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Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army										Date: March 2019		
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 1: Basic Research					R-1 Program Element (Number/Name) PE 0601101A / In-House Laboratory Independent Research							
COST (\$ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	-	11.783	11.579	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
91A: ILIR-AMC	-	10.867	10.620	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
F16: ILIR-SMDC	-	0.916	0.959	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is realigned with continuity of effort to the following:

? PE 0601102A Defense Research Sciences

A. Mission Description and Budget Item Justification

This PE supports basic research at the Army laboratories through the In-House Laboratory Independent Research (ILIR) program. Basic research lays the foundation for future developmental efforts by identifying fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The ILIR program serves as a catalyst for major technology breakthroughs by providing laboratory directors flexibility in implementing novel research ideas, by nurturing promising young scientists and engineers, and is used to attract and retain top doctoral degreed scientists and engineers. The ILIR program also provides a source of competitive funds for peer reviewed efforts at Army laboratories to stimulate high quality, innovative research with significant opportunity for payoff to Army warfighting capability.

This PE supports ILIR at the Army Futures Command's six Research, Development, and Engineering Centers (Project 91A), and at the United States (US) Space and Missile Defense Command (SMDC) (Project F16).

Work in the PE provides a foundation for applied research initiatives at the Army laboratories and research, development and engineering centers.

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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Appropriation/Budget Activity		R-1 Program Element (Number/Name)			
2040: Research, Development, Test & Evaluation, Army / BA 1: Basic Research		PE 0601101A / In-House Laboratory Independent Research			
B. Program Change Summary (\$ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	12.010	11.585	11.779	-	11.779
Current President's Budget	11.783	11.579	0.000	-	0.000
Total Adjustments	-0.227	-0.006	-11.779	-	-11.779
• Congressional General Reductions	-0.005	-0.006			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.222	-			
• Adjustments to Budget Years	-	-	-11.779	-	-11.779
Change Summary Explanation					
FY20 reduction related to Science and Technology financial restructuring.					

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Appropriation/Budget Activity 2040 / 1					R-1 Program Element (Number/Name) PE 0601101A / <i>In-House Laboratory Independent Research</i>				Project (Number/Name) 91A / <i>ILIR-AMC</i>			
COST (\$ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
91A: <i>ILIR-AMC</i>	-	10.867	10.620	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
Program Element (PE) 0601102A Defense Research Sciences
* Project AA1 ILIR - AMC

A. Mission Description and Budget Item Justification

This Project funds basic research within the Army Materiel Command's (AMC) Research, Development, and Engineering Centers (RDECs) and lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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

	FY 2018	FY 2019	FY 2020
Title: Edgewood Chemical Biological Center	1.071	0.955	-
Description: Funds basic research in chemistry, biology, biotechnology, and aerosol for countering improvised explosive devices (IEDs), obscurants, and/or target defeat. Work in this Project provides theoretical underpinnings for PE 0602622A (Chemical, Smoke, and Equipment Defeating Technologies).			
FY 2019 Plans: Conduct fundamental research in hierarchical systems through selective deposition and growth of metal-organic frameworks; synthetic biology focuses on understanding genetic drift, mutation rates, as well as the structure function relationships of proteins; and extend physical and mathematical investigations into aerosol particle charge behaviors that will help develop knowledge on their behavior during deposition into the atmosphere as well as in the respiratory tract.			
FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.			
Title: Armaments Research, Development and Engineering Center	1.386	1.409	-
Description: Funds basic research in weapons component development, explosives synthesis/detection and area denial. Work in this Project provides theoretical underpinnings for PE 0602307A (Advanced Weapons Technology).			
FY 2019 Plans:			

