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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 5: System Development & Demonstration (SDD) | | | | | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | | | | | | | |
|---|--------------------|----------------|----------------|---------------------|--|----------------------|----------------|----------------|----------------|----------------|-------------------------|-------------------|
| 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 | - | 43.762 | 27.439 | 17.294 | - | 17.294 | 20.026 | 12.420 | 13.738 | 14.597 | Continuing | Continuing |
| L86: <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> | - | 2.051 | 4.189 | 4.913 | - | 4.913 | 5.379 | 3.459 | 4.288 | 4.557 | Continuing | Continuing |
| L87: <i>Hypervelocity Armament System (HAS)</i> | - | 34.562 | 17.595 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 52.157 |
| L88: <i>Enhanced AN/TPQ 36</i> | - | 7.149 | 5.655 | 12.381 | - | 12.381 | 14.647 | 8.961 | 9.450 | 10.040 | Continuing | Continuing |

A. Mission Description and Budget Item Justification

This program funds design, development and test of primary target acquisition and counterfire radars to automatically detect, locate and classify hostile indirect fire weapons (mortars, artillery, and rockets). The program directly supports the prioritization, tracking and locating of targets, and dissemination of that information for simultaneous attack of multiple threats. It provides the Warfighter with continuous and responsive counterfire target acquisition systems for all types and phases of military operations. Project L86, Lightweight Counter Mortar Radar (LCMR), version AN/TPQ-50 provides 360 degrees of azimuth coverage from ranges of 500 meters to 10 kilometers. The AN/TPQ-50 and AN/TPQ-53 radars are currently fielded to multiple Continental United States (CONUS) and Outside Continental United States (OCOUS) locations to include operational support to Operation Inherent Resolve (OIR) and Operation Freedom's Sentinel (OFS). Project L88, AN/TPQ-53 is a highly mobile radar system that leverages the latest in technology design to accelerate technology infusion and increase range while improving false location rate, reducing obsolescence and increasing reliability. The AN/TPQ-53 provides a system with increased range and accuracy throughout a 90 degree search sector (stare mode) as well as 360 degree coverage (rotating) for locating mortar, artillery and rocket firing positions.

This program line also funds development of an integrated Hypervelocity Armament System (HAS), and associated technologies as they mature to support accelerated demonstration and transition of advanced gun weapon systems, command guided maneuverable projectiles, and tactical sensors. The development of HAS would include advancing artillery powder guns firing Hypervelocity Projectiles (HVPs), resulting in next-generation, common, low drag, guided cannon artillery projectiles capable of completing multiple missions with improved cost effectiveness across different gun systems. Integration with a fire control radar and sensor array will allow closed-loop targeting of moving and relocatable targets beyond the range of conventional artillery.

The Fiscal Year FY 2020 Base funding in the amount of \$17.294 million will support ongoing AN/TPQ-53 test efforts and Army interoperability certifications (AICs), AN/TPQ-50 and AN/TPQ-53 development and testing of modernization efforts for electronic protection and new and emerging threats as well as the performance of technical assessments, engineering studies, risk reduction and required documentation.

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| Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army | | | | Date: March 2019 | |
|---|---------|-----------------------------------|--------------|------------------|---------------|
| Appropriation/Budget Activity | | R-1 Program Element (Number/Name) | | | |
| 2040: Research, Development, Test & Evaluation, Army / BA 5: System Development & Demonstration (SDD) | | PE 0604823A / Firefinder | | | |
| B. Program Change Summary (\$ in Millions) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
| Previous President's Budget | 45.605 | 45.473 | 48.745 | - | 48.745 |
| Current President's Budget | 43.762 | 27.439 | 17.294 | - | 17.294 |
| Total Adjustments | -1.843 | -18.034 | -31.451 | - | -31.451 |
| • Congressional General Reductions | -0.037 | -0.034 | | | |
| • Congressional Directed Reductions | - | -18.000 | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.028 | - | | | |
| • SBIR/STTR Transfer | -1.778 | - | | | |
| • Adjustments to Budget Years | - | - | -31.451 | - | -31.451 |
| Change Summary Explanation | | | | | |
| FY 2020 Adjustment to Budget Year reflects a decrease of \$31.451M for the Hypervelocity Armament System. | | | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | | | | | | | | | Date: March 2019 | | |
|---|-------------|---------|---------|--------------|--|---------------|---------|---------|---|------------------|------------------|------------|
| Appropriation/Budget Activity 2040 / 5 | | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | | Project (Number/Name) L86 / <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</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 |
| L86: <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> | - | 2.051 | 4.189 | 4.913 | - | 4.913 | 5.379 | 3.459 | 4.288 | 4.557 | Continuing | Continuing |
| Quantity of RDT&E Articles | - | - | - | - | - | - | - | - | - | - | | |

