Exhibit R-2, PB 2010 Defense Advanced Research Projects Agency RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603286E ADVANCED AEROSPACE SYSTEMS					
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	55.256	87.619	338.360						Continuing	Continuing
AIR-01: ADVANCED AEROSPACE SYSTEMS	55.256	87.619	338.360						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Advanced Aerospace Systems program element is budgeted in the Advanced Technology Budget Activity because it addresses high pay-off opportunities to dramatically reduce costs associated with advanced aeronautical systems and provide revolutionary new system capabilities for satisfying current and projected military mission requirements. Research and development of integrated system concepts, as well as enabling vehicle subsystems will be conducted. Studies conducted under this project include examination and evaluation of emerging aerospace threats, technologies, concepts, and applications for missiles, munitions, and vehicle systems.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	71.925	107.857	324.607	
Current BES/President's Budget	55.256	87.619	338.360	
Total Adjustments	-16.669	-20.238	13.753	
Congressional Program Reductions	0.000	-20.238		
Congressional Rescissions	-18.500	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	3.800	0.000		
SBIR/STTR Transfer	-1.969	0.000		
TotalOtherAdjustments			13.753	

Change Summary Explanation

FY 2008

Decrease reflects Section 8042 rescission, a below threshold reprogramming action, and the SBIR/STTR transfer.

FY 2009

Decrease reflects the reductions for Section 8101 Economic Assumptions and unexecutable growth.

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FY 2010

Increases reflect planned funding for technical milestones of major programs such as Rapid Eye, Vulture, ISIS, Vulcan and the Long Range Anti Ship Missile.

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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**
AIR-01: ADVANCED AEROSPACE SYSTEMS	55.256	87.619	338.360						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Advanced Aerospace Systems program element is budgeted in the Advanced Technology Budget Activity because it addresses high pay-off opportunities to dramatically reduce costs associated with advanced aeronautical systems and provide revolutionary new system capabilities for satisfying current and projected military mission requirements. Research and development of integrated system concepts, as well as enabling vehicle subsystems will be conducted. Studies conducted under this project include examination and evaluation of emerging aerospace threats, technologies, concepts, and applications for missiles, munitions, and vehicle systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Heliplane	15.400	8.000	4.000	

(U) The Heliplane program is evaluating the key enabling technologies for an air vehicle that combines the vertical take-off and landing (VTOL) and low disk loading characteristics of a helicopter with the speed and efficiency characteristics of a fixed wing aircraft. The Heliplane design will be tailored to a Combat Search and Rescue (CSAR) mission with a 400 mph cruise speed, a 1,000 lb payload, and an unrefueled range of 1,000 miles. The Heliplane program will conduct a combination of analysis and experiments to develop and demonstrate key enabling technologies. Once key enabling technologies have been demonstrated, a preliminary design of the Heliplane system will be completed, a subscale test of the rotor system will be conducted to demonstrate that the rotor is stable in high-speed flight, and a combination of analysis and experiments will be conducted to verify that the tip-jet meets noise requirements.

FY 2008 Accomplishments:
- Initiated the preliminary design of an alternate rotor configuration with a >10 dB reduction in noise from the tip-jet.

FY 2009 Plans:
- Complete preliminary design of an alternate rotor configuration with a >10 dB reduction in noise from the tip-jet.
- Complete the design of the rotor and controls.

