| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602211A *I AVIATION TECHNOLOGY* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | - | 46.828 | 55.586 | 63.433 | - | 63.433 | 57.290 | 66.288 | 66.255 | 68.995 | - | - |
| 47A: *AERON & ACFT Wpns Tech* | - | 41.627 | 48.786 | 55.409 | - | 55.409 | 48.729 | 56.473 | 55.759 | 58.230 | - | - |
| 47B: *Veh Prop & Struct Tech* | - | 5.201 | 6.800 | 8.024 | - | 8.024 | 8.561 | 9.815 | 10.496 | 10.765 | - | - |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY13 funding decreased to accomodate Congressional Undistributed Reductions (-112 thousand), SBIR/STTR transfers (-602 thousand) and Sequestration reductions (-4065 thousand)
FY15 funding increased for Degraded Visual Environment, Rotorcraft Transmission, the National Rotorcraft Technology Center, and system design efforts.

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

This program element (PE) conducts air vehicle component design, fabrication and evaluation to enable Army aviation transformation. Emphasis is on developing aviation platform technologies to enhance manned and unmanned air vehicle combat and combat support operations for attack, reconnaissance, air assault, survivability, logistics and command and control missions. Project 47A researches and evaluates components and subsystems for air vehicles in the areas of aviation and aircraft weapons technology. Project 47B researches and evaluates components and subsystems for air vehicles in the areas of propulsion and structures. Focus areas include: engines & drive trains; rotors & vehicle management systems; platform design & structures; aircraft & occupant survivability; aircraft weapons & sensors; maintainability & sustainability; and unmanned & optionally manned systems. This PE supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia.

Work in this PE contributes to the Army Science and Technology (S&T) air systems portfolio and is fully coordinated with efforts in PE 0603003A (Aviation-Advanced Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602303A (Missile Technology) and PE 0603710A (Night Vision Advanced Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy.
Work in this PE is performed by the U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC), located at Redstone Arsenal, AL; Joint Base Langley Eustis, VA; NASA Ames Research Center, Moffett Field, CA; NASA Langley Research Center, Hampton, VA; and at the U.S. Army Research Laboratory (ARL), located at Adelphi, MD; Aberdeen Proving Ground, MD; Hampton, VA; and Cleveland, OH.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602211A / *AVIATION TECHNOLOGY* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 51.607 | 55.615 | 57.280 | - | 57.280 |
| Current President's Budget | 46.828 | 55.586 | 63.433 | - | 63.433 |
| Total Adjustments | -4.779 | -0.029 | 6.153 | - | 6.153 |
| • Congressional General Reductions | -0.112 | -0.029 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.602 | - | | | |
| • Adjustments to Budget Years | - | - | 6.153 | - | 6.153 |
| • Sequestration | -4.065 | - | - | - | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>2040 / 2 | R-1 Program Element (Number/Name)<br>PE 0602211A / *AVIATION TECHNOLOGY* | Project (Number/Name)<br>47A / *AERON & ACFT Wpns Tech* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47A: *AERON & ACFT Wpns Tech* | - | 41.627 | 48.786 | 55.409 | - | 55.409 | 48.729 | 56.473 | 55.759 | 58.230 | - | - |

# The FY 2015 OCO Request will be submitted at a later date.

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

This project designs and evaluates technologies for Army/Department of Defense (DoD) vertical lift and unmanned air systems to increase strategic and tactical mobility/deployability, improve combat effectiveness, increase aircraft and crew survivability; and improve combat sustainability. Areas of research address desired characteristics applicable to all aviation platforms, such as enhanced rotor efficiencies, improved survivability, increased structure and airframe capability, improved engine performance, improved sustainability, improved mission avionics performance, and reduced cost. This project supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia. This project leverages work accomplished in collaboration with the National Aeronautics and Space Administration (NASA). Technologies within this project transition to advanced technology development programs with application to future, as well as current, Army/DoD aircraft systems.