A. Mission Description and Budget Item Justification

The AN/TPQ-50 Lightweight Counter Mortar Radar (LCMR) is a highly mobile radar that automatically detects, classifies, tracks, and locates the point of origin of projectiles fired from mortar, artillery, and rocket systems with sufficient accuracy for first round fire for effect. It mitigates close combat radar coverage gaps by providing 360 degrees of azimuth coverage from ranges of 500 meters to 10 kilometers and is capable of being deployed in two configurations, standalone or vehicle mounted. The AN/TPQ-50 system interoperates with mission command systems to provide the maneuver commander increased counterfire radar flexibility. The AN/TPQ-50 is deployed as part of the Counter-Rocket, Artillery, Mortar (C-RAM) system of systems. It provides data to the Forward Area Air Defense Command and Control (FAAD C2) node for the sense and warn force protection capability. The AN/TPQ-50 is currently fielded to multiple Continental United States (CONUS) and Outside Continental United States (OCONUS) locations to include support to Operation Inherent Resolve (OIR) and Operation Freedom's Sentinel (OFS).

The fiscal year (FY) 2020 Research, Development, Test and Evaluation (RDTE) funds of \$4.913 million will continue the work required to enhance the AN/TPQ-50's capability to address electronic protection against cyber electromagnetic activity (CEMA) and other known, new, emerging and evolving threats identified in the Validated Online Lifecycle Threat (VOLT) report. This funding enables the program to develop and integrate sensor protect capabilities into the software baseline, develop advanced protection techniques which take advantage of hardware upgrades, and develop documentation for hardware and software capability improvements. Funding supports all associated testing costs and program support.

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

| | FY 2018 | FY 2019 | FY 2020 |
|---|---------|---------|---------|
| Title: Modernization & Emerging Threats | 2.051 | 4.036 | 4.913 |
| Description: Program modernization effort which completes the development of hardware kits and develops advanced electronic protection techniques via software to combat CEMA. This effort funds the development of capabilities to address vulnerabilities identified in the bi-annual release of the VOLT report and changes on the battlefield due to new tactics, techniques, procedures (TTPs) and/or areas of operation. | | | |
| FY 2019 Plans: Continue the work required to enhance the AN/TPQ-50's capability to address electronic protection against CEMA and other known, new, emerging and evolving threats identified in the VOLT. In addition, it integrates developed capabilities into the baseline, develops documentation for hardware and software capability improvements. Funding supports all associated testing costs and program support. | | | |
| FY 2020 Plans: | | | |

