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PE NUMBER: 0602201F
 PE TITLE: Aerospace Vehicle Technologies

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2006
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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies
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Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
Total Program Element (PE) Cost	75.195	104.469	112.751	106.517	111.837	113.689	115.123	Continuing	TBD
22SP Applied Space Access Vehicle Tech	0.000	0.000	3.811	7.989	7.456	7.758	7.695	Continuing	TBD
2401 Structures	29.569	40.420	46.311	37.611	42.000	42.618	43.204	Continuing	TBD
2403 Flight Controls and Pilot-Vehicle Interface	17.526	35.197	33.011	27.309	29.157	29.596	30.026	Continuing	TBD
2404 Aeromechanics and Integration	28.100	28.852	29.618	33.608	33.224	33.717	34.198	Continuing	TBD

Note: Funds for FY 2006 Congressionally-directed Unmanned Systems Initiative at Army Missile Research, Development, Engineering Center (AMRDEC) in the amount of \$2.4 million are in the process of being moved to PE 0602303A, Missile Technology, from PE 0602201F, Aerospace Vehicle Technologies, for execution. In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace and access to space 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. Note: In FY 2006, Congress added \$1.0 million for the Intelligent Flight Control Simulation Research Laboratory, \$1.4 million for the Unique Stealth Unmanned Air Vehicle Houck Aircraft Design program, \$1.7 million for Sentient Adaptive Systems for Rapid Vehicle Condition-Based Maintenance, \$1.7 million for Modeling and Simulation for Rapid Integration and Technology Evaluation, \$2.5 million for Unmanned Systems Initiative at AMRDEC, and \$1.0 million for Wight Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers. 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.

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

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) Previous President's Budget	76.401	96.679	104.229
(U) Current PBR/President's Budget	75.195	104.469	112.751
(U) Total Adjustments	-1.206	7.790	
(U) Congressional Program Reductions			
Congressional Rescissions	-0.059	-1.510	
Congressional Increases		9.300	
Reprogrammings	-0.095		
SBIR/STTR Transfer	-1.052		
(U) <u>Significant Program Changes:</u>			
Not Applicable.			
(U) C. Performance Metrics			
Under Development			

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER AND TITLE 22SP Applied Space Access Vehicle Tech		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
22SP Applied Space Access Vehicle Tech	0.000	0.000	3.811	7.989	7.456	7.758	7.695	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops technologies in areas of advanced structures, flight controls, and aerodynamics to enable affordable on-demand military access to space. Resulting technologies contribute significantly towards the development of reliable, responsive space access systems with aircraft-like operations. Payoffs to the warfighter include enhanced mission effectiveness, improved flight safety, improved maintenance, and decreased size, weight, and cost.

(U) B. Accomplishments/Planned Program (\$ in Millions)

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop advanced structure, flight control, and aerodynamic technologies to enable horizontal launch for affordable on-demand military access to space.	0.000	0.000	3.811
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Not Applicable.			
(U) In FY 2007: Further define and develop integrated guidance and control laws to expand the launch vehicle performance envelope.			
(U) Total Cost	0.000	0.000	3.811

(U) C. Other Program Funding Summary (\$ in Millions)

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
(U) Related Activities:									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER AND TITLE 2401 Structures		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2401 Structures	29.569	40.420	46.311	37.611	42.000	42.618	43.204	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) 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 actual aircraft 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.

(U) B. Accomplishments/Planned Program (\$ in Millions)

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. Note: Decrease in FY 2006 and out is due to reduction of related sustainment efforts in PE 0603211F.	5.707	2.310	2.120
(U) In FY 2005: Continued to develop alternative methodologies and concepts for structural repair. Developed structural health monitoring schemes for structures susceptible to damage. Pursued additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft enhancing capabilities, component replacement, and technology direction. Incorporated newly developed analysis tools for life prediction and failure analysis. Continued to develop failure criteria tools for advanced high temperature aircraft components and concepts. Completed the development of unitized structural concepts and multi-disciplinary methodologies that enhance affordability and decrease vulnerability for current and future aerospace vehicles.			
(U) In FY 2006: Continue to pursue additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools into life prediction and failure analysis. Continue to refine failure criteria tools for advanced high temperature aircraft components and concepts.			
(U) In FY 2007: 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. 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.			
(U) MAJOR THRUST: Develop methodologies to allow for analytical airworthiness certification that will reduce the	5.914	7.136	7.293