Work in this project is fully coordinated with PE 0603003A (Aviation Advanced Technology) and work in this project related to aircraft weapons integration is also fully coordinated with PE 0602624A (Weapons and Munitions Technology), PE 0602303A (Missile Technology), and PE 0603710A (Night Vision Advanced Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy.

Work in this project is performed by the Aviation Development Directorate of the U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC), (located at the NASA Ames Research Center, Moffett Field, CA, NASA Langley Research Center, Hampton, VA; and Joint Base Langley Eustis, VA).

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** National Rotorcraft Technology Center (NRTC) | 1.000 | 3.064 | 5.071 |
| ***Description:*** The goal of the NRTC is to focus government, U.S. rotorcraft industry and academia resources on pre-competitive, high priority, military focused technology development to maintain U.S. preeminence in rotorcraft capabilities. | | | |
| ***FY 2013 Accomplishments:***<br>Conducted test of tail rotor in icing tunnel to provide data for validation; initiated testing on composite structures and investigated severe pull-up maneuvers using high-fidelity computational fluid dynamic/structural analyses for UH-60. | | | |
| ***FY 2014 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Develop modeling tools to determine lubricated/loss-of-lube gear performance; develop measurable criteria for repairable gear tooth damage and standardized repair methods; and execute extensive correlation efforts for time-accurate, analytic coupling methods for model-scale rotors in hover and full scale rotors in forward flight.<br>***FY 2015 Plans:***<br>Will develop industry accepted criteria and repair methods for lightly damaged gear tooth repair, enhance understanding of surface finish effect on gear noise; improve fatigue life and stress corrosion cracking mitigation for magnesium castings; and explore laser scanning technology to improve the fidelity and speed of housings and dynamic components inspection techniques. | | | |
| ***Title:*** Rotors & Vehicle Management Technologies<br>***Description:*** Design and investigate advanced airfoil and rotor blade technologies, including active control elements, to support goals of increased hover and cruise efficiency. Design and evaluate advanced flight control and vehicle management component technologies to support goals of increased maneuverability, reliability, and reduced weight and cost.<br>***FY 2013 Accomplishments:***<br>Assessed advanced computational methods for prediction of helicopter main rotor and pylon aerodynamic interaction with fixed tail surfaces; performed post-test computations for an international active twist rotor experiment; continued to analyze rotorcraft configurations for improved performance; completed development of new software that includes the ability to model full vehicle interactional aerodynamics including main-rotor, fuselage and tail-rotor interactions; and initiated flight mechanics modeling and handling qualities criteria development for advanced aircraft configurations.<br>***FY 2014 Plans:***<br>Conduct a sub-scale rotor test to refine current modeling and simulation tools for rotor structural loads; conduct sub-scale experimental studies in drag reduction using active and passive techniques where combined rotor and fuselage flows are complex; analyze rotorcraft configurations for improved performance, including both aerodynamics and structural dynamics; complete new software that includes the ability to model high fidelity simulations of helicopter missile launch; conduct analysis and simulation to evaluate autonomous multi-ship teaming (e.g., twin lift); develop and validate flight simulation models of compound high-speed configurations for handling qualities requirements; and initiate development of flight control architectures for advanced configurations with many control surfaces and widely changing dynamic responses over the flight envelope.<br>***FY 2015 Plans:***<br>Will conduct studies on the highly complex, non-linear, downwash/outwash flow field beneath a sub-scale rotor in hover to refine current physical understanding and non-intrusive diagnostics techniques; improve the accuracy and efficiency of computational software that models full-vehicle rotorcraft aerodynamics on high-performance parallel computers; analyze performance, aerodynamics and structural dynamics for advanced rotorcraft configurations; update Aeronautical Design Standards (ADS-33) to integrate lessons learned from degraded visual environment mitigation and slung load handling qualities measurements into | 8.360 | 8.856 | 8.698 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| new requirements; develop and simulate methods of controlling dual lift configurations; and analyze and simulate flight control concepts for advanced rotorcraft configurations. | | | |