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|---|----------------|----------------|-------------------------------|---|--------------------------------|----------------|--|----------------|----------------|-----------------------------------|-------------------|
| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | | | | | | Date: March 2019 | | | | |
| Appropriation/Budget Activity 2040 / 5 | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | Project (Number/Name) L86 / <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> | | | | |
| B. Accomplishments/Planned Programs (\$ in Millions) | | | | | | | FY 2018 | FY 2019 | FY 2020 | | |
| Funding enables the continuation of work required to enhance the AN/TPQ-50's capability to address electronic protection against cyber electromagnetic activity (CEMA) and other known, new, emerging and evolving threats identified in the Validated Online Lifecycle Threat (VOLT) report. In addition, it integrates developed capabilities into the baseline, develops documentation for hardware and software capability improvements, and includes operational assessments for capability improvements. Funding supports all associated testing costs and program support. These efforts are executed by the LCMR program. | | | | | | | | | | | |
| FY 2019 to FY 2020 Increase/Decrease Statement: The increase in funding from FY 2019 to FY 2020 covers increased modernization development scope and additional testing required to release new software and address capability improvements. | | | | | | | | | | | |
| Title: Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Description: FY 2019 SBIR/STTR transfer | | | | | | | - | 0.153 | - | | |
| FY 2019 Plans: FY 2019 SBIR/STTR transfer | | | | | | | | | | | |
| FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 SBIR/STTR transfer | | | | | | | | | | | |
| Accomplishments/Planned Programs Subtotals | | | | | | | 2.051 | 4.189 | 4.913 | | |
| C. Other Program Funding Summary (\$ in Millions) | | | | | | | | | | | |
| <u>Line Item</u> | <u>FY 2018</u> | <u>FY 2019</u> | <u>FY 2020</u> <u>Base</u> | <u>FY 2020</u> <u>OCO</u> | <u>FY 2020</u> <u>Total</u> | <u>FY 2021</u> | <u>FY 2022</u> | <u>FY 2023</u> | <u>FY 2024</u> | <u>Cost To</u> <u>Complete</u> | <u>Total Cost</u> |
| • B05201: <i>Lightweight Counter Mortar Radar</i> | 17.080 | 6.107 | 5.400 | - | 5.400 | 5.500 | 8.326 | 7.380 | 10.072 | Continuing | Continuing |
| Remarks | | | | | | | | | | | |
| D. Acquisition Strategy | | | | | | | | | | | |
| The AN/TPQ-50 Lightweight Counter Mortar Radar was developed in 2009 to meet Training and Doctrine Command (TRADOC) Capabilities Production Document (CPD) requirements. A favorable full rate production (FRP) decision was achieved on 21 June 2013. The AN/TPQ-50 is currently in full rate production; 400 systems have been procured to complete the program's current AAO requirement. | | | | | | | | | | | |
| Research, Development, Test and Evaluation (RDT&E) funding supports modernization development task orders under the national maintenance contract (NMC). The efforts extend through the current Program Objective Memorandum (POM) period. | | | | | | | | | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | Date: March 2019 |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | Project (Number/Name) L86 / <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> |
| <p>The fiscal year (FY) 2020 RDTE funds of \$4.913 million continues the work required to enhance the AN/TPQ-50's capability to address electronic protection against CEMA and other known, new, emerging and evolving threats identified in the VOLT report. This effort develops and integrates sensor protect capabilities into the software baseline, develop advanced protection techniques which take advantage of hardware upgrades, and develops documentation for hardware and software capability improvements. Funding supports all associated testing costs and program support.</p> <p><u>E. Performance Metrics</u> N/A</p> | | |

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Army | | | | | | | | | | | | Date: March 2019 | | | |
|---|------------------------|--------------------------------|-------------|---------|------------|--|------------|--------------|------------|---|------------|------------------|------------------|------------|--------------------------|
| Appropriation/Budget Activity 2040 / 5 | | | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | | Project (Number/Name) L86 / <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> | | | | | |
| Management Services (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Program Management (Government Support) | Various | Various : Activities | 1.582 | - | | 0.376 | Mar 2019 | 0.569 | Nov 2019 | - | | 0.569 | Continuing | Continuing | Continuing |
| Program Management (Contractor Support) | C/CPFF | Various : APG, MD | 0.564 | 0.363 | Mar 2018 | - | | - | | - | | - | Continuing | Continuing | Continuing |
| Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) | TBD | Various : Various | - | - | | 0.153 | Dec 2018 | - | | - | | - | 0.000 | 0.153 | - |
| Subtotal | | | 2.146 | 0.363 | | 0.529 | | 0.569 | | - | | 0.569 | Continuing | Continuing | N/A |
| Product Development (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Electronic Protection | SS/CPFF | Various : Various | 2.330 | - | | - | | - | | - | | - | 0.000 | 2.330 | 1.410 |
| Modernization & New and Emerging Threats | SS/CPFF | Various : Various | 2.473 | 1.375 | Nov 2017 | 2.447 | May 2019 | 2.819 | Nov 2019 | - | | 2.819 | Continuing | Continuing | Continuing |
| Subtotal | | | 4.803 | 1.375 | | 2.447 | | 2.819 | | - | | 2.819 | Continuing | Continuing | N/A |
| Test and Evaluation (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Test Support (Government) | Various | Various : Activities | 4.871 | 0.313 | Jul 2018 | 1.213 | Aug 2019 | 1.525 | Nov 2019 | - | | 1.525 | Continuing | Continuing | Continuing |
| Subtotal | | | 4.871 | 0.313 | | 1.213 | | 1.525 | | - | | 1.525 | Continuing | Continuing | N/A |
| | | | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
| Project Cost Totals | | | 11.820 | 2.051 | | 4.189 | | 4.913 | | - | | 4.913 | Continuing | Continuing | N/A |
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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Army | | | | | | | Date: March 2019 | | | |
| Appropriation/Budget Activity 2040 / 5 | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | Project (Number/Name) L86 / <i>LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)</i> | | | |
| | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract | |
| Remarks | | | | | | | | | | |