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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601101A / <i>In-House Laboratory Independent Research</i>	Project (Number/Name) 91A / <i>ILIR-AMC</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019
Continue to conduct basic research that provides the underpinnings necessary for developing new explosives and propellants, smaller and more lethal warheads, lighter and stronger composite materials for guns and weapon platforms, algorithms for future intelligent munitions, and area denial technologies.			
FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.			
Title: Tank-Automotive Research, Development and Engineering Center		1.277	1.208
Description: Funds basic research in ground vehicle technologies to include power, mobility, and unmanned systems. Work in this Project provides theoretical underpinnings for PE 0602601A (Combat Vehicle and Automotive Technology).			-
FY 2019 Plans: Solicit research proposals to improve understanding and accelerate technology development focused on those topics of strategic importance to the Army ground vehicle community such as; semi-, fully-, and multiple autonomous vehicle operation and control, ground vehicle cybersecurity threat detection algorithms and resilience, lightweight materials and dissimilar material joining for thick section materials, advanced energy storage materials, corrosion modeling, and early detection mechanisms, and electrophoretic displays.			
FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.			
Title: Natick Soldier Research, Development, and Engineering Center		1.125	1.102
Description: Funds basic research in food sciences, textiles, and lightweight materials with potential for individual protection. Work in this Project provides theoretical underpinnings for PE 0601102A (Defense Research Sciences), Project H52 (Equipment for the Soldier).			-
FY 2019 Plans: Combine theoretical and experimental studies to investigate point contact antenna response to infrared/visible laser beams and understand photon-assisted tunneling (PAT), conductance, and rectification to advance future capability of lightweight, tunable visible/infrared Soldier borne power harvesting systems. Explore creating liquid crystals with tunable melting points and establish an understanding of the phases, and phase transitions of liquid crystals when confined in polymer matrices to enable future development of lightweight "smart" textiles that can efficiently respond to external stimuli.			
FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.			
Title: Aviation and Missile Research, Development and Engineering Center: Missile Efforts		2.388	2.302
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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>Description: Funds basic research in guided missile and rocket systems, directed energy weapons, unmanned vehicles, and related components. Work in this Project provides theoretical underpinnings for PE 0602303A (Missile Technology).</p> <p>FY 2019 Plans: Investigate optimal signal detection using mutual information to improve radar performance; explore the connection between nonlinear dynamics and communication theory to engineer chaotic oscillators in wireless datalinks, radar, and acoustic sensor devices; design hybrid nano-antennas based on nested and nearly overlapping plasmonic resonant modes for enhanced sensing, detection, energy harvesting, and nanoscale light manipulation; explore effects of low pressure collision broadening and interatomic forces for atom-based inertial navigation sensors; investigate linear and nonlinear optical materials with dielectric constant near zero for accurate clocks used for Global Positioning System (GPS) and inertial navigation.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.</p>				
<p>Title: Aviation and Missile Research, Development and Engineering Center: Aviation Efforts</p> <p>Description: Funds basic research for aviation enabling technologies in the areas of aerodynamics, structural dynamics, and material science. Work in this Project provides theoretical underpinnings for PE 0602211A (Aviation Technology).</p> <p>FY 2019 Plans: Conduct research on measurement techniques such as a hub-based camera system for rotor blade deformation measurements, microelectromechanical systems based sensors for unsteady airfoil pressure gradient measurements, and tomographic particle image velocimetry for volumetric flow measurements; conduct research on parallel-in-time computational fluid dynamics algorithms to realize the computation speed benefits of emerging peta-scale computer architecture.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.</p>		1.380	1.313	-
<p>Title: Communications-Electronics Research, Development, and Engineering Center</p> <p>Description: Funds basic research for communication and network enabling technologies in the areas of antenna design, network management, power generation and storage, and sensors. Work in this Project provides theoretical underpinnings for PE 0602705A (Electronics and Electronic Devices).</p> <p>FY 2019 Plans: Conduct research on techniques for reducing the computational complexity and burden associated with massive multiple input ? multiple output antenna arrays; will research the mathematical relationship between the electric permittivity, magnetic permeability</p>		2.240	2.143	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019
<p>and thickness of the metamaterial in a conformal antenna; research energy harvesting which has a net zero or net positive effect on the metabolic rate by only harvesting energy during certain stages of the gait cycle; research deep learning algorithms and confidence-based likelihoods associated with classification decisions; innovate and create new integrable material solutions to enable smaller, lower cost phase shifters and tunable filters for use in radar, electronic warfare and communications systems; research phase shifting diode networks to use with 2-dimensional planar phased array with integrated antennas that operate at 60GHz ~ 1 THz; and research material parameters and device models for high fidelity simulation of III-V and II-VI optoelectronics.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project 91A will move to PE 0601102A Defense Research Sciences / Project AA1 ILIR - AMC in FY20.</p>			
<p>Title: FY 2019 SBIR / STTR Transfer</p> <p>Description: FY 2019 SBIR / STTR Transfer</p> <p>FY 2019 Plans: FY 2019 SBIR / STTR Transfer</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 SBIR / STTR Transfer</p>		-	0.188
Accomplishments/Planned Programs Subtotals		10.867	10.620
C. Other Program Funding Summary (\$ in Millions)			
N/A			
Remarks			
D. Acquisition Strategy			
N/A			
E. Performance Metrics			
N/A			

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COST (\$ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
F16: <i>ILIR-SMDC</i>	-	0.916	0.959	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
Program Element (PE) 0601102A Defense Research Sciences
* Project AA2 ILIR - SMDC

A. Mission Description and Budget Item Justification

This Project provides In-house Laboratory Independent Research (ILIR) at the United States (US) Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT). This basic research on lasers and directed energy lays the foundation for future developmental efforts on high energy lasers and directed energy systems by identifying the fundamental principles governing various directed energy phenomena.

Work in this Project is related to, and fully coordinated with, efforts in PE 0602307A (Advanced Weapons Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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

	FY 2018	FY 2019	FY 2020
Title: SMDC In-house Laboratory Independent Research	0.916	0.959	-
Description: Funds basic research to investigate laser propagation phenomenology for application in modeling and simulation and future directed energy weapons design. Activities in this Project transition to High Energy Laser Technology in PE 0602307A (Advanced Weapons Technology).			
FY 2019 Plans: Complete data analysis and verification of engineering models to understand the viability of increasing the power to 10?s of watts for a diode pumped Xenon gas laser; investigate a laboratory bench top experiment of a direct diode concept to combine 10?s of diode sources into a single laser beam at the milli-watt level to understand key laser metrics and begin to evaluate scalability of the approach to watt class; and complete investigation of the beaconless adaptive optics approach for correcting a high energy laser beam (greater than 10kW) for propagation in the presence of particulates beyond 1km.			
FY 2019 to FY 2020 Increase/Decrease Statement: PE 0601101A Project F16 will move to PE 0601102A Defense Research Sciences / Project AA2 ILIR - SMDC in FY20.			
Accomplishments/Planned Programs Subtotals	0.916	0.959	-

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C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		
E. Performance Metrics N/A		