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate the design of a scale model of the Heliplane and of a tip-jet nozzle. *FY 2010 Plans:* - Complete the design and fabrication of a scale model of the Heliplane and a tip-jet nozzle. - Demonstrate the capability for stable operation of the Heliplane at high speed in a wind tunnel. - Demonstrate a >10 dB reduction in noise from the tip-jet.					
Oblique Flying Wing (OFW) (U) The goal of the Oblique Flying Wing (OFW) program was to expand the design space for future aircraft concepts, particularly for those missions that demand both supersonic speed and long endurance. The potential for a unique combination of excellent high speed and low speed performance would enable rapid deployment and long loiter time, for example, in surveillance or combat air patrol (CAP) roles. The OFW program considered technologies such as advanced controls to develop and fly a small-scale supersonic technology demonstrator X-Plane, and identified key design requirements for an objective system. *FY 2008 Accomplishments:* - Conducted stability and control analysis to evaluate predicted trim and handling characteristics of OFW design. - Completed development of a dynamic flight simulation tool, which couples modeling of rigid-body aerodynamics and aeroelasticity effects for control system development and evaluation. - Completed preliminary design review of OFW X-Plane. - Evaluated feasibility of OFW concept and confirmed that the concept is feasible, with no known technical obstacles preventing stable flight through sweep changes for a supersonic vehicle.		1.650	0.000	0.000	
Advanced Aerospace System Concepts (U) Studies conducted under this program examine and evaluate emerging aerospace technologies and system concepts for applicability to military use. This includes the degree and scope of potential impact/ improvements to military operations, mission utility, and warfighter capability. Studies are also conducted to analyze emerging aerospace threats along with possible methods and technologies to counter them. The feasibility of achieving potential improvements, in terms of resources, schedule, and technological risk,		3.706	2.649	2.500	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
is also evaluated. The results from these studies are used, in part, to formulate future programs or refocus ongoing work. Topics of consideration include: methods of defeating enemy anti-aircraft attacks; methods to intercept and defeat enemy UAVs; autonomous refueling for air vehicles; munition technologies to increase precision, range, endurance, and lethality of weapons for a variety of mission sets; novel launch systems; air vehicle control, power, propulsion, materials, and architectures; payload and cargo handling systems; and the ability of fixed wing UAVs to perform perch-and-stare missions. *FY 2008 Accomplishments:* - Performed studies on critical strike munitions, hypersonics, and novel propulsion systems. - Investigated the use of novel propulsion systems allowing small fixed wing UAVs to perform perch-and-stare missions. - Evaluated advanced high-performance rotor system concepts for tiltrotor aircraft. *FY 2009 Plans:* - Perform studies of candidate technologies and develop system concepts. - Conduct modeling and simulation of system architectures and scenarios. - Develop, analyze, and assess initial munition concepts that would allow aircraft to rapidly switch between air-to-air and air-to-surface capabilities. *FY 2010 Plans:* - Analyze materials, designs and techniques for air systems weight reduction and structural efficiency, including complex fittings associated with propulsion and drive system housings and gearbox cases. - Conduct enabling technology and sub-system feasibility experiments.				
A160 (U) The A160 program will exploit a hingeless, rigid rotor concept operating at the optimum rotational speed to produce a vertical take-off and landing (VTOL) unmanned aerial vehicle (UAV) with low disk loading and rotor tip speeds resulting in an efficient low power loiter and high endurance system. This unique concept offers the potential for significant increases in VTOL UAV range (>2,000 nautical miles) and/or endurance (>20 hours). The focus of the remaining program is on reliability and airworthiness	5.000	2.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
improvements, sensor carriage Electro-Optics/Infrared (EO/IR), stub wings – weapons carriage capability and flight envelope expansion. To date, proof of concept flight tests have demonstrated platform performance goals, including an endurance of over eighteen hours unrefueled, hover outside ground effect at an altitude of 15,000, high speed flight at 145 knots and carriage of a logistic payload of 1000 lb over a distance of 962 kilometers. Improved airworthiness, reliability, and autonomous capabilities of the vehicle have also been demonstrated. The A160 concept has the potential to meet a range of surveillance and targeting, communications and data relay, crew recovery, resupply of forces in the field, and special operations missions in support of Army, Navy, Marine Corps, and other agency needs. The program also provides a platform for integration and testing of emerging sensor technologies for the detection of persons moving below the forest canopy or otherwise obscured. These technologies can further advance current range and endurance. The A160 program will transition to the Army and Special Operations Command (SOCOM). *FY 2008 Accomplishments:* - Achieved flight endurance, hover outside ground effect, payload and high speed performance goals. *FY 2009 Plans:* - Complete flight envelope expansion, reliability and airworthiness improvements and sensor and weapon facility enablement. - Transition program to the Army and SOCOM.					