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PE 0604823A: *Firefinder*
Army

R-1 Line #138

R-1 Program Element (Number/Name)
PE 0604823A / *Firefinder*

Project (Number/Name)
L86 / LIGHTWEIGHT COUNTER MORTAR
RADAR (LCMR)

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| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Army | | Date: March 2019 |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | Project (Number/Name) L86 / LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR) |

Schedule Details

| Events | Start | | End | |
|--|---------|------|---------|------|
| | Quarter | Year | Quarter | Year |
| Electronic Protection | 3 | 2016 | 4 | 2017 |
| Modernization & New and Emerging Threats | 3 | 2016 | 4 | 2024 |
| Government Test | 3 | 2017 | 4 | 2024 |

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|---|-------------|---------|---------|--------------|---|---------------|---------|---------|--|------------------|------------------|------------|
| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | | | | | | | | | Date: March 2019 | | |
| Appropriation/Budget Activity 2040 / 5 | | | | | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | | | | Project (Number/Name) L87 / Hypervelocity Armament System (HAS) | | | |
| 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 |
| L87: Hypervelocity Armament System (HAS) | - | 34.562 | 17.595 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 52.157 |
| Quantity of RDT&E Articles | - | - | - | - | - | - | - | - | - | - | | |
| A. Mission Description and Budget Item Justification | | | | | | | | | | | | |
| Project L87 The Hypervelocity Armament System (HAS) and associated technologies are composed of advanced gun weapon systems, command guided maneuverable projectiles, and tactical sensors. The development of HAS would include advancing artillery powder guns firing Hypervelocity Projectiles (HVPs), resulting in a next generation, common, low drag, guided cannon artillery projectiles capable of completing multiple missions with improved cost effectiveness. Integration with a fire control radar and sensor array will allow closed-loop targeting of moving and relocatable targets beyond the range of conventional artillery. | | | | | | | | | | | | |
| B. Accomplishments/Planned Programs (\$ in Millions) | | | | | | | | | | FY 2018 | FY 2019 | FY 2020 |
| Title: Hypervelocity Armament System (HAS) (RDECOM) | | | | | | | | | | 34.562 | - | - |
| Description: The Hypervelocity Armament System (HAS) will integrate advanced artillery gun systems firing HVPs with closed loop fire control sensors to engage high value moving targets beyond common artillery ranges. | | | | | | | | | | | | |
| Title: Development | | | | | | | | | | - | 11.200 | - |
| Description: Funding is provided for all development efforts on Hypervelocity Armament System (HAS) technology transitions. | | | | | | | | | | | | |
| FY 2019 Plans: Finalize initial incremental technology transition requirements and specifications, contract requirements package development and begin execution of contracts and development. Continue support for system evaluation, requirement/specification work, integration development and test plans, prototyping, and developmental testing for the Hypervelocity Armament System to include projectile, sensor arrays and radars, launch platforms, fire control software and tracking to verify and validate performance against high value threats at greatly increased ranges. | | | | | | | | | | | | |
| FY 2019 to FY 2020 Increase/Decrease Statement: FY 2020 funding has been adjusted to support the Army's modernization priorities. | | | | | | | | | | | | |
| Title: Program Management | | | | | | | | | | - | 5.173 | - |
| Description: Funding is provided for all program management efforts on Hypervelocity Armament System (HAS). | | | | | | | | | | | | |
| FY 2019 Plans: | | | | | | | | | | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | Date: March 2019 | |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | Project (Number/Name) L87 / <i>Hypervelocity Armament System (HAS)</i> | |

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|--|----------------|----------------|----------------|
| B. Accomplishments/Planned Programs (\$ in Millions) | FY 2018 | FY 2019 | FY 2020 |
| Begin the development for all required documents, office staff and engineering Integrated Product Team (IPT) development. | | | |
| <i>FY 2019 to FY 2020 Increase/Decrease Statement:</i> FY 2020 funding has been adjusted to support the Army's modernization priorities. | | | |
| <i>Title:</i> Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) <i>Description:</i> FY 2019 SBIR/STTR transfer <i>FY 2019 Plans:</i> FY 2019 SBIR/STTR transfer <i>FY 2019 to FY 2020 Increase/Decrease Statement:</i> FY 2019 SBIR/STTR transfer | - | 1.222 | - |
| Accomplishments/Planned Programs Subtotals | 34.562 | 17.595 | - |

