| Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification | | | | | | | | | DATE: May 2009 | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | | | | | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | | | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 135.401 | 123.036 | 127.129 | | | | | | Continuing | Continuing |
| 622401: Structures | 36.667 | 37.310 | 44.494 | | | | | | Continuing | Continuing |
| 622403: Flight Controls and Pilot-Vehicle Interface | 40.741 | 33.885 | 28.874 | | | | | | Continuing | Continuing |
| 622404: Aeromechanics and Integration | 57.993 | 51.841 | 53.761 | | | | | | Continuing | Continuing |

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

This program investigates, develops, and analyzes aerospace vehicle technologies in the three primary areas of structures, controls, and aeromechanics. Advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Flight control technologies are developed and simulated for aerospace vehicles. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analysis. Resulting technologies reduce life cycle costs and improve the performance of existing and future manned and unmanned aerospace vehicles.

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

| Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification | DATE: May 2009 |
|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies |

**B. Program Change Summary ($ in Millions)**

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| Previous President's Budget | 139.855 | 122.870 | 143.289 | |
| Current BES/President's Budget | 135.401 | 123.036 | 127.129 | |
| Total Adjustments | -4.454 | 0.166 | 0.000 | |
| Congressional Program Reductions | 0.000 | 0.000 | | |
| Congressional Rescissions | 0.000 | -0.334 | | |
| Total Congressional Increases | 0.000 | 4.100 | | |
| Total Reprogrammings | -2.017 | -3.600 | | |
| SBIR/STTR Transfer | -2.437 | 0.000 | | |

**Change Summary Explanation**

Note 1: In FY 2008, Congress added $1.9 million for Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force, $0.9 million for Cognitive Unmanned Air Vehicle, $0.9 million for Modeling and Simulation for Rapid Integration and Technology Evaluation, $3.9 million for Characterization of Airborne Environment for Tactical Lasers, and $0.7 million for Single-Mode Optical Connectors for Advanced Air Vehicles. Note 2: In FY 2009, Congress added $0.5 million for Cognitive Unmanned Air Vehicle

(U) C. Performance Metrics
Under Development

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | | | | | | | DATE: May 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | | | | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | | | PROJECT NUMBER<br>622401 | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| 622401: Structures | 36.667 | 37.310 | 44.494 | | | | | | Continuing | Continuing |

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

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new structural concepts and design techniques. New structural concepts include incorporating subsystem hardware items (e.g., antennas, sensors, directed energy weapon components, and integrated energy storage) and adaptive mechanisms into the aerospace structures and/or skin of the aircraft. Resulting technologies strengthen and extend the life of current and future manned and unmanned aerospace vehicle structures, while providing increased capabilities. Payoffs to the warfighter include reduced weight and cost, as well as improved operability and maintainability of aerospace vehicles.