| ***Title:*** Aircraft and Occupant Survivability Technologies<br>***Description:*** Investigate advanced technologies to reduce susceptibility and vulnerability of aircraft to damage from threats or accidents, as well as technologies to defeat small arms, rocket and missile threats.<br>***FY 2013 Accomplishments:***<br>Researched advanced infrared (IR)/signature control materials to counter current and emerging threat sensors; continued investigation of improved materials and airframe structural configurations that provide threat protection against conventional and nonconventional weapons, to include directed energy, blast/overpressure, and high velocity low mass fragments; designed and validated active crash energy management subsystems; and evaluated and validated fuel containment technologies that provide self-sealing capability independent of fuel type.<br>***FY 2014 Plans:***<br>Conduct coupon testing of developed electro-optical (EO)/IR materials for signature control and environmental durability; begin design of advanced systems/subsystems and configurations that provide threat protection against conventional ballistic threats and non-conventional weapons to include directed energy, active crash protection for full spectrum crashworthiness, and crashworthy ballistic tolerant fuel containment systems independent of fuel type.<br>***FY 2015 Plans:***<br>Will complete performance and material analyses of lightweight composite transparent armor system and validate analyses through laboratory test; complete chemical analysis of JP-8 and alternative fuel blends; complete fabrication of test specimens for crashworthy ballistic fuel containment systems, and validate analyses through laboratory tests; leverage flight test in part and full mission simulators to validate performance models of active crash protection system algorithms; complete the development of EO/IR materials, and conduct sub-scale testing of developed EO/IR materials for signature control and environmental durability; investigate preliminary near real-time survivability route planning algorithms; investigate Adaptive IR engine suppressor capability designed to optimize IR signature reduction and aircraft lift and range performance. | 6.149 | 9.917 | 9.382 |
| ***Title:*** Engine and Drives Technologies<br>***Description:*** Design and evaluate advanced turboshaft engine component technologies to support goals of reduced fuel consumption, engine size, weight, and cost, as well as improved reliability and maintainability. Design and evaluate advanced drive system component technologies to support multi-speed transmissions, lighter weight gearboxes, and reduced costs, while improving reliability and maintainability.<br>***FY 2013 Accomplishments:*** | 3.024 | 5.028 | 5.083 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Completed component testing of advanced mechanical systems technology in a dynamic laboratory environment for improved engine performance and structural life; completed fabrication of advanced combustor design for reduced size, weight, and cost; and completed design of advanced power turbine design for improved performance and operational capability.<br>***FY 2014 Plans:***<br>Complete component testing of advanced combustor designs for reduced size, weight, and cost; fabricate an advanced power turbine for improved performance and operational capability; investigate clutch and gear systems to permit multi-speed transmissions required for high speed rotor and prop/rotor operation.<br>***FY 2015 Plans:***<br>Will complete test and evaluation of advanced variable speed power turbine for improved performance and operational capability; complete alternate engine concepts design and analysis effort; perform conceptual design analysis of advanced integrated engine/flight controls with integrated health management for reduced weight/cost and improved reliability/fault detection; design/ fabricate clutches concepts for multi-speed gearbox component testing; develop integral shaft/bearing races to reduce weight in large gearboxes and investigate new high-strength, corrosion resistant materials for drive system applications. | | | |
| ***Title:*** Platform Design & Structures Technologies | 4.932 | 5.377 | 7.493 |