| | |
|---|--|
| C. Other Program Funding Summary (\$ in Millions) | |
| N/A | |
| Remarks | |
| D. Acquisition Strategy The Army will leverage Strategic Capabilities Office (SCO) prototypes and technologies to continue transition from the FY 2018 program into programs of record. The Army is transitioning prototype articles from the SCO demonstration to develop advanced gun systems, command guided maneuverable projectiles, and fire control sensors capable of engaging tactical range targets. Emerging requirements include communication suite changes, munitions updates, and introduction of new munitions require software and/or hardware updates to ensure full compatibility and maintain operational viability. | |
| E. Performance Metrics N/A | |

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Army | | | | | | | | | | | | | Date: March 2019 | | |
| Appropriation/Budget Activity 2040 / 5 | | | | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | | Project (Number/Name) L87 / <i>Hypervelocity Armament System (HAS)</i> | | | | |
| Product Development (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| HAS Product Development | C/Various | TBD : TBD | - | 34.562 | | 11.212 | | - | | - | | - | 0.000 | 45.774 | - |
| Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) | TBD | Various : Various | - | - | | 1.222 | Dec 2018 | - | | - | | - | 0.000 | 1.222 | - |
| Subtotal | | | - | 34.562 | | 12.434 | | - | | - | | - | 0.000 | 46.996 | N/A |
| Support (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Program Management | MIPR | PM/PEO : VARIOUS | - | - | | 5.161 | | - | | - | | - | 0.000 | 5.161 | - |
| Subtotal | | | - | - | | 5.161 | | - | | - | | - | 0.000 | 5.161 | N/A |
| | | | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
| Project Cost Totals | | | - | 34.562 | | 17.595 | | - | | - | | - | 0.000 | 52.157 | N/A |
| Remarks | | | | | | | | | | | | | | | |

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Exhibit R-4, RDT&E Schedule Profile: PB 2020 Army

Date: March 2019

Appropriation/Budget Activity

2040 / 5

R-1 Program Element (Number/Name)

PE 0604823A / Firefinder

| Project (Number/Name) | Start Date | End Date | Duration (Days) | Team Lead | Status | Progress (%) | Budget (USD) | Actual Cost (USD) | Variance (USD) | Risk Level | Notes |
|-----------------------|------------|------------|-----------------|-----------|-------------|--------------|--------------|-------------------|----------------|------------|------------------------------|
| 101/Alpha | 2023-01-15 | 2023-03-10 | 55 | J. Doe | Completed | 100 | 120000 | 118000 | 2000 | Low | Exceeded budget by 2000. |
| 102/Beta | 2023-02-01 | 2023-04-15 | 74 | A. Smith | In Progress | 75 | 150000 | 155000 | -5000 | Medium | Minor budget overrun. |
| 103/Gamma | 2023-03-01 | 2023-05-20 | 79 | M. Chen | On Hold | 20 | 180000 | 180000 | 0 | High | Waiting for client approval. |
| 104/Delta | 2023-04-01 | 2023-06-10 | 70 | S. Kim | Planned | 0 | 90000 | 90000 | 0 | Low | Initial planning phase. |
| 105/Epsilon | 2023-05-01 | 2023-07-15 | 75 | L. Garcia | Not Started | 0 | 110000 | 110000 | 0 | Medium | Resource allocation pending. |

L87 / Hypervelocity Armament System (HAS)

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| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Army | | Date: March 2019 |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | Project (Number/Name) L87 / Hypervelocity Armament System (HAS) |

Schedule Details

| Events | Start | | End | |
|---|---------|------|---------|------|
| | Quarter | Year | Quarter | Year |
| Hypervelocity Armament System Development | 1 | 2018 | 4 | 2019 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | | | | | | | | | Date: March 2019 | | |
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| Appropriation/Budget Activity 2040 / 5 | | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | | Project (Number/Name) L88 / <i>Enhanced AN/TPQ 36</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 |
| L88: <i>Enhanced AN/TPQ 36</i> | - | 7.149 | 5.655 | 12.381 | - | 12.381 | 14.647 | 8.961 | 9.450 | 10.040 | Continuing | Continuing |
| Quantity of RDT&E Articles | - | - | - | - | - | - | - | - | - | - | | |