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. Note: Increased funding in FY 2010, is due to increased emphasis being placed on service life extension initiatives.<br><br>In FY 2008: Based upon results of demonstration efforts in Program Element 0603211F - Aerospace Technology Dev/Demo, refined development of structural health management schemes for structures susceptible to damage. Continued the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Continued the development of analysis tools into life prediction and failure analysis. Continued to develop failure criteria tools for advanced high temperature aircraft components and concepts.<br><br>In FY 2009: Continue development of structural health management schemes for structures susceptible to damage. Continue the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Continue the development of analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.<br><br>In FY 2010: Initiate the development of health reasoners for determination of system health. Continue the development of economic service life analysis and structural design tools for current and future aircraft, | 3.705 | 3.593 | 26.163 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622401 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| enhancing capabilities, component replacement, and technology direction. Continue to incorporate newly developed analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts. Continue the development of residual stress processes to enhance service life. | | | | | |
| MAJOR THRUST: Develop methodologies to allow for analytical airworthiness certification that will reduce the cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.<br><br>In FY 2008: Continued the development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into aircraft components and airframe design. Incorporated newly developed analysis in real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.<br><br>In FY 2009: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into aircraft components and airframe design. Initiate development of high-fidelity and continue real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.<br><br>In FY 2010: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into aircraft components, airframe design and mission planning. Initiate the development of response prediction methodologies. Based on work performed on reliability for structures components, initiate development of reliability based certification. | | 3.716 | 3.322 | 4.043 | |
| MAJOR THRUST: Develop design methods to capitalize on new materials, multirole considerations, and integration of various subsystem hardware items (e.g., antennas, sensors, direct energy weapon components, | | 16.442 | 17.017 | 5.806 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | PROJECT NUMBER<br>622401 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Note: Decreased funding in FY 2010 is due to higher Air Force priorities.<br><br>In FY 2008: Continued the development, evaluation, and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Continued the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create multi-function or ultra-lightweight concepts. Continued development, analysis, evaluation, and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners, and active denial concepts. Initiated characterization of high energy laser concepts. Initiated development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.<br><br>In FY 2009: Continue the development, evaluation, and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Initiate analysis for capabilities for conformal load bearing antenna structure. Continue the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create multi-function or ultra-lightweight concepts, which provides for increased energy efficiencies. Continue development, analysis, evaluation, and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners, and active denial concepts. Continue characterization of high energy laser concepts. Continue development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.<br><br>In FY 2010: Continue the development of multirole aircraft structural concepts. Continue the development, evaluation, and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Continued the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create | | | | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622401 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| multi-function or ultra-lightweight concepts. Continue the development, analysis, and evaluation of innovative technologies that integrate active aeroelastic design concepts, adaptive structures, aerodynamic flow control technologies and aerodynamic handling/maneuverability to enable viable long-range and long endurance air vehicle and micro air vehicle concepts. Continue development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts and integrated distributed electronics. | | | | | |
| MAJOR THRUST: Develop technologies that will permit the structural development of aircraft that can operate at an extreme altitude, while at sustained speeds greater than Mach 2. Note: Decreased funding in FY 2010 is due to having completed efforts in FY 2009.<br><br>In FY 2008: Further developed technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Incorporated newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.<br><br>In FY 2009: Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Incorporate newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.<br><br>In FY 2010: Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Complete the development of concepts to advanced, all weather, durable, thermal protections systems. Continue and refine operationally responsive space access concepts. Initiate research to develop and apply these technologies for lower cost, reduced weight expendable vehicle airframes. | | 12.804 | 13.378 | 8.482 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | PROJECT NUMBER<br>622401 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| | | | | |

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

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity Not Provided/ Related Activities: | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0602102F/ Materials. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0603112F/ Advanced Materials for Weapon Systems. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0603211F/ Aerospace Technology Dev/Demo. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0604015F/ Next Generation Bomber. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate | 0.000 | 0.000 | | | | | | | Continuing | Continuing |

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | | | | | | | DATE: May 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | | | | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | | | PROJECT NUMBER<br>622403 | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| 622403: Flight Controls and Pilot-Vehicle Interface | 40.741 | 33.885 | 28.874 | | | | | | Continuing | Continuing |

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

This project develops technologies that enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous unmanned air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft. Payoffs to the warfighter include enhanced mission effectiveness, optimized flight safety, increased survivability, improved maintenance, and decreased size, weight, and cost. Leverages a network of synthetic environments for evaluation of advanced concepts.