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BUDGET ACTIVITY 02 Applied Research		February 2006			
PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies		PROJECT NUMBER AND TITLE 2401 Structures			
(U) B. Accomplishments/Planned Program (\$ in Millions)		<table border="0"> <tr> <td><u>FY 2005</u></td> <td><u>FY 2006</u></td> <td><u>FY 2007</u></td> </tr> </table>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>			
cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.					
(U) In FY 2005: Continued to develop analytical certification methodologies for the incorporation of advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Improved airworthiness certification process for aircraft subject to dynamic loads and with high fidelity.					
(U) In FY 2006: Continue development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.					
(U) In FY 2007: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Complete development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.					
(U) MAJOR THRUST: Develop design methods to capitalize on new materials and integration of various subsystem hardware items (e.g., antennas, sensors, direct energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Note: In FY 2006 and out, funding increased due to initiation of full-scale feasibility determination of air vehicle monitoring in advanced structures. Efforts in this thrust are integrated with efforts in Project 2403 for advanced flight controls, components, and integrated vehicle health monitoring.	4.879	13.826			
(U) In FY 2005: Continued refinement concepts, 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 of future systems. Continued the development of concepts that include adaptive structures, subsystem hardware, and antenna integration into a load-bearing structure to create multi-function or ultra-lightweight concepts.		19.617			
(U) In FY 2006: Continue development and initiate 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 the development and analysis of critical subsystem hardware integration methods to enable directed energy weapons to be carried out on future air vehicles. Complete analysis and continue feasibility determination of energy storage concepts that are integrated into load-bearing structures. Continue the development and initiate evaluation, assessment, and ground evaluation of adaptive structures and antenna integration concepts into load-bearing structures to create multi-function or ultra-lightweight concepts.					

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**0602201F Aerospace Vehicle
Technologies**PROJECT NUMBER AND TITLE
2401 Structures

(U) B. Accomplishments/Planned Program (\$ in Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) In FY 2007: 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. 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. Complete feasibility determination efforts of energy storage concepts that are integrated into load-bearing structures. Complete the development and analysis, and initiate evaluation and testing of critical subsystem hardware integration methods that enable directed energy weapons to be carried out on future air vehicles. Initiate development, analysis, and evaluation of innovative technologies that integrate active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long-range and long endurance air vehicle concepts.			
(U) 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: In FY 2006 and out, funding increased due to increased emphasis placed on air vehicle structures for high-speed vehicles.	13.069	17.148	17.281
(U) In FY 2005: Continued to develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continued the development of concepts germane to advanced, all-weather, durable, thermal protection systems; attachment techniques; vehicle health monitoring; joining concepts; and tanks.			
(U) In FY 2006: Refine the development of 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. Continue the development of concepts germane to advanced, all weather, durable, thermal protection systems; attachment techniques; vehicle health management; joining concepts; and tanks.			
(U) In FY 2007: 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 development of concepts germane to advanced, all weather, durable, thermal protections systems; attachment techniques; vehicle health management; hot primary structures; hybrid structures; joining concepts; and tanks.			
(U) Total Cost	29.569	40.420	46.311

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**0602201F Aerospace Vehicle
Technologies**

PROJECT NUMBER AND TITLE
2401 Structures

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

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	

- (U) Related Activities:
- (U) PE 0602102F, Materials.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603211F, Aerospace Technology Dev/Demo.
- (U) PE 0604015F, Next Generation Bomber.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Acquisition Strategy**
Not Applicable.

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface		
Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2403 Flight Controls and Pilot-Vehicle Interface	17.526	35.197	33.011	27.309	29.157	29.596	30.026	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into flight controls. Funds for FY 2006 Congressionally-direct Unmanned Systems Initiative at Army Missile Research, Development, Engineering Center (ARMDEC) in the amount of \$2.4 million are in the process of being moved to PE 0602303A, Missile Technology, from PE 0602201F, Aerospace Vehicle Technologies, for execution.

(U) 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.

(U) B. Accomplishments/Planned Program (\$ in Millions)

- (U) 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: Increased funding in FY 2006 and out, is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into the flight control systems.
- (U) In FY 2005: Continued to develop and assess advanced control mechanization to provide highly reliable operations for manned and unmanned systems at reduced size, weight, and cost. Developed and assessed tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Continued to develop design analyses and technologies that enable analytical safety of flight certification of advanced complex control systems for applications in legacy and future air vehicles. Continued evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continued to enhance real-time fault compensation for aerospace vehicles using an integrated prognostic health management system. Initiated the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.
- (U) In FY 2006: 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. Develop high-density optical component technologies for adverse environments that reduce