| ***Description:*** Enables new rotorcraft configurations by evaluating critical advanced aviation technologies using design and analysis methods with greater modeling fidelity with an ultimate goal of reducing the timelines associated with overall design of new aircraft. Introduces high fidelity methodology for improved performance and design predictions earlier in the development and acquisition process. Use physics of failure modeling and coupled discipline analysis to drastically improve component and system reliability. Work is coordinated with Aviation Component Failure Modeling efforts in PE 0602211, Project 47B at Army Research Laboratory (ARL).<br>***FY 2013 Accomplishments:***<br>Updated advanced technology representations at the component level for design codes used for joint vertical lift aircraft concept size, weight, and performance estimation; assessed modeling and simulation methods for rotorcraft application, including rotor hubs, airfoils, blades, and interactional aerodynamics of rotors and fuselage with focus on performance improvements; and applied modeling and simulation technologies developed to inform Joint Multi-Role and future aircraft designs.<br>***FY 2014 Plans:***<br>Expand the vehicle design analysis and modeling environment to improve analytic efficiency, including enhanced component weights methodology, incorporation of vehicle cost methodologies, and linkage of design tools to specialized higher fidelity analytic codes.<br>***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Will continue enhancement and refinement of vehicle costing methodologies and analytical efficiencies and accuracy; apply modeling and simulation tools to design and analysis of the Family of Systems (FoS) for Future Vertical Lift (FVL) to support "Zero Maintenance" helicopter concepts; investigate and develop physics of failure modeling to improve reliability of system components, and to enable damage tolerant component design; investigate methods to monitor component loads and integrate with aircraft controls to stay within component failure limits; and investigate modeling and simulation methods to reduce the time required to design and develop new aircraft. | | | |
| ***Title:*** Unmanned and Optionally Manned Technologies<br><br>***Description:*** Design and develop collaboration and cooperation algorithms to support goal of intelligent teaming for manned-unmanned operations. Design and develop advanced unmanned aerial system (UAS) components to support goal of improved small UAS performance. When applicable, technologies in this area are leveraged to support mitigation of degraded visual environments.<br><br>***FY 2013 Accomplishments:***<br>Validated UAS supervisory control techniques from the cockpit for manned-unmanned teaming in high fidelity simulation; and completed UH-60 flight test of symbology sets for degraded visual environment and integrated forward perspective displays for improved flight path and landing precision.<br><br>***FY 2014 Plans:***<br>Complete evaluation of brown-out symbology software (BOSS) in actual brown-out conditions at Yuma Proving Ground for approach-to-landing, hover and take-off flight regimes; and evaluate simulation of BOSS symbology for forward tactical flight regimes; evaluate the use of high priority "plays", or pre-defined UAS operational functions, based on pilot feedback from Manned/ Unmanned-Teaming (MUM-T) simulation studies.<br><br>***FY 2015 Plans:***<br>Will develop optimal human-machine visual, aural, and tactile interfaces for manned-unmanned teaming that supports efficient mission execution and safe flight operations with high situation awareness for pilots and unmanned aerial system operators. Building upon previous sensor and symbology efforts, will design and develop methods to optimally blend forward-looking synthetic and enhanced vision sensor information with cueing symbology that aids the helicopter pilot or operator in control of the helicopter in degraded visual environments; and investigate advanced technologies to increase task and mission effectiveness of unmanned aerial systems when partnered with ground and airborne soldiers, including autonomous behaviors, perception, autonomy architectures, and human aiding. | 3.251 | 5.311 | 6.489 |
| ***Title:*** Aircraft Weapon & Sensor Technologies<br><br>***Description:*** Design and develop innovative approaches for integrating advanced weapons and sensors on aircraft platforms, including smart dispensers, data transfer, and post-launch weapon communication. | 1.509 | 1.624 | 1.613 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>Investigated advanced lethality concepts to include on-the-move fire control for improved hit probability and reduced collateral damage, and applied concepts to inform future system level demonstration.<br>***FY 2014 Plans:***<br>Research and determine applicability of advanced sensor technologies for improved situational awareness; research lightweight remote control weapons turrets to eliminate the need for dual door gunners, and advanced weapons system management algorithms for reconnaissance, attack, and utility aircraft.<br>***FY 2015 Plans:***<br>Will investigate integrated targeting/intelligence, surveillance, and reconnaissance (ISR) sensors and alternative targeting sensors; assess emerging lethal and non-lethal deterrent weapons capabilities for development and aircraft integration; and prepare the lightweight remote control system for follow on testing. | | | |