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| MAJOR THRUST: Develop advanced flight control systems, components, and integrated vehicle health monitoring systems for both manned and unmanned aircraft. In addition to increased reliability, efforts will also focus on reducing the size, weight, and cost of control and prognostic systems. Note: Decreased funding in FY 2010 is due to higher Air Force priorities.<br><br>In FY 2008: Furthered the development and assessment of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Completed development of high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Completed systems design for safety-critical electromagnetic tolerant systems. Completed the assessment of enhanced tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Completed refinement of actuation fault compensation technologies for integrated vehicle health management.<br><br>In FY 2009: Further the development and assessment of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Initiate development of control architecture enhancements to | 19.307 | 17.997 | 7.981 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622403 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| enable design for certification to ease validation and verification for complex and adaptive unmanned systems. Initiate development of low-maintenance/fault tolerant control-effector technology for aerospace applications.<br><br>In FY 2010: Further the development, assessment, and certification of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop control configurations for small and micro-sized unmanned air vehicles to enable air deployment as well as operations in complex and urban environments. | | | | | |
| MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned and unmanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Note: Increased funding in FY 2010 is due to increased emphasis being placed on interoperability between unmanned platforms and manned platforms.<br><br>In FY 2008: Continued to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continued to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continued development and assessment of cooperative control techniques for close-in surveillance of urban environments. Completed control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations. Developed and assessed adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations.<br><br>In FY 2009: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Complete reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Complete development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate technology development for interoperability of unmanned vehicles in terminal area and ground operations. Continue to develop and assess adaptive guidance and control technologies for fault/ damage tolerant aerospace vehicle operations. | | 9.817 | 8.665 | 16.426 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622403 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| In FY 2010: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe, interoperable, and integrated application of manned and unmanned aerospace systems. Initiate reliability and performance analysis of mixed-initiative control of multi-unmanned vehicle packages. Initiate development and assessment of cooperative control techniques of heterogeneous systems for close-in surveillance. Initiate technology development for the safe interoperability of unmanned vehicles in airspace, the terminal area, and ground operations. Refine the development and assessment of adaptive guidance and control technologies for fault/damage tolerance and rapid flight planning of aerospace vehicle operations. | | | | | |
| MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles.<br><br>In FY 2008: Refined network-centric environment to broaden advanced technology assessment capability. Expanded the breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continued technology trade studies for next generation theater transports. Conducted simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continued technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.<br><br>In FY 2009: Refine network-centric environment to broaden advanced technology assessment capability. Expand breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continue technology trade studies for next generation theater transports. Conduct simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.<br><br>In FY 2010: Refine multi-disciplinary, net-centric simulation environments and models to enable the quantitative and qualitative assessment of advanced aerospace vehicle concepts and technologies under realistic mission conditions. Design and conduct simulation events to evaluate and assess the military utility | | 6.931 | 6.724 | 4.467 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622403 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| and suitability of new technologies and new aerospace concepts. Continue simulation analyses and multi-directorate technology trade studies on strike, transport, access-to-space, and reconnaissance concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments. | | | | | |
| CONGRESSIONAL ADD: Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force.<br><br>In FY 2008: Conducted Congressionally-directed effort for Advancement of Intelligent Aerospace Systems (AIAS) for the U.S. Air Force.<br><br>In FY 2009: Not Applicable.<br><br>In FY 2010: Not Applicable. | | 1.953 | 0.000 | 0.000 | |
| CONGRESSSIONAL ADD: Cognitive Unmanned Air Vehicles.<br><br>In FY 2008: Conducted Congressionally-directed effort for Cognitive Unmanned Air Vehicles.<br><br>In FY 2009: Conduct Congressionally-directed effort for Cognitive Unmanned Air Vehicles.<br><br>In FY 2010: Not Applicable. | | 0.976 | 0.499 | 0.000 | |
| CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation.<br><br>In FY 2008: Conducted Congressionally-directed effort for Modeling and Simulation for Rapid Integration and Technology Evaluation. | | 0.976 | 0.000 | 0.000 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | PROJECT NUMBER<br>622403 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| In FY 2009: Not Applicable.<br><br>In FY 2010: Not Applicable. | | | | |
| CONGRESSIONAL ADD: Single-Mode Opitcal Connectors for Advanced Air Vehicles.<br><br>In FY 2008: Conducted Congressionally-directed effort for Single-Mode Opitcal Connectors of Advanced Air Vehicles.<br><br>In FY 2009: Not Applicable.<br><br>In FY 2010: Not Applicable. | 0.781 | 0.000 | 0.000 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | PROJECT NUMBER<br>622403 |

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

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity Not Provided/ Related Activities: | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0602202F/ Human Effectiveness Applied Research. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0602204F/ Aerospace Sensors. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0603211F/ Aerospace Technology Dev/Demo. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0604015F/ Next Generation Bomber. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate | 0.000 | 0.000 | | | | | | | Continuing | Continuing |

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | | | | | | | DATE: May 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | | | | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | | | PROJECT NUMBER<br>622404 | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| 622404: Aeromechanics and Integration | 57.993 | 51.841 | 53.761 | | | | | | Continuing | Continuing |

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

This project develops aerodynamic configurations of a broad range of revolutionary, affordable aerospace vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration. Technologies developed will greatly enhance warfighter capability in aircraft, missiles, and high-speed aerospace vehicles. The payoffs from these technology programs include lower vehicle costs (both production and operations and support costs), increased payload and range capability, and improved supportability, safety, and survivability of aerospace vehicles.