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
	7.010	13.533	16.270

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(U) B. Accomplishments/Planned Program (\$ in Millions)		<table border="0"> <tr> <td><u>FY 2005</u></td> <td><u>FY 2006</u></td> <td><u>FY 2007</u></td> </tr> </table>	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>			
<p>subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Develop technologies and analysis tools to extend design-time verification and validation of intelligent, autonomous, and reconfigurable control systems for enhanced assurance. Continue the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continue to enhance real-time fault compensation for aerospace vehicles using integrated health management. Continue the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.</p>					
(U) In FY 2007: 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. Develop high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Refine technologies and analysis tools for reconfigurable control systems. Complete the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in aerospace operations. Refine technologies that permit integrated vehicle health management.					
(U) MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned aircraft and unmanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on developing flight controls for small air platforms operating in an urban environment.	3.593	6.436			
(U) In FY 2005: Continued efforts to develop and assess novel control automation techniques and algorithms to enable safe and interoperable applications of unmanned vehicle systems. Continued efforts to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continued development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems.		9.783			
(U) In FY 2006: Assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations.					
(U) In FY 2007: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and					
Project 2403	R-1 Shopping List - Item No. 6-10 of 6-18	Exhibit R-2a (PE 0602201F)			

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<u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Initiate development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations.				
(U) MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft.		5.661	8.429	6.958
(U) In FY 2005: Refined efforts to assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Conducted simulation assessments of advanced manned and unmanned aerospace vehicles concepts. Completed the enhancement of simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Completed the development of the virtual simulation environment for future strike aircraft. Continued to formulate and simulate concepts for future intelligence, surveillance, and reconnaissance platforms, future high-speed vehicles, advanced transports, and future tankers.				
(U) In FY 2006: Conduct assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Conduct analysis of future strike concepts in a 2020+ virtual environment. Continue analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Continue to support simulation activities for advanced transports and future tankers. Support the analysis of new concepts in hostile urban environments and missions requiring aircraft-like access to space.				
(U) In FY 2007: Complete assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Complete analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Conduct technology trade studies for next generation theater transports. Conduct the analysis of new concepts in access to space missions. Conduct analyses of new concepts in hostile urban environments.				
(U) CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research.		1.262	0.986	0.000
(U) In FY 2005: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.				
(U) In FY 2006: Continue Congressionally-directed effort for intelligent flight control simulation research laboratory.				
(U) In FY 2007: Not Applicable.				
(U) CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Condition-Based Maintenance.		0.000	1.676	0.000
(U) In FY 2005: Not Applicable.				

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface
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(U) B. Accomplishments/Planned Program (\$ in Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) In FY 2006: Initiate Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation.	0.000	1.676	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Initiated Congressionally-directed effort for rapid integration and technology evaluation.			
(U) In FY 2007: Not Applicable.			
(U) CONGRESSIONAL ADD: Unmanned Systems Initiative for Army Missile Research, Development, Engineering Center (AMRDEC).	0.000	2.461	0.000
(U) In FY 2005: Not Applicable.			
(U) In FY 2006: Initiated Congressionally-directed effort for unmanned systems initiative for AMRDEC.			
(U) In FY 2007: Not Applicable.			
(U) Total Cost	17.526	35.197	33.011

(U) C. Other Program Funding Summary (\$ in Millions)	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>Cost to Complete</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>		
(U) Related Activities:									
(U) PE 0602202F, Human Effectiveness Applied Research.									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603211F, Aerospace Technology Dev/Demo.									
(U) PE 0604015F, Next Generation Bomber.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

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PE NUMBER AND TITLE

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PROJECT NUMBER AND TITLE

2403 Flight Controls and Pilot-Vehicle
Interface

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies			PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration		
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Cost (\$ in Millions)	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2404 Aeromechanics and Integration	28.100	28.852	29.618	33.608	33.224	33.717	34.198	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable air 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.

