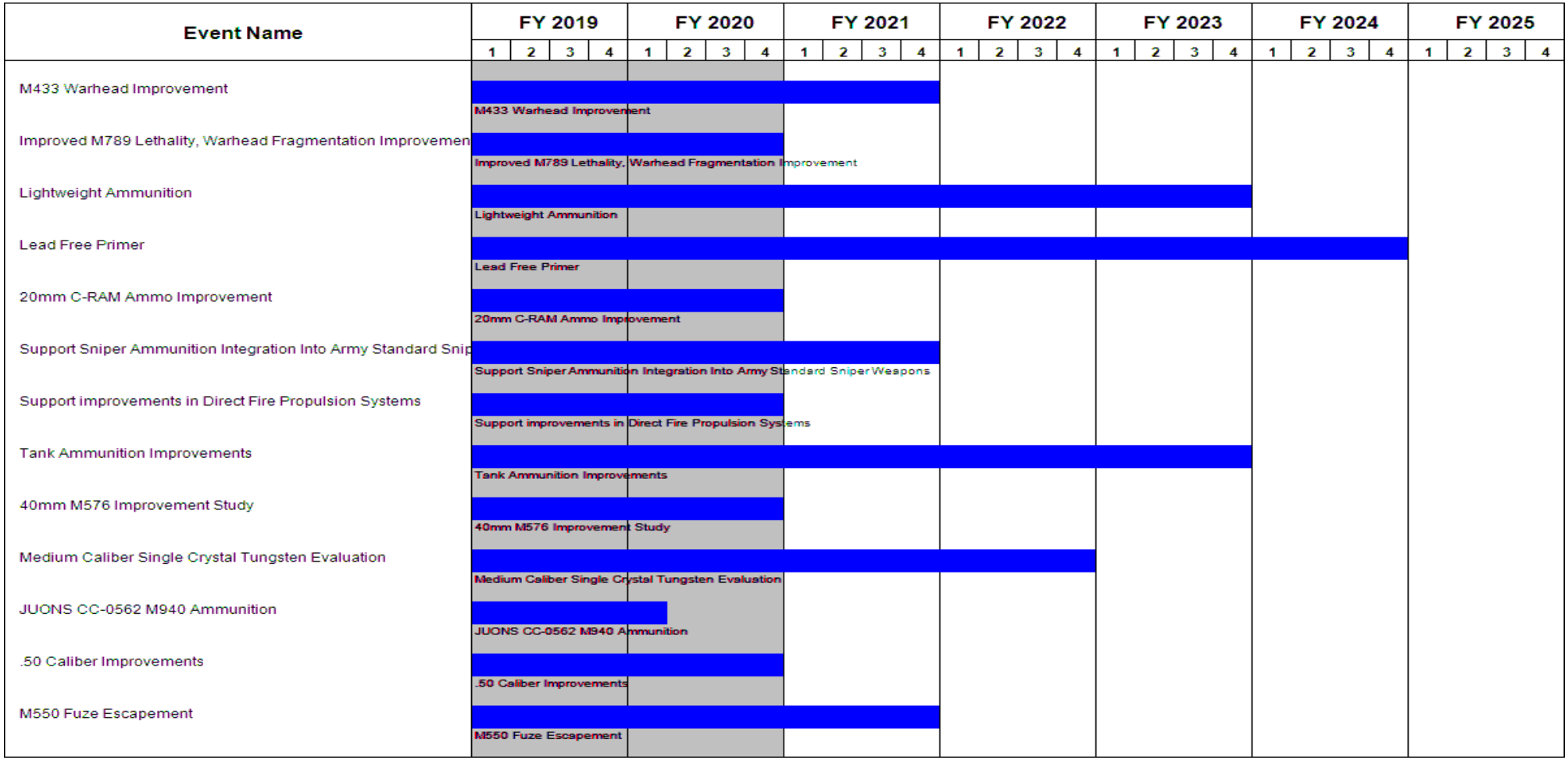

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

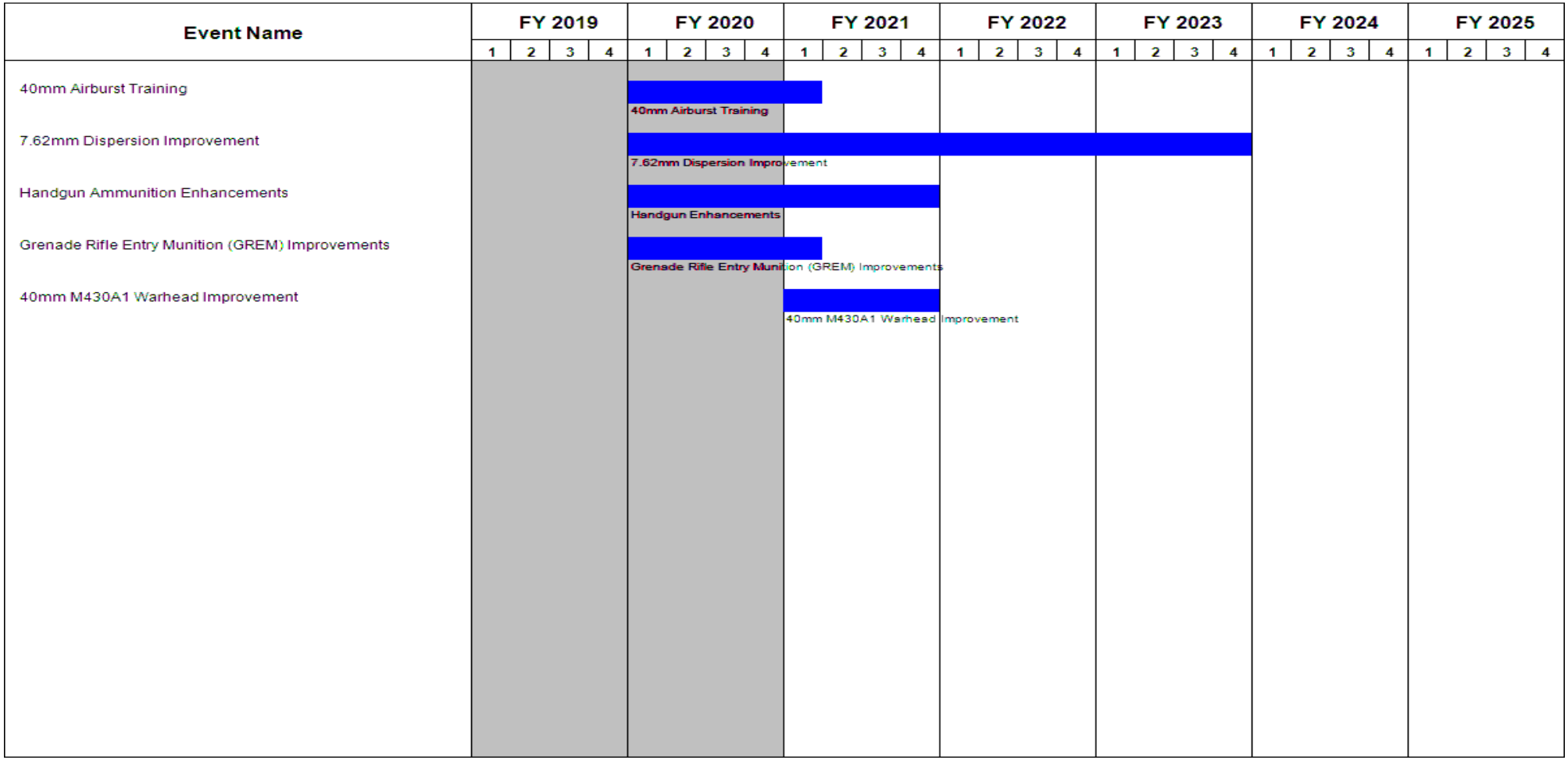

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 7	**R-1 Program Element (Number/Name)** PE 0607131A / *Weapons and Munitions Product Improvement Programs*	**Project (Number/Name)** ER6 / *Direct Fire Technology*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
M433 Warhead Improvement	1	2015	4	2021
Improved M789 Lethality, Warhead Fragmentation Improvement	1	2015	4	2020
Lightweight Ammunition	1	2015	4	2023
Lead Free Primer	1	2015	4	2024
20mm C-RAM Ammo Improvement	1	2017	4	2020
Support Sniper Ammunition Integration Into Army Standard Sniper Weapons	1	2017	4	2021
Support improvements in Direct Fire Propulsion Systems	1	2017	4	2020
Tank Ammunition Improvements	1	2018	4	2023
40mm M576 Improvement Study	1	2018	4	2020
Medium Caliber Single Crystal Tungsten Evaluation	1	2018	4	2022
JUONS CC-0562 M940 Ammunition	1	2019	1	2020
.50 Caliber Improvements	1	2019	4	2020
M550 Fuze Escapement	1	2019	4	2021
40mm Airburst Training	1	2020	1	2021
7.62mm Dispersion Improvement	1	2020	4	2023
Handgun Ammunition Enhancements	1	2020	4	2021
Grenade Rifle Entry Munition (GREM) Improvements	1	2020	1	2021
40mm M430A1 Warhead Improvement	1	2021	4	2021