| ***Title:*** Maintainability & Sustainability Technologies<br>***Description:*** Develop prognostic and system health assessment technologies to enable transition to a condition based maintenance supportability structure.<br>***FY 2013 Accomplishments:***<br>Developed prognostic technologies for predicting and isolating failures within aircraft electrical wiring systems; validated algorithms for engine controls, sensors, and lubrication systems; developed a multi-functional sensor to provide improved bearing prognostics and reduce system weight; and developed and validated a combined crack and corrosion detection sensor for improved accuracy on airframe structural components.<br>***FY 2014 Plans:***<br>Develop technologies to enable lighter weight designs through loads monitoring of critical components; develop multi-use sensors to monitor cracking and delamination in composites as well as crack growth algorithms; develop wireless sensors for on-component processing of part health and usage history; investigate probabilistic failure initiation and progression analysis methods to estimate remaining component life, including improved analysis techniques for metallic and composite rotating and non-rotating structures; investigate methodologies to allow for probability of failure predictions based on vehicle current state and anticipated mission, and develop improved load and usage spectrum characterization techniques; and investigate durable structural concepts including application of high-strain capability designs through advanced design, analysis and/or material solutions, while also considering repairability.<br>***FY 2015 Plans:*** | 3.535 | 3.609 | 3.580 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Will develop embedded multifunctional sensors with built-in processing and communications; develop health assessment systems to support adaptive controls; develop technologies for component self assessment, usage tracking and embedded history; and investigate technologies to provide health monitoring to support and optimize design conservation. | | | |
| ***Title:*** Survivability For Degraded Visual Environment Operations<br><br>***Description:*** Research advanced sensor and cockpit display technologies to provide ability to maintain terrain and obstacle situational awareness during degraded visual environments caused by dust and snow particulates (brown-out & white-out). Work in this area is being done in coordination with efforts at U.S. Army Communications-Electronics Research, Development, and Engineering Center (CERDEC), PE 603710A, Night Vision Advanced Technology.<br><br>***FY 2013 Accomplishments:***<br>Characterized sensor transmission as a function of wavelength, particulate size and volumetric density; defined required spatial resolution for safe pilotage, scan rates for terrain updates, and sensor transmission relative to operational dust and snow volumetric densities; investigated multi-band sensor fusion techniques to enhance performance; and investigated cockpit display technology (heads-up and heads-down) to provide terrain representation to aircrew.<br><br>***FY 2014 Plans:***<br>Execute studies that include simulation, laboratory, ground test, and flight test to determine the parametric relationship between aircraft handling qualities, sensors and cueing to allow safe flight operations in degraded visual environments; define and test required levels of handling qualities, appropriate sensor trade-offs to include active and synthetic fusion, and visual display (symbology) and tactile cueing.<br><br>***FY 2015 Plans:***<br>Will investigate multi-resolution fusion sensor package comprised of a 94 GHz millimeter wave radar, a laser radar (LADAR) and an infrared (IR) camera; will investigate alternative fusion techniques with a different form of LADAR and an IR camera; conduct experiments focused on optimizing the forward flight modernized control laws (MCLAWS) of the UH-60 aircraft in preparation for a planned FY16 NATO capstone flight test; and explore the value of additional cueing techniques such as tactile and aural technologies in the AMRDEC simulation facility at Redstone Arsenal, Alabama. This work will feed a 6.3 Degraded Visual Environment mitigation tech demo effort beginning in FY16. | 9.867 | 6.000 | 8.000 |
| **Accomplishments/Planned Programs Subtotals** | 41.627 | 48.786 | 55.409 |