Rapid Eye (U) The goal of the Rapid Eye program is to develop a high altitude, long endurance unmanned aircraft that can be rocket-deployed from the continental United States world-wide within 1-2 hours to perform intelligence, surveillance, reconnaissance (ISR), and communication missions. The enabling technologies are inflatable/folding structures, stable and dense energy storage, and low-oxygen propulsion. Rapid Eye will provide decision makers rapid-reaction ISR and persistent communication capability for emerging situations. The anticipated transition partner is the U.S. Air Force.		16.200	38.100	64.690	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Performed multi-team conceptual design study of system trades to include launch locations and systems; aircraft altitude, survivability and endurance; and technology possibilities, effectiveness, and affordability through modeling and simulation. *FY 2009 Plans:* - Develop Rapid Eye risk management, technology development and system maturation plan. - Complete system conceptual design and system requirements review. *FY 2010 Plans:* - Perform subsystem technology development and laboratory subscale tests. This will include engine cycle demonstration in an altitude chamber; laboratory packing, deployment, and load testing of the wing concept and atmospheric decelerator; wind tunnel deployment and performance testing of the wing concept and atmospheric decelerator; and material heat flux and temperature testing of atmospheric decelerator.				
Vulture (U) The objective of the Vulture program is to develop an aircraft capable of remaining on-station uninterrupted for over five years to perform intelligence, surveillance, and reconnaissance (ISR), and communication missions over an area of interest. The technology challenges include development of energy management and reliability technologies capable of allowing the aircraft to operate continuously for five years. Vulture, in effect, will be a re-taskable, persistent pseudo-satellite capability, in an aircraft package. The Vulture program will conduct a subscale three-month flight demonstration to prove out critical technologies. Subsequently, the program will conclude with a year-long flight demonstration with a fully functional payload. The anticipated transition partner is the Air Force. *FY 2008 Accomplishments:* - Performed multi-team conceptual design study of system trades to include aircraft altitude, survivability, payloads, and missions; effectiveness; and affordability through modeling and simulation. - Developed risk mitigation and technology maturation plan.	8.900	22.870	52.450	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Began technology development in the area of aeroelastic modeling tools. *FY 2009 Plans:* - Downselect a configuration for demonstration in Phase II and III. - Maturation of energy management and reliability technologies. - Conduct initial risk reduction sub-subscale tests. - Demonstration of component performance and reliability including energy storage, propulsion, and flight management/control systems. - Initiate detailed design of the sub-scale and full-scale demonstrator aircraft. *FY 2010 Plans:* - Continue subsystem and component risk reduction testing for reliability and performance. - Perform subscale flight demonstration vehicle critical design review and initiate long lead fabrication. - Downselect a system for Phase III demonstration.					
Multi-Modal Missile (U) The Multi-Modal Missile program will explore the development of an integrated, networked man-portable weapon system capable of performing surface-to-surface, and surface-to-air missions with an emphasis on extreme precision. The program will focus on delivering precision targeting accuracy in both direct and indirect fire modes against multiple targets, and beyond line-of-sight functionality including; armored and soft ground vehicles, bunkers, personnel, helicopters and unmanned aerial vehicles (UAVs). The Multi-Modal Missile will be compatible with existing Javelin and TOW launch infrastructures. The objective Multi-Modal Missile capability will integrate a variety of existing weapons-systems functions and provide both mounted and dismounted soldiers with an affordable compact system. Critical characteristics of this weapon system concept include light weight, simple operation, and affordability. Technologies under consideration will include advanced imaging seekers, precision terminal guidance, propulsion, power storage, vertical launch with lock-on-after-launch capability, and novel warhead concepts to support a wide range of engagement geometries with desired lethality effects against a range of targets. Anticipated service users include the Army, Marines and Special Forces.		0.000	6.500	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Develop, analyze and assess initial Multi-Modal Missile technical approaches.				