A. Mission Description and Budget Item Justification

The AN/TPQ-53 Counterfire Target Acquisition Radar System is a highly mobile radar set that automatically detects, classifies, tracks, and locates the point of origin of projectiles fired from mortar, artillery, and rocket systems with sufficient accuracy for first round fire for effect. It mitigates close combat radar coverage gaps by providing a 90 degree search sector (stare mode) as well as 360 degree coverage (rotating) and will replace the current AN/TPQ-36 and AN/TPQ-37 Firefinder Radars. The AN/TPQ-53 system interoperates with mission command systems to provide the maneuver commander increased counterfire radar flexibility. The AN/TPQ-53 is deployed as part of the Counter-Rocket, Artillery, Mortar (C-RAM) system of systems. It provides data to the Forward Area Air Defense Command and Control (FAAD C2) node for the sense and warn force protection capability. The AN/TPQ-53 currently supports contingency operations to include Operation Inherent Resolve (OIR) and is fielded to Brigade Combat Teams (BCTs), Field Artillery Brigades (FABs) and Division Artilleries (DIVARTYs).

The FY 2020 funds of \$12.381 million supports ongoing test efforts, continued extended range development and testing, Army interoperability certifications (AICs), testing of modernization efforts for electronic protection and emerging threats as well as the performance of technical assessments, engineering studies, risk reduction and required documentation.

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

| | FY 2018 | FY 2019 | FY 2020 |
|---|----------------|----------------|----------------|
| Title: Test support | 2.414 | 3.189 | 4.250 |
| Description: Funding supports testing efforts and associated Program Management Office (PMO) requirements. | | | |
| FY 2019 Plans: Test activities include engineering and customer testing, Army interoperability certification (AIC) testing, a network vulnerability and penetration assessment, electronic protection testing, as well as associated PMO and test support costs. | | | |
| FY 2020 Plans: Conduct engineering and customer testing, Army interoperability certification (AIC) testing, a network vulnerability and penetration assessment, and electronic protection testing. Funds include associated PMO and test support costs. Funds will be executed by the Enhanced AN/TPQ-36 program. | | | |
| FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 funds redirected to support extended range development. FY 2019 - FY 2020 increase due to concurrent development and testing of multiple software builds. | | | |
| Title: Electronic Protection and Emerging Threats | 1.060 | 0.171 | 2.269 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | Date: March 2019 | | |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | Project (Number/Name) L88 / Enhanced AN/TPQ 36 | | |
| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2018 | FY 2019 | FY 2020 |
| <p>Description: The effort improves spectrum management and mitigates electromagnetic interference (EMI) from commercial and military bands. This effort also develops and improves radar signal data processor electronic protection algorithms which counter electronic threats. Additionally, this effort funds the development of capabilities to address emerging threats identified in the bi-annual release of the System Threat Assessment Report (STAR)/Validated Online Lifecycle Threat (VOLT) report and changes on the battlefield due to new adversarial tactics, techniques, and procedures (TTPs) and/or areas of operation.</p> <p>FY 2019 Plans: Conduct a live fire test demonstrating enhanced electronic protection algorithms against surrogate threats.</p> <p>FY 2020 Plans: Develop additional electronic protection techniques to mitigate cyber electromagnetic activity (CEMA). Continue development of capabilities to address emerging threats identified in the biannual release of the VOLT, changes in the battlefield and areas of operations. Implement tools and TTPs to allow the radar to operate more efficiently in the presence of electromagnetic interference (EMI). Funding supports associated developmental testing and program support. Funds will be executed by the Enhanced AN/TPQ-36 program.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 funds were redirected to address increased test scope. Development efforts for electronic protection and emerging threats resume in FY 2020.</p> | | | | |
| <p>Title: Extended Range</p> <p>Description: Funding supports the development, integration, and testing of an extended range capability supporting the Army Chief of Staff's number one modernization priority of Long-Range Precision Fires.</p> <p>FY 2019 Plans: Funds support the development, integration and testing of an extended range prototype capability. Funds also support the updates to systems engineering and design documentation.</p> <p>FY 2020 Plans: Will conduct regression and live fire testing of the extended range capability. Implement design and software changes based on results from testing performed in an operationally representative environment. Integrate a proven extended range capability into the program's software baseline and conduct initial integration testing. These funds will be executed by the Enhanced AN/TPQ-36 program.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2020 funds increase to continue the development of extended range software and supports initial integration testing.</p> | | 3.675 | 2.087 | 5.862 |
| Title: Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) | | - | 0.208 | - |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | | | | | | Date: March 2019 | | | |
| Appropriation/Budget Activity 2040 / 5 | | | | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | | | Project (Number/Name) L88 / <i>Enhanced AN/TPQ 36</i> | | | |