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

N/A

**Remarks**

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|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47A / *AERON & ACFT Wpns Tech* |

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>2040 / 2 | R-1 Program Element (Number/Name)<br>PE 0602211A / *AVIATION TECHNOLOGY* | Project (Number/Name)<br>47B / *Veh Prop & Struct Tech* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47B: *Veh Prop & Struct Tech* | - | 5.201 | 6.800 | 8.024 | - | 8.024 | 8.561 | 9.815 | 10.496 | 10.765 | - | - |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

Not applicable for this item.

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

This project investigates engine, drive train, and airframe enabling technologies such as multifunctional materials, fluid mechanics and high temperature, high strength, low cost shaft materials.

Work in this project complements and is fully coordinated with PE 0603003A (Aviation Advanced Technology) and leverages basic research performed in PE 0601104/ Project H54 (Micro Autonomous Systems Technology Collaborative Technology Alliance) and PE 0601104/Project H09 (Robotics Collaborative Technology Alliance).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army Research Laboratory (ARL) at the NASA Glenn Research Center, Cleveland, OH, the NASA Langley Research Center, Hampton, VA, and the Aberdeen Proving Ground, MD.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** Rotor and Structure Technology | 1.861 | 2.269 | 2.398 |
| ***Description:*** Devise improved tools and methodologies to more accurately design for improved component reliability and durability, resulting in platforms that are lighter in weight and less costly to acquire and maintain. | | | |
| ***FY 2013 Accomplishments:***<br>Enhanced damage tolerance analysis and analytical methods to support the Army joint multi-role aircraft development; conducted flight studies using an unmanned aircraft vehicle, as a cost effective surrogate for full scale manned and unmanned rotorcraft, equipped with a health and usage monitoring system to assess and validate advanced sensors for prognostics and diagnostics; assessed structural health monitoring methods to optimize sensing strategies for reducing Army maintenance labor; validated a modeling and simulation capability for the study of improved rotor system performance; and investigated nanosecond pulsed plasma actuators for on-blade separated flow control to increase the performance of rotor systems. | | | |
| ***FY 2014 Plans:*** | | | |