Stealthy, Persistent, Perch and Stare (SP2S) (U) The goal of the Stealthy, Persistent, Perch and Stare (SP2S) program is to develop the technology to enable an entirely new generation of perch-and-stare micro air vehicles, based on the Wasp platform, capable of: 1) vertical launch, 2) forward flight to a target, 3) transition from forward flight to hover, 4) vertical landing at the target site, 5) secure, stable attachment to its "perch," 6) sustained perch-and-stare missions, to include data collection, and 7) at mission end SP2S would re-launch from the perch and fly home. During perch-and-stare, SP2S would perform surveillance and transmit live video/still images beyond line-of-sight back to the home base, utilizing other low altitude unmanned aerial vehicles (UAVs) as relay links, as required. Anticipated service users include the Army, Marines and Special Forces. *FY 2008 Accomplishments:* - Analyzed materials, designs and techniques for air systems weight reduction and structural efficiency, including complex fittings associated with propulsion and drive system housings and gearbox cases. - Conducted enabling technology and sub-system feasibility experiments. *FY 2009 Plans:* - Mature and integrate advanced technologies and subsystems. - Fabricate perch-and-stare field test systems. - Conduct field/operational tests. *FY 2010 Plans:* - Develop auto-pilot for semi autonomous landing. - Identify energy harvesting technologies and methodologies that enable aircraft to remain operational over a 24-hour period. - Develop attachment/perching technologies that are applicable to a wide variety of terrains. - Develop schemes for exploitation of digital communications.	2.400	2.500	2.700	
Triple Target Terminator (T3)	0.000	0.000	7.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
(U) The Triple Target Terminator (T3) program will develop a high speed, long-range missile that can engage counter air, counter cruise missile and Destruction of Enemy Air Defenses (DEAD) targets. T3 would be carried internally on stealth aircraft or externally on fighters, bombers and UAVs. The enabling technologies are: propulsion, multi-mode seekers, data links, digital guidance and control, and advanced warheads. T3 would allow any aircraft to rapidly switch between air-to-air and air-to-surface capabilities. T3's speed, maneuverability and network-centric capabilities would significantly improve U.S. aircraft survivability and increase the number and variety of targets that could be destroyed on each sortie. *FY 2010 Plans:* - Conduct studies to define T3 trade space and concepts of operation. - Initiate preliminary design studies. - Conduct risk reduction experiments and modeling to validate designs.					
Integrated Sensor is Structure (ISIS) (U) The Integrated Sensor is Structure (ISIS) program, previously funded under PE 0603287E, Project SPC-01, is developing a sensor of unprecedented proportions that is fully integrated into a stratospheric airship that will address the nation's need for persistent wide-area surveillance, tracking, and engagement for hundreds of time-critical air and ground targets in urban and rural environments. ISIS is achieving radical sensor improvements by melding the next-generation technologies for enormous lightweight antenna apertures and high-energy density components into a highly integrated lightweight multi-purpose airship structure - completely erasing the distinction between payload and platform. The ISIS concept includes ninety-nine percent on-station 24/7/365 availability for simultaneous Airborne Moving Target Indicator (AMTI) (600 kilometers) and Ground-Based Moving Target Indicator (GMTI) (300 kilometers) operation; ten years of autonomous, unmanned flight; hundreds of wideband in-theater covert communications links; responsive reconstitution of failed space assets; plus CONUS-based sensor analysis and operation. The ISIS technology is planned for transition to the Air Force. *FY 2010 Plans:* - Conduct critical design review of demonstration system. - Conduct radar system operational modeling and simulation.		0.000	0.000	63.400	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Develop and demonstrate flight dynamic controls in a lab environment. - Demonstrate large-scale manufacturing of prototypes and initial integration.					
Vulcan (U) The goal of the Vulcan demonstration program, previously funded from PE 0602702E, Project TT-07 (HiSTED Program), is to design, build and ground test an engine capable of accelerating a full scale hypersonic vehicle from rest to Mach 4+. Constant Volume Combustion (CVC) engines have been under development for more than a decade. Considerable progress has been made and the technology is believed mature enough to enable a dramatic new propulsion system capability. CVC engines, when combined with turbine engines, offer the ability to design a new class of Mach 4+ air breathing engines. The Vulcan engine will consist of a CVC engine, a full-scale turbine engine, an inlet and a nozzle. CVC engine architectures could include Pulsed Detonation Engines (PDE's), Continuous Detonation Engines (CDE's) or other unsteady CVC engine architectures. The CVC engine would operate from below the upper Mach limit of the turbine engine to Mach 4+. The turbine engine will be a current production engine capable of operating above Mach 2. Key objectives of the program are to integrate the turbine engine into the Vulcan engine with minimal modification to the turbine engine; to operate the turbine engine from rest to its upper Mach limit; and to cocoon the turbine engine when it is not in use. The Vulcan engine will enable full-scale hypersonic cruise vehicles for Intelligence, Surveillance and Reconnaissance (ISR), strike or other critical national missions. *FY 2010 Plans:* - Complete designs and simulations of critical components. - Conduct risk reduction demonstrations of the combustor rig, fuel system, material rig, valve rig, initiator rig, seal rig, inlet rig, nozzle rig, and thermal management system rig components. - Complete CVC engine preliminary design review. - Initiate detailed design of subsystems.		0.000	0.000	53.730	