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|--|----------------|----------------|----------------|
| B. Accomplishments/Planned Programs (\$ in Millions) | FY 2018 | FY 2019 | FY 2020 |
| Description: FY 2019 SBIR/STTR transfer | | | |
| FY 2019 Plans: FY 2019 SBIR/STTR transfer | | | |
| FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 SBIR/STTR transfer | | | |
| Accomplishments/Planned Programs Subtotals | 7.149 | 5.655 | 12.381 |

| | | | | | | | | | | | |
|--|----------------|----------------|-------------------------|------------------------|--------------------------|----------------|----------------|----------------|----------------|-----------------------------|-------------------|
| C. Other Program Funding Summary (\$ in Millions) | | | | | | | | | | | |
| | 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 |
| • B05310: <i>AN/TPQ-53 Counterfire Target Acquisition Radar</i> | 400.530 | 324.150 | 16.416 | - | 16.416 | 10.267 | 12.175 | 30.239 | 42.312 | Continuing | Continuing |
| Remarks | | | | | | | | | | | |
| D. Acquisition Strategy | | | | | | | | | | | |
| <p>The AN/TPQ-53 leverages technology developed in the multi-mission radar advanced technology objective (ATO) program. In 2006, the Government awarded a contract following full and open competition for the design of the AN/TPQ-53 radar and the purchase of four non-recurring engineering (NRE) radars. Twelve additional quick reaction capability (QRC) radars were purchased under the same contract in response to an urgent directed procurement in July 2008. The Milestone Decision Authority (MDA) approved the acquisition of up to 20 more QRC radars. Twenty systems were procured through two separate contract actions in 2010 and 2011. A competitive production contract for Low Rate Initial Production (LRIP) systems was awarded in 2012 and options for additional systems were awarded in 2013, 2014, and 2015. Production and delivery of all QRC/Initial Production (IP) systems are complete, and production of LRIP systems is ongoing. A Full Rate Production (FRP) decision was obtained in December 2015. The FRP contract to fill the remainder of the Army Acquisition Objective (AAO) was awarded in March 2017. Additionally, all initial production systems will be retrofitted to the FRP configuration. The AAO was increased from 174 to 189 systems in May 2017; 174 systems have been procured to date. FRP system deliveries continue through FY 2021. The system replaces all of the AN/TPQ-36 and AN/TPQ-37 systems in the fleet.</p> <p>RDT&E funding supports modernization development and extended range software development task orders under the existing FRP contract. The efforts extend through the current Program Objective Memorandum (POM) period.</p> <p>The FY 2020 funds of \$12.381 million supports ongoing test efforts, continued extended range development and testing, Army interoperability certifications (AICs), testing of modernization efforts for electronic protection and emerging threats as well as the performance of technical assessments, engineering studies, risk reduction and required documentation.</p> | | | | | | | | | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2020 Army | | Date: March 2019 |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | Project (Number/Name) L88 / <i>Enhanced AN/TPQ 36</i> |
| E. Performance Metrics N/A | | |