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| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47B / *Veh Prop & Struct Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Develop and demonstrate seat damper technology using "smart magnetic material" that will enhance the crash-worthiness of rotorcraft; evaluate the performance of an advanced, structurally-integrated, trailing edge rotor flap for its simplicity of operation and aerodynamic control authority; perform prognostic and diagnostic (P&D) inspection experiments aimed at improving structural risk assessment; develop self sensing strategies to monitor damage precursors; incorporate optimized sensing strategies into P&D systems; commission operation of, and begin data collection on the full scale helicopter landing gear test stand facility; utilize multi-functional structural materials to augment sensing, power and energy storage, or actuation in micro air and ground vehicles; and develop coupled plasma/fluid models and utilize computational models to quantitatively assess potential impacts of plasma on rotor aerodynamic performance; begin experimental studies to determine the potential of nanosecond pulsed plasma discharges for enhancing current and next-gen rotorcraft speed, range, and payload; develop quantitative technology payoff assessment and analysis models; and expand models from first-order relationships to comprehensive codes to allow researchers to understand which technologies are the most critical to achieving future aviation capabilities.<br>***FY 2015 Plans:***<br>Will investigate novel approaches to improve rotorcraft vehicle maintainability; investigate the feasibility of aeroelastic/ aeromechanical stability enhancement of composite rotor blades through novel material concepts; develop wind-tunnel models to study advanced active-control helicopter rotor systems; develop advanced structural dynamics models of rotorcraft fuselage structures;and explore and evaluate plasma discharge based active flow control techniques for rotor dynamic stall alleviation and diffuser augmented rotor systems. | | | |
| ***Title:*** Engine and Drive Train Technology (previously titled Propulsion and Drive Train Technology)<br>***Description:*** Investigate high temperature materials, advanced models for flow physics and improved methods for predicting propulsion system mechanical behavior to increase fuel efficiency and reduce propulsion system weight.<br>***FY 2013 Accomplishments:***<br>Continued to conduct evaluations of the potential for variable speed power turbines to enable efficient operation of gas turbine engines at reduced power operating conditions to enable faster rotorcraft vehicles; and begin characterization the dynamics of a pericyclic variable transmission (PVT) for use in rotorcraft applications to reduce transmission weight.<br>***FY 2014 Plans:***<br>Complete evaluation of the potential for variable speed power turbines to enable efficient operation of gas turbine engines at reduced power operating conditions to enable faster rotorcraft vehicles; and complete dynamic characterization of a PVT.<br>***FY 2015 Plans:***<br>Will evaluate the benefits of advanced technologies such as improved fuel spray, multi-fuel capability, etc., for aviation system engine performance and durability at sea level and simulated altitude conditions; and demonstrate drive train technologies with | 3.340 | 3.931 | 3.126 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47B / *Veh Prop & Struct Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| 50% increase in time-to-scuffing-failure after lubricant supply is terminated in a simulated gear environment and identify promising technologies to achieve +50% oil-out time in support of Next Generation Rotorcraft Transmission objectives. | | | |
| ***Title:*** Micro/Small Scale Unmanned Aerial Systems<br><br>***Description:*** Investigate platform, aerodynamic, actuation, transmission, and control technologies for handheld autonomous Unmanned Aerial Systems (UAS); provide small units with significantly increased tactical mobility and deployability by extending soldier perception to real-time local Intelligence, Surveillance, and Reconnaissance (ISR) with handheld organic assets, and by minimizing the supporting infrastructure needed for deployment.<br><br>***FY 2014 Plans:***<br>Develop and use various levels of model fidelity, including High-Performance Computing (HPC) modeling and simulation, experimentation, and evaluation, to advance and improve the coupled wing-actuator-control system and its components; where component-level investigation includes, but is not limited to, aspects of low speed airfoil design, airfoil turbulence sensitivity analysis, implementation-plausible (at the handheld-scale) flow control, membrane and tendon-like actuation.<br><br>***FY 2015 Plans:***<br>Will transition open loop control strategies employing active aerodynamic or elastic actuation to aircraft form factors for achieving gust and other disturbance rejection capability; incorporate bio-inspired sensors for enhanced state and disturbance awareness, and evaluate technologies addressing the communication and processing needs of size, weight, and power constrained platforms; develop an aeromechanics analysis tool integrating fluid dynamics and structural dynamics solvers; and investigate wing flexibility/ morphing for performance enhancements; and will perform quantitative technology and tradeoff analyses of independent flapping wing control for maneuvering micro aerial vehicles (MAVs). This effort is coordinated with PE 0601104/project H54 (Micro Autonomous Systems Technology Collaborative Technology Alliance). | - | 0.600 | 1.500 |
| ***Title:*** Aviation Component Failure Modeling<br><br>***Description:*** Develop failure analysis and prediction models and techniques to support a "zero maintenance helicopter" concept.<br><br>***FY 2015 Plans:***<br>Will develop and improve failure models to characterize and categorize specific material damage precursors relevant to aviation components; develop a probabilistic framework for predicting remaining useful life of vehicle platforms; investigate the integration of advanced aviation component health monitoring techniques into health-usage monitoring systems (HUMS); and develop self-sensing structural material technologies that incorporate damage precursor detection philosophy. | - | - | 1.000 |
| **Accomplishments/Planned Programs Subtotals** | 5.201 | 6.800 | 8.024 |

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

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Army | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>2040 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602211A / *AVIATION TECHNOLOGY* | **Project (Number/Name)**<br>47B / *Veh Prop & Struct Tech* |

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

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

N/A