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. Note: In FY 2010, efforts in this thrust were reduced due to higher AF priorities.<br><br>In FY 2008: Continued efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continued to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Continued development and evaluation of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance on low-speed vehicles. Initiated development of fluid-based thrust vectoring concepts for unmanned air vehicles. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.<br><br>In FY 2009: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concepts to perform tactical surveillance and weapon delivery. Initiate development of innovative aerodynamic control methods for small unmanned air vehicles. Refine development of fluid-based thrust vectoring concept for | 4.061 | 3.508 | 2.700 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 | | | |
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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622404 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| unmanned air vehicles. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.<br><br>In FY 2010: Continue to perform mission assessments and develop low-cost unmanned air vehicle concepts to perform current and future missions including tactical surveillance and weapon delivery. Continue to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions to reduce life cycle costs and decrease human risk. Continue development of technologies for improved weapon delivery and propulsion system performance. Continue work to develop and demonstrate flow control to enable fluidic thrust vectoring, area control, and thermal management for an unmanned air vehicle exhaust nozzle. Continue development of innovative aerodynamic control methods for small unmanned air vehicles. | | | | | |
| MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for sustained high-speed flight and re-useable high altitude aerospace vehicle efforts. Note: Decrease in FY 2010 due to moving the Energy Conservation - Assured Fuels Initiative support to the major thrust for technologies for the next generation of multi-role large aircraft.<br><br>In FY 2008: Continued the development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continued development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Initiated study of energy-based analysis and optimization techniques for vehicle design. Evaluated supersonic tailless aerodynamic concepts. Initiated efforts to characterize hypersonic phenomena and develop and validate fundamental hypersonic component technologies through experimental flight techniques in a relevant high-speed environment. Initiated efforts to integrate self-defense systems to counter multi-spectrum system threats. Evaluated sub-scale aerodynamic integrated inlet concepts on high efficiency aero configurations for system level performance. Evaluated thermally integrated structures for lightweight integrated exhaust systems and airframes. Continued high fidelity aerodynamic testing of advance control techniques for low-speed and high-speed operation. Validated analytical stability and control simulations for system level operability. Note: Provided support to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that | | 25.031 | 21.121 | 15.044 | |

| Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification | | DATE: May 2009 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | PROJECT NUMBER<br>622404 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.<br><br>In FY 2009: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Continue efforts to integrate self-defense systems to counter multi-spectrum system threats. Initiate advanced high-speed aero/flight control development. Initiate study of interaction of high-load, high-temperature flexible structural materials and fluid mechanics of inlet. Initiate component development enabling shock/boundary layer interaction control. Initiate study of exhaust systems for advanced hypersonic vehicles and initiate cold-flow testing of sub scale components. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Note: Provide support to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.<br><br>In FY 2010: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of technologies and configurations for high performance airframe propulsion integrations for reusable and expendable high-speed aerospace vehicles. Continue development of analysis/design techniques and tools to enable shock/boundary layer interaction flow control and enhanced stability for high speed propulsion concepts. Initiate development and demonstration of high performance high speed mixed compression inlet concepts utilizing advanced flow control technologies for Mach 3+ expendable systems. Develop and test inlet variable geometry concepts that meet balanced mission performance and survivability requirements. Initiate work to demonstrate key propulsion integration technologies and propulsion flow path configurations that work in concert with variable cycle engines to enable revolutionary system performance for supersonic long range strike applications. These vehicle configurations will also have efficient subsonic loiter capabilities and will meet balanced mission performance and survivability requirements. Continue efforts to integrate self-defense systems to counter multi-spectrum system threats. Continue to develop advanced high-speed aero/flight control and study of aeroelastic effects for high speed vehicles. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Initiate work | | | | |