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Army | | | | | | | | | | | | Date: March 2019 | | | |
|---|------------------------|--------------------------------|-------------|---------|------------|---|------------|-----------------|------------|---|------------|------------------|------------------|------------|--------------------------|
| Appropriation/Budget Activity 2040 / 5 | | | | | | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | | | | Project (Number/Name) L88 / Enhanced AN/TPQ 36 | | | | | |
| Management Services (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Program Management (Government) | Various | Various : Various | 1.587 | 0.566 | Apr 2018 | 0.417 | Nov 2018 | 1.117 | Oct 2019 | - | | 1.117 | Continuing | Continuing | Continuing |
| Program Management (Contractor) | Various | Various : APG, MD | 3.969 | 0.405 | May 2018 | 0.125 | May 2019 | 0.129 | May 2020 | - | | 0.129 | Continuing | Continuing | Continuing |
| Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) | TBD | Various : Various | - | - | | 0.208 | Dec 2018 | - | | - | | - | Continuing | Continuing | Continuing |
| Subtotal | | | 5.556 | 0.971 | | 0.750 | | 1.246 | | - | | 1.246 | Continuing | Continuing | N/A |
| Product Development (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Electronic Protection and Emerging Threats | SS/FPIF | Lockheed Martin : Syracuse, NY | 5.680 | 1.060 | Mar 2018 | 0.171 | Dec 2018 | 2.269 | Oct 2019 | - | | 2.269 | Continuing | Continuing | Continuing |
| High Clutter Environment | SS/CPFF | Lockheed Martin : Syracuse, NY | 10.340 | - | | - | | - | | - | | - | 0.000 | 10.340 | - |
| Low Quadrant Elevation (QE) Shots | SS/CPFF | Lockheed Martin : Syracuse, NY | 4.865 | - | | - | | - | | - | | - | 0.000 | 4.865 | - |
| Extended Range | SS/FPIF | Lockheed Martin : Syracuse, NY | - | 3.675 | Sep 2018 | 2.087 | Jan 2019 | 5.862 | Oct 2019 | - | | 5.862 | Continuing | Continuing | Continuing |
| Signal Data Processor (SDP) | SS/CPFF | Lockheed Martin : Syracuse, NY | 1.992 | - | | - | | - | | - | | - | 0.000 | 1.992 | - |
| Global Positioning System (GPS) Military Code (M-Code) | SS/CPFF | Lockheed Martin : Syracuse, NY | 1.411 | - | | - | | - | | - | | - | Continuing | Continuing | Continuing |
| Wireless Communication Upgrade | SS/CPFF | Lockheed Martin : Syracuse, NY | 1.942 | - | | - | | - | | - | | - | 0.000 | 1.942 | - |
| Subtotal | | | 26.230 | 4.735 | | 2.258 | | 8.131 | | - | | 8.131 | Continuing | Continuing | N/A |
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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Army | | | | | | | | | | | | Date: March 2019 | | | |
| Appropriation/Budget Activity 2040 / 5 | | | | | | R-1 Program Element (Number/Name) PE 0604823A / Firefinder | | | | Project (Number/Name) L88 / Enhanced AN/TPQ 36 | | | | | |
| Support (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Program Support | SS/CPFF | Georgia Tech Research Institute (GTRI) : Atlanta, GA | 0.996 | 0.365 | Mar 2018 | 0.300 | Mar 2019 | 0.300 | Mar 2020 | - | | 0.300 | Continuing | Continuing | Continuing |
| Subtotal | | | 0.996 | 0.365 | | 0.300 | | 0.300 | | - | | 0.300 | Continuing | Continuing | N/A |
| Test and Evaluation (\$ in Millions) | | | | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Test Support | Various | Various : Activities | 52.806 | 1.078 | Nov 2017 | 2.347 | Jan 2019 | 2.704 | Oct 2019 | - | | 2.704 | Continuing | Continuing | Continuing |
| Subtotal | | | 52.806 | 1.078 | | 2.347 | | 2.704 | | - | | 2.704 | Continuing | Continuing | N/A |
| | | | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
| Project Cost Totals | | | 85.588 | 7.149 | | 5.655 | | 12.381 | | - | | 12.381 | Continuing | Continuing | N/A |
| Remarks | | | | | | | | | | | | | | | |

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| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Army | | | | | | | | | | Date: March 2019 | | | |
| Appropriation/Budget Activity | | | | | R-1 Program Element (Number/Name) | | | | | Project (Number/Name) | | | |
| 2040 / 5 | | | | | PE 0604823A / Firefinder | | | | | L88 / Enhanced AN/TPQ 36 | | | |

| Event Name | FY 2018 | | | | FY 2019 | | | | FY 2020 | | | | FY 2021 | | | | FY 2022 | | | | FY 2023 | | | | FY 2024 | | | |
|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Test Support | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Electronic Protection (EP) and Emerging Threats | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EP and Emerging Threats | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Extended Range | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Army | | | Date: March 2019 |
| Appropriation/Budget Activity 2040 / 5 | R-1 Program Element (Number/Name) PE 0604823A / <i>Firefinder</i> | Project (Number/Name) L88 / <i>Enhanced AN/TPQ 36</i> | |

Schedule Details

| Events | Start | | End | |
|---|---------|------|---------|------|
| | Quarter | Year | Quarter | Year |
| Test Support | 1 | 2016 | 4 | 2024 |
| Electronic Protection (EP) and Emerging Threats | 1 | 2016 | 2 | 2019 |
| EP and Emerging Threats | 1 | 2020 | 4 | 2024 |
| Extended Range | 4 | 2018 | 4 | 2021 |