(U) B. Accomplishments/Planned Program (\$ in Millions)

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
(U) MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. Note: In FY 2006, efforts for both manned and unmanned air vehicles were combined in this Major Thrust.	2.782	3.462	3.402
(U) In FY 2005: 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 to apply flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Initiated research into rapid prototyping and analysis techniques to support virtual and physical models. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.			
(U) In FY 2006: 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. Evaluate the application of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.			
(U) In FY 2007: 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 concept to perform tactical surveillance and weapon delivery. Initiate 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. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air			

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Exhibit R-2a, RDT&E Project Justification		DATE February 2006		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
vehicles.				
(U) 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: In FY 2005, reuseable, high altitude aircraft efforts were broken out for increased visibility between high-speed and reuseable, high altitude aircraft efforts. In FY 2006 and out, increased emphasis has been placed on assessing the next generation long-range, high-speed air vehicle concepts.		9.469	13.260	16.484
(U) In FY 2005: Developed and assessed aerospace technologies that enable sustained high-speed (greater than Mach 2) flight to permit global reach. Continued development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Developed analytic methods for modeling the plasma flow field over high-speed vehicles to reduce drag. Continued development of techniques to carry and deploy weapons from aerospace vehicles operating at high speeds (greater than Mach 2) and high temperatures.				
(U) In FY 2006: 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. Conduct computational aerodynamic analysis and sub-scale aerodynamic testing of advanced inlet boundary layer flow control techniques, secondary flow devices, and high-speed inlet apertures. Conduct computational aerodynamic analysis of high performance vectoring exhaust nozzles. Continue development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag. Conduct computational aerodynamic analysis of high efficiency wing-body aero configurations including advanced flight control techniques.				
(U) In FY 2007: 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. Conduct sub-scale aerodynamic testing of integrated inlet concepts on high efficiency aero configurations for system level performance validation. Develop and analyze thermally integrated structures for lightweight integrated exhaust systems and airframes. Conduct high fidelity aerodynamic testing of advance control techniques for low speed and high-speed operation. Develop analytical stability and control simulations to verify system level operability. Complete development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag				
(U) MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude aircraft. Note: In FY 2005, the reuseable, high altitude aircraft efforts previously described in the above related Major Thrust area were broken out to allow for increased visibility		7.812	3.663	1.842

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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2005</u> <u>FY 2006</u> <u>FY 2007</u>
<p>between high-speed and reusable, high altitude aircraft efforts. The FY 2006 and FY 2007 efforts will be leveraging the results of the high-speed Major Thrust area previously listed above.</p>		
(U) In FY 2005: Developed and assessed aerospace technologies that enable high-speed flight to permit reusable, high altitude aircraft operations. Continued development of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Developed techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.		
(U) In FY 2006: Continue development and assessment of aerospace technologies that enable high-speed flight to permit reusable, high altitude aircraft. Continue development and initiate evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments. Continue and evaluate development of techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.		
(U) In FY 2007: Develop and assess aerospace technologies that enable reusable, high altitude aircraft. Complete development and evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Complete development of techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.		
(U) MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms. Note: In FY 2006 and out, investment is decreasing pending further development of directed energy applications.	4.412	2.544 1.789
(U) In FY 2005: Developed and evaluated critical aeronautical technologies to enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Continued analysis of the tactical utility a high energy laser on fighter aircraft. Continued measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.		
(U) In FY 2006: Continue development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Complete analysis of tactical utility of high energy laser on fighter aircraft. Continue measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.		
(U) In FY 2007: Complete development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness.		
Project 2404	R-1 Shopping List - Item No. 6-16 of 6-18	Exhibit R-2a (PE 0602201F)

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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>
Complete measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.				
(U) MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft.		2.445	3.557	6.101
(U) In FY 2005: Continued efforts to develop and assess aeronautical technologies to enable revolutionary tanker and transport aircraft designs for rapid global mobility, including multi-role designs. Continued to develop technologies to enable multiple roles and missions for delivery and support aircraft.				
(U) In FY 2006: Continue to develop and assess aeronautical technologies including high lift systems, transonic, and structural designs 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.				
(U) In FY 2007: Further development and assessment of aeronautical technologies including high lift systems, transonic, and structural 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.				
(U) CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck Aircraft Design Program.		1.180	1.380	0.000
(U) In FY 2005: Initiated Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.				
(U) In FY 2006: Continue Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.				
(U) In FY 2007: Not Applicable.				
(U) CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers.		0.000	0.986	0.000
(U) In FY 2005: Not Applicable.				
(U) In FY 2006: Initiate Congressionally-directed effort for Wright Brothers Institute (WBI) - characterization of airborne environment for tactical lasers.				
(U) In FY 2007: Not Applicable.				
(U) Total Cost		28.100	28.852	29.618

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BUDGET ACTIVITY
02 Applied Research

PE NUMBER AND TITLE
0602201F Aerospace Vehicle Technologies

PROJECT NUMBER AND TITLE
2404 Aeromechanics and Integration

(U) C. Other Program Funding Summary (\$ in Millions)

	<u>FY 2005</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	

(U) Related Activities:

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0604015F, Next Generation Bomber.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.