Long Range Anti-Ship Missile Demonstration (LRASM) (U) In response to emerging threats, DARPA is building on recent technology advances to develop and demonstrate standoff anti-ship strike technologies to reverse the significant and growing U.S. naval		0.000	0.000	54.950	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
surface strike capability deficit. The Long Range Anti-Ship Missile (LRASM) program, previously funded in PE 0602702E, Project TT-03 Naval Warfare Technology, will invest in advanced component and integrated system technologies capable of providing a dramatic leap ahead in U.S. surface warfare capability, focusing on organic wide area target discrimination in a network denied environment, innovative terminal survivability in the face of advanced defensive systems, and high assurance target lethality approaches. Specific technology development areas will include: robust precision guidance, navigation and control with GPS denial, multi-modal sensors for high probability target identification in dense shipping environments, and precision aimpoint targeting for maximum lethality. Component technologies will be developed, demonstrated, and integrated into a complete weapon system. The program will result in a high fidelity demonstration to support military utility assessment. The anticipated transition partner will be the U.S. Navy. *FY 2010 Plans:* - Continue risk reduction testing of critical components, including over-water seeker test, wind tunnel tests, and propulsion direct-connect tests. - Complete integrated system preliminary designs and hold Preliminary Design Reviews. - Conduct high fidelity independent government performance assessment of preliminary designs against key performance criteria. - Generate supporting documentation including flight test and safety plans, system engineering master plans, test and evaluation master plans, lifecycle cost estimates, and transition plans. - Commence subsystem detail designs and developmental testing. - Initiate long-lead procurements.				
Disc-Rotor Compound Helicopter (U) The goal of the Disc-Rotor Compound Helicopter program is to design and demonstrate the enabling technologies required to develop a new type of compound helicopter capable of high-efficiency hover, high-speed flight, and seamless transition between these flight states. The aircraft will be equipped with an aft-swept wing, as well as a mid-fuselage disc with extendable rotor blades, enabling the aircraft to take-off and land like a helicopter. Transition from helicopter flight to airplane flight would be achieved by fully retracting the blades within the disc. An aircraft capable of long range high speed (300-400 kts)	0.000	5.000	7.940	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and vertical take-off and landing (VTOL)/hover will provide mobility and responsiveness for troop and cargo insertion, satisfy an ongoing military interest for higher speed VTOL and hover capable vehicles, be survivable and bridge the gap in helicopter escort and insertion missions. The enabling technologies are disc-rotor configuration, variable thrust ducted prop-fans, the extension of the telescoping blades and seamless reversible transition between hover and wing borne flight. Specific objectives of the Disc-Rotor Compound Helicopter program include: demonstrating the feasibility of retracting the extendable blades into the disc, characterizing the flowfield environment created by a disc-rotor, demonstrating disc-rotor enabling technologies, and design and flight testing a demonstrator. In FY 2008, this program was funded from PE 0602702E, Project TT-07. The anticipated transition partner is the Air Force. *FY 2009 Plans:* - Complete small scale rotor design, and initiate fabrication. - Conduct analysis and refinement of the vehicle conceptual approach and configurations. - Perform computational fluid dynamics analyses and predictions. *FY 2010 Plans:* - Develop, and fabricate sixteen foot rotor model. - Conduct wind tunnel testing of air vehicle and rotor model.				
Mode Transition (MoTr) Demonstration (U) The Mode Transition (MoTr) Demonstration program, an outgrowth of the Falcon program, seeks to ground test a turbine-based combined-cycle (TBCC) engine using hydrocarbon fuel. The MoTr program will demonstrate transition from turbojet to ramjet/scramjet cycle and is the critical experiment required to enable reusable, air-breathing, hypersonic flight. MoTr leverages previous and on-going advances in air-breathing propulsion technology, including Falcon combined-cycle engine technology and the Air Force/DARPA High Speed Turbine Engine Technology Demonstration (HiSTED) program. In FY 2009, this program was funded in PE 06032867E, Project SPC-01, Space Programs and Technologies. The anticipated transition partner is the Air Force.	0.000	0.000	25.000	

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B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2010 Plans: - Complete critical design of a TBCC engine model. - Complete critical design of primary testing modifications. - Initiate demonstration hardware fabrication. - Complete primary test rig modifications and checkouts.				
Buoyancy Assisted Lift Air Vehicle	2.000	0.000	0.000	
FY 2008 Accomplishments: - Investigated a buoyancy assisted lift air vehicle.				

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**
ISIS/Air Force	0.000	0.000	75.000						Continuing	Continuing
LRASM/Navy	0.000	0.000	21.700						Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.