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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622404 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
| to develop vehicle concepts and technologies to enable safe and reliable store dispense/separation at Mach 4 and above. | | | | | |
| MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude vehicle. Note: Decreased funding in FY 2010 is due to higher Air Force priorities.<br><br>In FY 2008: Continued development and assessment of aerospace technologies that enable reusable, space-access vehicle. Developed robust design methodology and integration approaches for high-speed aeropropulsion. Developed extensive application and 3-D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Developed unique high temperature structures and materials in support of re-usable space-access aircraft. Pursued multi-disciplinary optimization of complex high speed, high temperature, reusable air vehicles.<br><br>In FY 2009: Continue development and assessment of aerospace technologies that enable re-usable, space-access vehicle. Enhance robust design methodology and integration approaches for high-speed aeropropulsion. Continue extensive application and 3-D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Refine unique high temperature structures and materials in support of high speed re-usable space-access aircraft. Continue multi-disciplinary optimization of complex high-speed, high temperature, re-usable air vehicles. Initiate design and test of components of integrated high-speed, space-access air vehicle system.<br><br>In FY 2010: Continue development and assessment of aerospace technologies that enable re-usable, space-access vehicle. Continue extensive application and 3-D validation efforts in applying aerothermal and material response computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Continue development of multi-disciplinary optimization methods for complex high-speed, high temperature, re-usable air vehicles. Continue development of the robust hypersonic propulsion design methodology and exploration of advanced hypersonic propulsion integration approaches. Continue design and testing of components, subsystems and integrated systems for high-speed space-access vehicles. Initiate work to | | 6.717 | 7.965 | 2.060 | |

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| APPROPRIATION/BUDGET ACTIVITY<br>3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research | R-1 ITEM NOMENCLATURE<br>PE 0602201F Aerospace Vehicle Technologies | | | PROJECT NUMBER<br>622404 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| develop and validate technologies and methods for assessing the operability, availability and operational cost of high speed flight vehicles and reusable space access systems. | | | | | |
| MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms.<br><br>In FY 2008: Initiated development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Initiated development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems.<br><br>In FY 2009: Continue development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Continue development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems.<br><br>In FY 2010: Continue development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Initiate work to apply advanced analysis tools to predict the performance of flow control and adaptive optics systems for capabilities of interest to the Air Force. | | 2.278 | 1.205 | 2.210 | |
| MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft. Note: Increase in FY 2010 is due to moving the Energy Conservation - Assured Fuels Initiative into this major thrust.<br><br>In FY 2008: Continued development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continued to develop technologies that enable multiple roles and missions for delivery and support aircraft. Initiated trade studies between short take-off and landing performance and high-speed cruise. Conducted development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities. | | 16.000 | 18.042 | 31.747 | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| In FY 2009: Continue development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft. Optimize configuration for trade-off between short take-off and landing performance and high speed cruise. Continue development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities. Continue support to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative). Conduct wind tunnel experiments and multidisciplinary design concept assessments to show the feasibility of mobility aircraft using 40% less energy through the use of natural and artificial laminar boundary layers, alternative fuels, and very high bypass propulsion integration.<br><br>In FY 2010: Continue development and assessment of aeronautical technologies including high-lift systems, transonic configuration optimization, and structural concepts that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft. Optimize configuration for trade-off between short take-off and landing performance, and high speed cruise. Continue development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities. | | | | |
| CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers.<br><br>In FY 2008: Conducted Congressionally-directed effort for WBI - Characterization of Airborne Environment for Tactical Lasers.<br><br>In FY 2009: Not Applicable.<br><br>In FY 2010: Not Applicable. | 3.906 | 0.000 | 0.000 | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| | | | | |

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

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity Not Provided/ Related Activities: | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0603211F/ Aerospace Technology Dev/Demo. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| PE 0604015F/ Next Generation Bomber. | 0.000 | 0.000 | | | | | | | Continuing | Continuing |
| Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate | 0.000 | 0.000 | | | | | | | Continuing | Continuing |

**D. Acquisition Strategy**

Not Applicable.

**E. Performance Metrics**

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.